Abalone Recovery and Management Plan

Adopted by the California Fish and Game Commission

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FINAL

California Department of Fish and Game
Marine Region

Availability

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Abalone Recovery and Management Plan
Executive Summary

The Abalone Recovery and Management Plan provides a cohesive framework for the recovery of depleted abalone populations in southern California, and for the management of the northern California fishery and future fisheries. All of California's abalone species are included in this plan: red abalone, *Haliotis rufescens*; green abalone, *H. fulgens*; pink abalone, *H. corrugata*; white abalone, *H. sorenseni*; pinto abalone, *H. kamtschatkana* (including *H.k. assimilis*); black abalone, *H. cracherodii*; and flat abalone, *H. walallensis*. A recovery and management plan for these species is needed to manage abalone fisheries and prevent further population declines throughout California, and to ensure that current and future populations will be sustainable.

The decline and, in most cases, closure of California's abalone fisheries in the late 20th century is due to a variety of factors, primarily commercial and recreational fishing, disease, and natural predation. The recovery of a near-extinct abalone predator, the sea otter, has eliminated the possibility for an abalone fishery in most of central California. Withering syndrome, a lethal bacterial infection, has caused widespread decline among black abalone in the Channel Islands and along the central California coast. Withering syndrome also affects captive red, pink, green and white abalones, but the syndrome's impact on wild populations is not fully known.

Five species of abalone were commercially fished: red, pink, green, black and white. When combined, landings for these five species gave the impression of a stable fishery; however, individual species landings actually rose and fell in a sequential manner in an occurrence known as serial depletion. Thus, as landings dwindled for one species, the decline was compensated for by an increase in landings for another species, and the true extent of depletion for all five species was not detected until much later.

Serial depletion occurred by area as well as by species. As nearshore abalone populations became depleted, fishermen traveled to more distant locations, until stocks in most areas had collapsed. Advances in diving technology also played a part in stock depletion. The advent of self-contained underwater breathing apparatus (SCUBA) in the mid-1900s gave birth to the recreational fishery in southern California, which placed even more pressure on a limited number of fishing areas (in northern California, using SCUBA to take abalone has been illegal since 1952).

Because of the depleted condition of abalone resources, the Fish and Game Commission (Commission) took action to close fisheries beginning with the black abalone fishery in 1993. Following stock collapse, the Commission closed the southern California pink, green, and white abalone fisheries in 1996, and all abalone fishing south of San Francisco in early 1997. The southern abalone fishery was closed indefinitely with the passage of the Thompson bill (AB 663) in 1997. This bill created a moratorium on taking, possessing, or landing abalone for commercial or recreational purposes in ocean waters south of San Francisco, including all offshore islands.

The Thompson bill also mandated the creation of an Abalone Recovery and Management Plan (ARMP). The bill further required the Fish and Game Commission to undertake abalone management in a manner consistent with the ARMP. The Fish and

Game Code (FGC) that resulted from the passage of the Thompson bill [FGC §5522(a)] specifically calls for the following items in an ARMP:

- **Scientific Background**: An explanation of the current scientific knowledge of the biology, habitat requirements, and threats to abalone
- **Interim and Long-term Goals**: A summary of recovery goals, including alternative conservation and management goals and activities. The Department will report why it prefers the recommended activities
- **Alternatives for Allocation**: Alternatives for allocating harvest between recreational and commercial abalone harvesters
- **Costs**: An estimate of time and costs required for meeting interim and long-term recovery goals for each species
- **Time Frame**: An estimate of the time necessary to meet interim recovery goals, and a description of triggers for review and amendment of strategies
- **Evaluation Criteria**: A description of objective, measurable criteria by which to determine whether the goals and objectives of the recovery strategy are being met

FGC §5522(b) states that the following *may* be included in the ARMP:

- A description of a proposed network of no-take reserves
- A total allowable catch (TAC) using the best available science, reflecting the long-term yield each species is capable of sustaining, the ecological importance of each species, and the variability of marine ecosystems
- A permanent reduction in harvest

The Department assigned a team of biologists to create and refine the ARMP in consultation with many other entities, including the Recreational Abalone Advisory Committee, the Commercial Abalone Advisory Committee, and the ARMP Panel (which included representatives from all constituent groups interested in abalone). The Department also held a commercial constituent workshop early in the process to gather input on the conceptual plan, and two town-hall meetings to present the draft ARMP to the public and receive informal comments. The draft ARMP also underwent formal, academic peer review in 2002. The draft ARMP was submitted to the Commission for adoption in late 2002. The document was further revised based on formal public comment prior to adoption.

The ARMP currently includes nine chapters and various appendices and supporting materials, as follows:

- **Chapter 1– Introduction** includes a description of the project area, the purpose and need for action, and specific goals of the plan.
- **Chapter 2– Description of Stocks** includes biological information and status of the stock for each species.
- **Chapter 3– History and Socio-economics of the Fishery** covers the history of both the recreational and commercial fisheries and socio-economic characteristics of the fisheries.

- **Chapter 4– Legal Framework** outlines the legal framework that guides the formation and implementation of the ARMP, including authority and responsibility, state and federal law, and a plan for review and amendment.
- **Chapter 5– Overview of Recovery and Management in the ARMP** describes these two separate but complimentary processes. Includes the overall approach for recovering a depleted species of abalone until it is capable of providing a fishery, at which time management can be applied to help sustain the fishery.
- **Chapter 6– Abalone Recovery** outlines the recovery plans for each species, including goals (both interim and long-term), criteria for evaluating recovery and attainment of goals, and timelines for reaching goals. Also includes alternatives to the recommended approach.
- **Chapter 7– Abalone Management** describes the fishery management plans (both interim and long-term) for the existing northern California recreational fishery, and other fisheries after recovery is complete. Outlines research protocols for managing a sustainable fishery and alternatives to the recommended approach.
- **Chapter 8– Abalone Enforcement Activities** describes enforcement activities related to abalone, including a description of enforcement methods used, collaboration between enforcement and management, future enforcement needs, and the community outreach role of enforcement.
- **Chapter 9– Implementation (Activities, Timelines and Costs)** describes the time, costs and schedule for implementation of the recovery and management portions of the ARMP.
- **Appendices** include a historical summary of abalone laws, excerpts from legal documents relating to abalone, a table giving the location of elements required in FGC §5522 (a) and (b), maps of historical fishing areas, survey methods, constituent involvement processes, peer review, and public input.

Recovery of at-risk abalone species and management of abalone fisheries are separate but continuous and complementary processes in the ARMP. The recovery portion of the plan addresses all abalone species that are subject to the fishing moratorium. The management portion of the plan applies to populations considered sustainable and fishable, such as the current northern California red abalone fishery. The management plan will apply to any fully recovered species in central and southern California outside of the Central California Sea Otter Range.

Abalone in California vary in status from populations bordering on extinction (white abalone) to a sustainable population with surplus animals that is still being fished (northern California red abalone). The ultimate goal of recovery is to move species from a perilous condition to a sustainable one with surplus abalone available for fishing. The ultimate goal of management is to maintain sustainable fisheries under a long-term management plan that can be adapted quickly to respond to environmental or population changes.

The primary criteria used to evaluate progress in achieving recovery and management goals involve estimates of recruitment (the number of animals entering a population) and population abundance (measured by density, the number of animals in

a given area). Two density levels are integral to both recovery and management as measures of population abundance: minimum viable population size (MVP, Section 6.2.2.1 Criterion 2- First Density Level (2,000 ab/ha)) and a sustainable fishing density (Section 6.2.2.2 Criterion 2 - Fishery Density Level (6,600 ab/ha), Section 7.1.2.1 Criteria for Evaluating Stock). The density levels used in the ARMP are derived from red abalone populations in northern and southern California and published research of other abalone species (Section 6.2.2 Density-based Criteria). Density data for other California abalone species are not available at this time; therefore, red abalone densities are used because they represent the best available data until more data can be obtained to refine density levels for each species.

Abalone populations below the MVP (Figure 5-1) are at risk of recruitment failure and ultimately extinction, and require recovery. Populations at or above the upper limit of the precautionary area (Figure 5-1) are likely to have sufficient abalone to support a sustainable fishery.

The precautionary area is where recovery and management overlap. It is bounded on the lower end by an abalone density that combines the MVP with an additional density buffer (50% of the MVP), and on the upper end by the upper limit of the precautionary area. Populations in the precautionary area are likely to be self-sustaining (experiencing successful reproduction and recruitment to survive natural fluctuations in abundance), but excessive fishing mortality could cause these populations to decline. When a fishery closes, the affected abalone populations are subject to recovery, and fall within or below the lower boundary line of the precautionary area in Figure 5-1. No fishing is proposed for these populations until the sustainable fishery density is reached. Abalone populations that are actively managed as part of a fishery may be fished while their abundance level is in the precautionary area, but with progressively reduced take. The precautionary area thus acts as a buffer between conditions that mandate fishery closure and those that allow fishery reopening; conditions for fishery reopening are set at the sustainable fishing density to ensure that a fishable surplus has been rebuilt.

Recovery and Management

The ARMP consists of two stages: an interim plan and associated management goals, and a long-term plan and associated management goals. The interim management and recovery plans use available funding and data, and become effective upon approval of the ARMP. The long-term management and recovery plans are more refined in their controls, but require more data, resources, and further development.

Recovery–The Interim Plan - The goals of the interim plan are to reverse the decline of abalone populations that are in danger of extinction, and rebuild populations to self-sustaining levels throughout historic abalone ranges. Enhancement programs and monitoring schemes have been developed that will attempt to rebuild populations. Step-wise recovery criteria have also been developed to assess and evaluate the recovery process.

There are currently three criteria that measure recovery, based on size and density. Criterion 1 is satisfied when a broad range of sizes is present in the population, from small, younger abalones to large, older individuals. Satisfying Criterion 1 is considered a milestone in recovery. Next, populations must reach MVP levels in

multiple locations to satisfy Criterion 2. Finally, Criterion 3 is satisfied when populations are able to support a fishery (6,600 abalone per hectare). Satisfying Criterion 3 signifies the attainment of a central, long-term recovery goal. When Criterion 3 is close to being satisfied, the planning process for reopening the fishery can begin to address management options, allocation, and economic issues.

Recovery–The Long-term Plan - The primary goals of the long-term recovery plan are to rebuild abalone populations in at least three-quarters of the historic range, and to prepare for establishing fisheries, allocating resources, considering a network of no-take reserves, and further developing the long-term recovery plan.

Management–The Interim Plan - The northern California red abalone recreational fishery is the only fishery discussed in the management section of the ARMP, although similar management plans will apply to any southern California abalone fisheries reopened following recovery. Each management plan will be adjusted to accommodate individual species requirements.

The interim plan suggests managing fisheries using two measures:

- An adjustable, fishery-wide Total Allowable Catch (TAC)
- The ability to close severely depleted sites to allow stock recovery

Two decision tables will guide management action with regard to these measures. One table will be used for TAC decisions, and the other will direct the closure or reopening of depleted fishing areas. These decision tables constitute the core of the ARMP management framework.

For the northern California fishery, the TAC table will use fishery-independent data gathered from four sites that have been historically monitored, along with four additional sites. The TAC table uses two criteria: recruitment and density. Changes in these measurable criteria will guide adjustment of the TAC.

The area closure decision table is designed to close or reopen individual sites without affecting the remaining fishery sites. Here again, two criteria are used: density and catch-per-unit-of-effort (CPUE). Serial depletion and CPUE data are currently gathered in creel surveys at eight sites along the northern California coast. CPUE data will be periodically assessed using the area closure decision table to determine whether additional density surveys are needed. Density data will be used to determine whether a fishing area should be closed or reopened.

Limitations of the interim management plan include the following:

- Fishery-independent data are only gathered from a limited number of heavily and moderately fished sites. These sites may or may not be representative of other locations, or the condition of the population beyond these sites.
- The TAC is calculated for the entire fishery, and is not allocated among individual sites or areas. This could make some sites vulnerable to overfishing. The interim plan could curtail overfishing at individual sites by closing those sites, but implementation would be slow because the time needed to collect and analyze site data is around four years.
- TAC quotas can only set a target level of take, not an absolute limit on take, which makes it a crude, imprecise tool for management. In addition, the TAC

can only be adjusted every three years in the normal recreational fishing regulation cycle, except in the case of an emergency action.

Management–The Long-Term Plan - The long-term management plan for abalone is still in development; however, it should address three key limitations of the interim management plan through:

- **Instituting zonal management**: The long-term plan will divide the fishery into zones, or sub-units, of the Northern, Central and Southern California Regions, which can be managed more effectively than a single unit. Zone boundaries will be based on abalone reproductive characteristics, fishing effort, habitat quality, and enforcement considerations. In part, zone locations will be determined by the resources available to monitor them.
- **Distributing fisherman-applied abalone tags**: These tags would limit take from individual zones, and identify legally taken abalone.
- **Increasing fishery-independent data collection**: One requirement for effective zonal management is possessing adequate information about the status of the fisheries in each zone. Detailed fishery-independent diver surveys will be needed to adequately monitor abalone populations within zones.

Initial ARMP timelines will focus on recovery efforts. Timelines beyond those for initial recovery efforts will be developed based on the success of initial efforts.

The recovery of abalone populations, which will most likely take decades, may be hampered by events over which the Department has little or no control. Pollution, global warming, and frequent warm water events (El Niños) may slow productivity or alter habitat and render it unsuitable for abalone. Withering syndrome may have a larger impact on pink, white, green and red abalone than we currently understand. Sea otter range expansion will reduce recovery areas to an unknown extent. Poaching due to high economic value and demand for abalone is also likely to influence recovery efforts.

To make management tools more responsive to changes in abalone populations, more data are needed in every aspect of abalone biology. Constant data-gathering and monitoring for abalone recovery, population enhancement, and fishery maintenance will be necessary for successful implementation of the ARMP.

Unfortunately, there is no “quick and easy fix” for declining abalone populations off the California coast. However, the comprehensive scope of the ARMP provides hope for the future. Science-based management is the cornerstone of the ARMP, along with a precautionary, adaptive approach that uses measurable criteria to recover depleted stocks and improve the management of current and future fisheries.

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Abalone Recovery and Management Plan
List of Acronyms and Abbreviations

ab/ha	abalone per hectare
APA	Administrative Procedure Act
ARMP	Abalone Recovery and Management Plan
ARPA	Abalone Restoration and Preservation Account
CAA	California Abalone Association
CAAC	Commercial Abalone Advisory Committee
CalTIP	California "Turn in Poachers" program
CCR Title 14	California Code of Regulations -Title 14
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CIMRI	Channel Islands Marine Research Institute
CINP	Channel Islands National Park
CMLS	Commercial Minimum Legal Size
CPDB	Commercial passenger diving boat
CPUE	Catch-per-unit-of-effort*
DAAC	Director's Abalone Advisory Committee (now replaced by CAAC)
EFI	Essential Fisheries Information*
ENSO	El Niño/Southern Oscillation*
ESA	Endangered Species Act
FGC	Fish and Game Code
FMP	Fishery Management Plan
GIS	Geographical Information System*
GPS	Global Positioning System*
ha	Hectare
MLMA	Marine Life Management Act
MLPA	Marine Life Protection Act
MMPA	Marine Mammal Protection Act
MPAs	Marine Protected Areas*
MVP	Minimum Viable Population*
NMFS	National Marine Fisheries Service
PISCO	Partnership for Interdisciplinary Studies of Coastal Oceans
PY	Personnel Year
RAAC	Recreational Abalone Advisory Committee
RMLS	Recreational Minimum Legal Size
ROV	Remotely-operated Vehicle*
SOU	Special Operations Unit
TAC	Total Allowable Catch*
USFWS	United States Fish and Wildlife Service
WS	Withering Syndrome*

* defined in the Glossary of Terms and Abbreviations

Abalone Recovery and Management Plan
Conversion Tables

Metric System	*English System*
Linear Measure	
25.4 millimeter (mm)	1 inch (in.)
1 meter (m)	1.093 yards (yd)
1 kilometer (km)	0.621 mile (mi)
Area Measure	
1 square meter (m^2)	1.2 square yards (yd^2)
1 hectare (10,000 m^2)	2.47 acres (12,100 yd^2)
Weight Measure	
1 kilogram (kg)	2.21 pounds (lb)
1 metric ton (1,000 kg)	2,210 pounds (lb)

Commonly Used Length Measurements

102 mm (RMLS flat, pinto)	4 in.
127 mm (RMLS black)	5 in.
152 mm (RMLS pink, green, white)	6 in.
178 mm (RMLS red, CMLS green)	7 in.
146 mm (CMLS black)	5.75 in.
159 mm (CMLS pink and white)	6.25 in.
197 mm (CMLS red)	7.75 in.

Commonly Used Density Numbers

2,000 ab/ha (MVP)	800 ab/acre (0.165 ab/yd^2)
6,600 ab/ha (sustainable fishery)	2,672.05 ab/acre (0.55 ab/yd^2)
3,300 ab/ha (sustainable deep)	1,336.03 ab/acre (0.27 ab/yd^2)
3,000 ab/ha (fishery closure)	1,214.58 ab/acre (0.25 ab/yd^2)

Abalone Recovery and Management Plan
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Chapter 1. Introduction

1.1 Location of the Project Area

The proposed project area comprises all coastal and island areas of California. The California coast can be divided into three regions, each of which has different oceanographic characteristics and resident abalone species (Figure 1-1):

1. The Northern California Region, which extends from the California-Oregon border south to San Francisco Bay, excluding the Farallon Islands
2. The Central California Region, which extends from San Francisco Bay, including the Farallon Islands, south to Point Conception. This area includes:

    - The Central California Sea Otter Range. This area is excluded from management
    - The Central California Region not occupied by sea otters. This area's recovery and management falls under the Southern California Region guidelines due to its location within the abalone fishing moratorium area (FGC §5521)

3. The Southern California Region, which extends from Point Conception to the California-Mexico border, including southern California offshore islands

Abalone distribution varies in California (Figure 1-2). Green abalone, *Haliotis fulgens*; pink abalone, *H. corrugata*; and white abalone, *H. sorenseni,* are primarily found in the Southern California Region. Pinto abalone, *H. kamtschatkana* (including *H.k. assimilis*); black abalone, *H. cracherodii;* and flat abalone, *H. walallenis,* are found in all three Regions. Red abalone, *H. rufescens*, is also found in all three Regions, but its distribution in the Southern California Region is restricted to areas of cold, upwelling water. The threaded abalone, *H. assimilis*, once thought to be a separate species, has been made synonymous with the pinto abalone *H. kamtschatkana* (Geiger 2000).

1.2 Purpose and Need for Action

Management authority for abalone has been delegated to the Fish and Game Commission (Commission) by the Legislature with the intent that it undertake management in a manner consistent with the Abalone Recovery and Management Plan (ARMP) [Fish and Game Code (FGC) §5520]. The Department of Fish and Game (Department) is required by the State Legislature to prepare an Abalone Recovery and Management Plan (ARMP) for all of California's abalones (FGC §5522). The purpose of the ARMP is to provide a cohesive framework to direct recovery efforts, and to manage existing and future fisheries. The ARMP serves to prioritize short-term and identify long-term assessment, research, regulatory, and enforcement activities. Integrating these activities ensures effective sharing of available Department resources between recovery and management.

The history of the California abalone fishery points to the need for defined recovery and management guidelines. At one time, five species of abalone (red, pink, green, black, and white) supported recreational and commercial fisheries in California.

However, by 1997 central and southern California abalones had experienced stock collapse from both natural and human-related causes, resulting in the closure of all abalone fishing in those areas. The only abalone fishery currently open in the state is the red abalone sport fishery in the Northern California Region.

The five formerly fished species in the Central and Southern California Regions are at risk of further population declines and, in one case, extinction. The white abalone has been listed as an endangered species under the federal Endangered Species Act, while the black abalone is a candidate for listing. Without human intervention, and possibly even with it, these species may never recover. The recovery portion of the ARMP is directed at preventing further population declines and rebuilding populations.

Managing the northern California red abalone resource in a sustainable fashion is critical for the survival of the State's last remaining abalone fishery. A sustainable management framework will also be important for any abalone species that recovers to a level considered sustainable for fishing. The management portion of the ARMP addresses recreational and commercial fisheries that may re-open in the future, as well as the current red abalone recreational fishery. Abalone management under the ARMP will be responsive to changes in stock conditions that result from either natural or human-induced causes.

1.3 Specific Goals of the Plan

As the trustee agency for the State's fish and wildlife resources, the Department's overall goal is to manage those resources for optimum long-term benefits for the people of the State.

The interim goals for the ARMP are to reverse declines in populations by stabilizing all abalone species, and establish self-sustaining populations range-wide. The long-term goal is to attain resource levels that can sustain fisheries.

The interim management goal for the ARMP is to institute an adaptive plan that employs a precautionary approach to managing the existing red abalone fishery in northern California using available Department resources and data. The long-term goal is to implement a plan which may incorporate tag-based, zonal management using more extensive data collection, which would allow for more refined and responsive regulatory actions. Once implemented, the long-term goal should apply to all California abalone fisheries.

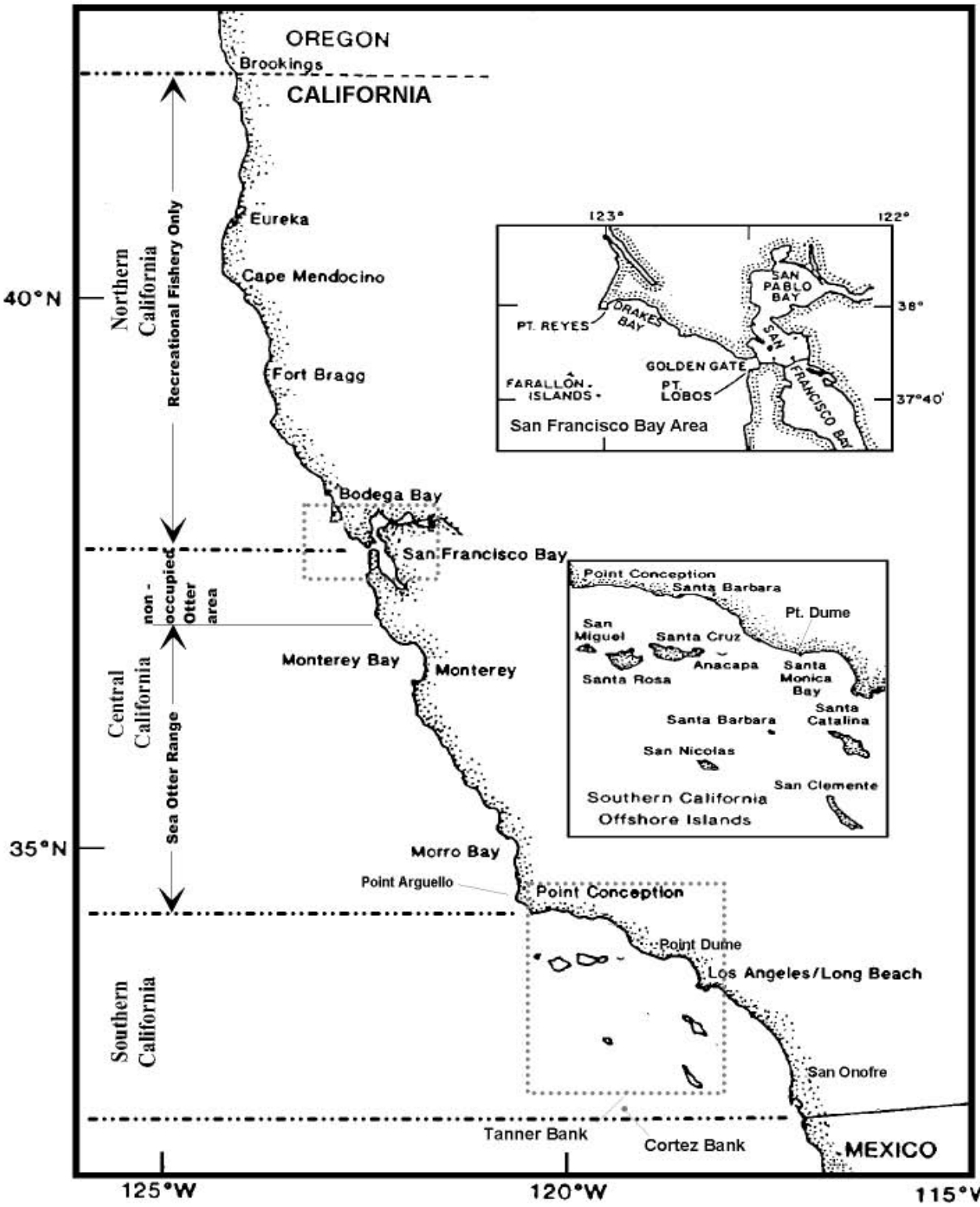

Figure 1-1. Map of California identifying regions, islands and points used in document

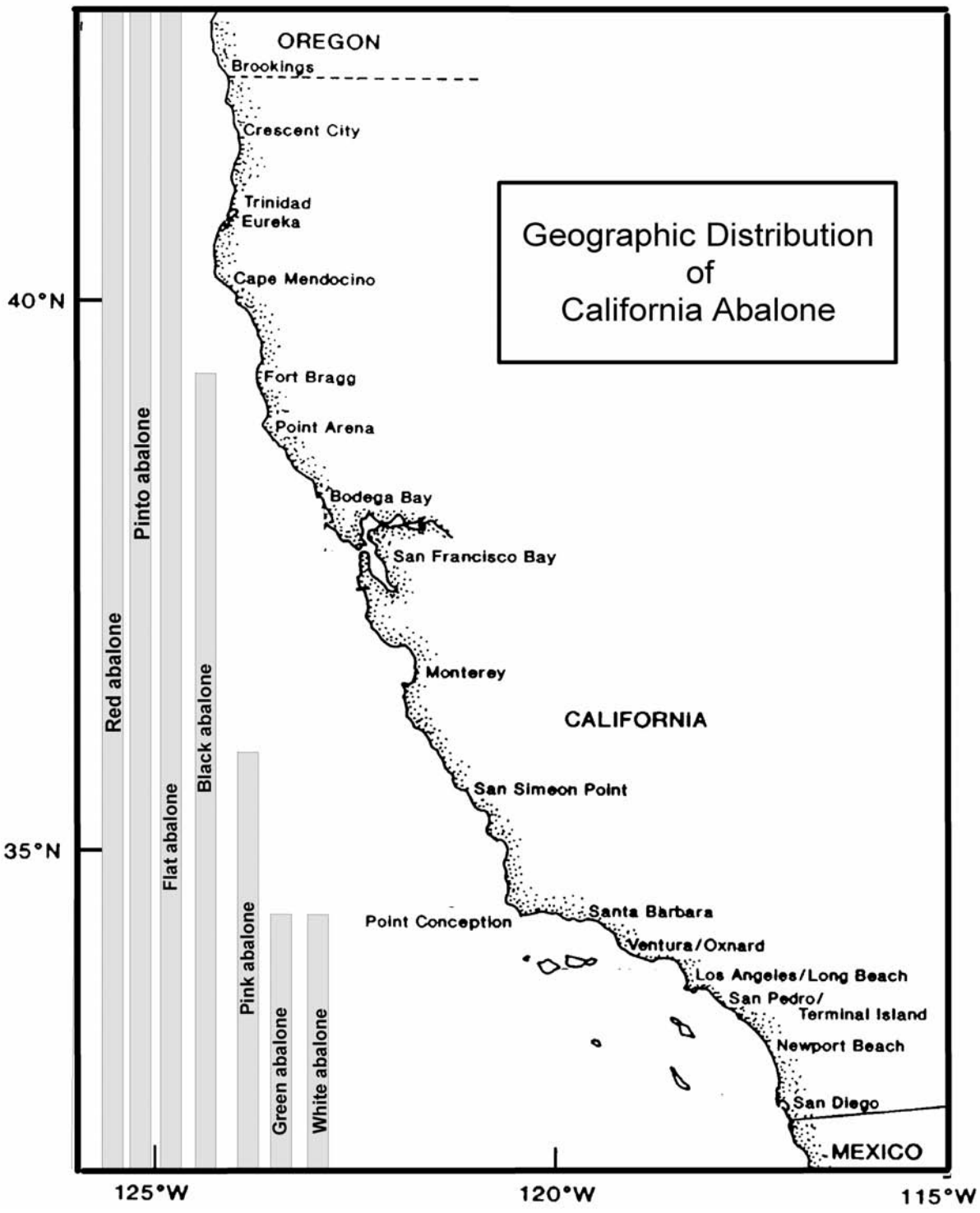

Figure 1-2. The geographic distribution of abalone species in California

Chapter 2. Description of the Stock

2.1 Biological Information

Seven species of abalone are found in California:

- red abalone, *Haliotis rufescens*
- pink abalone, *H. corrugata*
- green abalone, *H. fulgens*
- black abalone, *H. cracherodii*
- white abalone, *H. sorenseni*
- pinto abalone, *H. kamtschatkana* (includes *H.k. assimilis* and *H.k. kamtschatkana*)
- flat abalone, *H. walallenis*

2.1.1 Geographic Range and Distribution

California abalone occur in coastal waters intertidally to 60 m (197 ft) in depth. Abalone are found in boulder and rock habitat, and are usually associated with kelp forests. Several species may be found occupying the same coastal areas, but they are usually separated by depth. Red abalone occur along the entire California coastline (in appropriate habitat), while pink, green, and white abalones are associated with the warm, temperate waters south of Pt. Conception, Santa Barbara County. Black abalone occur from just north of San Francisco to Baja California, Mexico. The less common flat and pinto abalones are predominately found north of Point Conception, where water temperatures are generally cooler (Figure 1-2) (Cox 1960, Geiger 2000).

2.1.2 Reproduction

2.1.2.1 Maturation

Size at maturation varies among abalone species (Table 2-1). Abalone tend to mature earlier when food is plentiful.

2.1.2.2 Spawning and Fecundity

Abalone are broadcast spawners, releasing both eggs and sperm into the water during a synchronized event. Sex ratios are typically one to one. The spawning season varies among species (Table 2-2).

Broadcast spawners produce large numbers of eggs and sperm to compensate for high mortality and the low probability of successful fertilization in early life history stages. Female abalone produce only a few thousand eggs when they first reach maturity, while older adults can yield between three and 12 million eggs (Rogers-Bennett et al. 2004, Giorgi and DeMartini 1977). The number of eggs produced by a female also increases with size. Fecundity in abalone can be affected by the availability of food, sea water temperature, and local environmental conditions.

A minimum density of spawners is essential for successful broadcast spawning. When populations drop below the minimum spawning density (also called minimum viable population size, or MVP), individuals are often too far apart to ensure successful reproduction (mixing of eggs and sperm). This phenomenon is referred to as the “Allee

Table 2-1. Size and estimated age at maturity of California abalones. Age is derived from von Bertlanffy growth parameters, length infinity (L_∞) and the growth coefficient (k), as published in referenced papers.

Species	Sexual maturity		Location	Reference
	(mm)	Years		
Red	♀106 ♂75	1+ 2+	California	Rogers-Bennett *et.al.* 2004
Pink	40	1+-3	California	Parker *et al.* 1992
Pink	102-132*****	2+	Mexico	Guzman-Del Proo *et al.* 1992
Green	60-70	1+ 1- 5	Catalina Is. California	Tutschulte and Connell 1988, Parker *et al.* 1992
Green	117-152*****	2-5	Mexico	Guzman-Del Proo *et al.* 1992
Black	40, 44	2+	San Miguel Is., Pt. Arguello (mainland)	Leighton and Boolootian 1963, Parker *et al.* 1992, Haaker *et al.* 1995
White	♀88 ♂108	3	Coal Oil Point, Santa Barbara	Tutschulte 1976
Flat	not known	not known	not known	not known
Pinto	50	2+	Alaska	Woodby *et al.* 2000

***** Average size at maturity

effect", and results in population declines and sometimes local extinction (Valiela 1984;Dennis 1989; Levitan *et al.* 1992). Because abalone are subject to the Allee effect, they are especially vulnerable to population collapse at low densities.

2.1.3 Recruitment

The term "recruitment" may be used to describe more than one life history event. Recruitment may refer to the settlement of young-of-the-year (YOY) abalone (juveniles that have settled within the past year and are less than 31 mm (1.2 in.) in shell length), to growth into reproductive maturity, or to entry into the fishery.

The production of large numbers of eggs and sperm does not guarantee reproductive success leading to settlement recruitment. Successful recruitment occurs only occasionally (Tegner *et al.* 1989; Karpov *et al.* 1998) and is dependent on larval transport to suitable habitats, available habitat, and the intensity of predation on post-larval and juvenile abalone.

Table 2-2. Biological information summary

Species	Current Range	Depth	Spawning season	Foods
Red	southern Oregon to Baja California, Mexico (considered absent from southern California mainland)	intertidal to 24 m	N. CA: Oct. - Feb. S. CA: year-round	bull kelp, giant kelp *Laminaria, Egregia, Pterygophora, Ulva*
Pink	Pt. Conception to Baja California, Mexico	lower intertidal to 60 m	March - November	*Plocamium, Eisenia, Macrocystis, Dictyopteris*
Green	Pt. Conception to Baja California, Mexico	low tide line to 18 m	early summer to early fall	*Gelidium, Pterocladia, Plocamium, Gigartina*, red algae, bull kelp, giant kelp
Black	San Francisco Bay to Baja California, Mexico	intertidal	late spring and summer	giant kelp, *Egregia*
White	Pt. Conception to Baja California, Mexico	25 to 60 m	late winter to early spring	*Laminaria, Agarum fimbriatum*
Pinto	Alaska to Baja California, Mexico	Shallow water in north; deep colder water in south	April to June	small algae
Flat	Oregon to San Diego, California	6 to 21 m	not known	not known

2.1.4 Genetics

The ability to distinguish abalone populations using genetic characteristics will be important for future abalone management. Genetic tools can be used to identify populations, assess the success of recruitment and of population enhancement programs, and support law enforcement.

Hamm and Burton (2000) studied black abalone along the central California coast and found significant genetic differences between seven locations. Genetic differences between populations arise when eggs and larvae do not regularly disperse.

Kirby *et al.* (1998) used genetic techniques to differentiate red abalone populations at different locations. Studies suggest that genetic population differences among red abalone are minimal between northern and southern California (Kirby *et al.* 1998, Burton and Tegner 2000).

Genetic tools may also be useful in evaluating abalone out-planting techniques. For instance, Gaffney *et al.* (1996) used population genetics to suggest that red abalone out-planted in the 1970s enhanced natural populations, but a later genetic analysis (Burton and Tegner 2000) showed that populations had not been enhanced. However, the use of population genetics analysis tools in determining outplant success

has potential as long as some sort of genetic differentiation can be found (Burton and Tegner 2000) that identifies hatchery outplants.

2.1.5 Early Life History

2.1.5.1 Larval Development

Fertilized eggs hatch into free-swimming larvae within 24 hours. Larvae swim upwards in the water column initially (Crisp 1974), settling to the bottom as the shell develops (Forward *et al.* 1989). The rate of development in these non-feeding larvae is controlled primarily by temperature, and varies from 4 to15 days (Leighton 1972, 1974). Settlement marks the end of the larval phase and the beginning of the juvenile stage.

2.1.5.2 Larval Dispersal

The short duration of the free swimming larval phase of abalone (4-15 days) suggests that dispersal is limited (Tegner and Butler 1985, Prince *et al.* 1987).

2.1.5.3 Post-larval Development

Abalone larvae settle and metamorphose into juvenile abalone primarily on crustose coralline algae (Saito 1981, Shepherd and Turner 1985, Kitting and Morse 1997). Newly settled abalone graze on the cuticle and epithelial contents of coralline algae (Garland *et al.* 1985). Sea urchins and other grazers maintain coralline substrates which, in the absence of sea urchins, become overgrown and unsuitable for juvenile abalone (Saito 1984, Shepherd and Turner 1985). Juveniles remain in coralline habitats until they reach about 6 mm (0.24 in.) in shell length. The post-larval stage is critical, as over 90% mortality can occur at this stage (Siquieros-Beltrones and Voltolina 2000). Sources of mortality may include: poor substrate quality, physical displacement by wave action, incidental ingestion by large grazers, smothering by algae or detritus, genetic failure to fully metamorphose and begin feeding, and predation.

2.1.6 Age and Growth

Abalone are long-lived and can reach ages of 30 years or more. The growth rate varies among and within species, and with size and age. Variability also occurs on annual and seasonal bases, and has been attributed to water temperature shifts, spawning cycles (seasonal gonad production), and fluctuations in food supply. Growth rates are rapid during the first four or five years, and slows thereafter. Table 2-3 provides estimates of age at the current and past recreational minimum legal size and at the past commercial minimum legal size. Despite the wide variability of growth rates, some general trends are evident:

- Growth after the first year is irregular and varies according to the abundance and quality of food, location of the individual, intensity of competition and environmental factors
- Abalone tend to grow quickly (given favorable conditions) until they reach sexual maturity; growth slows thereafter

Table 2-3. Growth parameters of California abalones. MLS_R and MLS_C are minimum legal size (mm) recreational and commercial, respectively. Years is the time it takes to attain those sizes. Data are derived from the von Bertlanffy growth parameters, length infinity (L_∞) and the growth coefficient (k), as published in referenced papers.

Species	MLS_R		MLS_C		Location	Reference
	(mm)	Years	(mm)	Years		
Red	178	6-12	198	8-15+	Santa Rosa Is.	Haaker *et al.* 1998
Red	178	12	198	---	North Coast	Tegner *et al.* 1989
Pink	153	14	159	16	Santa Catalina Island	Tutschulte 1976
Pink	152	4-9+	159	4-11+	Mexico	Guzman-Del Proo *et al.* 1992
Green	152	14-21	178	21	Catalina Is. California	Tutschulte and Connell 1988, Parker *et al.* 1992
Green	150	5-6	178	9-10+	Mexico	Guzman-Del Proo *et al.* 1992
Black	127	20 - 30	146	–-	San Miguel Is., Pt. Arguello (mainland)	Parker *et al.* 1992, Haaker *et al.* 1995
White	?	?	?	?		
Flat	?	?	?	?		
Pinto	102	9	102	9	Alaska	Woodby *et al.* 2000

- The decrease in growth rate in mature abalone may be attributed to the shift in energy allocation from growth to gonadal production
- Abalone tend to grow faster in areas with high food quality and quantity

2.1.7 Food

Post-larval and early juvenile abalone feed mainly on bacteria, benthic diatoms, and single-celled algae that form surface films on rocky substrate (Daume et al. 1999, Leighton 1974). Juvenile abalone begin feeding on coralline algae and eventually switch to brown, red and green algae (Leighton 1959, Cox 1962). Adult abalone feed primarily on brown algae, often in the form of unattached, drifting kelp; but when drifting kelp is scarce, adult abalone feed on benthic diatom films.

In northern California, the predominant food source for abalone is bull kelp, an annual brown algae. Bull kelp dies back during the winter months, limiting the amount of available food. In central and southern California, the predominant food source is giant kelp, a perennial species that provides food throughout the year.

2.1.8 Movement

The extent of abalone movement depends on many factors, including size, availability of food, and shelter. Abalone move during nocturnal feeding excursions (Bonnot 1948; Leighton 1968; Shepherd 1973), and may move seasonally in response to food availability (Ault and DeMartini 1987). As they increase in size, juveniles move to areas that provide shelter to larger individuals, eventually emerging from more hidden locations (Ault and DeMartini 1987).

Ault and DeMartini (1987) observed a seasonal trend in red abalone movement from shallow water in spring to deep water in summer, and from deep water in fall to shallow water in winter in northern California. These movements by adult abalone were apparently in response to highly seasonal and depth-limited changes in food abundance. It is possible that offshore movement at the start of the fishing season (in April) could function to increase abalone density in the *de facto* deep water reserve, which is inaccessible to the fishery. This movement pattern could also support the fishery closure in winter, when abalone are more vulnerable to fishing as they move to shallow water to access limited algal food resources.

2.1.9 Mortality

Sources of abalone mortality include natural and human-induced causes. Human-induced causes include fishing (Chapter 3 History and Socio-economics of the Fishery), pollution, and impacts to habitat. Causes of natural mortality include predation, disease, and environmental factors.

2.1.9.1 Predation

Predation is a major cause of mortality in abalone populations. Vulnerability to predation is highest during the early life history stages (larvae and juvenile), and decreases with size and age. The major non-human abalone predators in California include other invertebrates, fish, and sea otters.

<u>Invertebrates</u>

The most common invertebrate predators of abalone are sea stars, rock crabs of the genus *Cancer* (Cox 1962), and octopuses (Pilson and Taylor 1961). Other known predators include the sheep crab, *Loxorhynchus grandis*; the California spiny lobster, *Panulirus interruptus* (Tegner and Butler 1985a); Nuttall's hornmouth (snail), *Ceratostoma nuttalli*; and Kellett's whelk, *Kellettia kelletti* (Tegner and Butler 1985a).

<u>Fish</u>

Fish predators of abalone include California sheephead, *Semicossyphus pulcher* (Cox 1962); cabezon, *Scorpaenichthys marmoratus* (O' Connell 1955); kelp greenling, *Hexagrammos decagrammus*; kelp bass, *Paralabrax clathratus*; moray eel, *Gymnothorax mordax* (Cox 1962); bat ray, *Myliobatis californica* (Tegner and Butler 1985a, Tegner 1992); and garibaldi, *Hypsypops rubicundus*. Larger adult abalone are less vulnerable to fish predation, unless injured or dislodged from the substrate (Cox 1962).

Sea Otters

Prior to sea otter exploitation by humans, abalone and sea otters co-existed and shared a long evolutionary history during which abalone were at low densities within crevice habitats. Human exploitation caused the local extinction of the southern sea otter throughout most of its range in California, allowing abalone populations to expand in the absence of sea otter predation. Remnant populations of sea otters along the central California coast increased from 1914 to the mid-1970s at an annual rate of 4% to 5%, gradually expanding their density and range (Kenyon 1969; Miller *et al*. 1974; Geibel and Miller 1984).

Within the Central California Sea Otter Range, sea otters are the primary predator of subtidal adult abalone. Because sea otter predation causes marked reduction of the numbers and sizes of abalone within established otter territory, abalone fisheries cannot co-exist with sea otter populations (Wendell 1994, Watson 2000). In otter-populated areas, abalone find shelter in protective, high-relief substrate, such as the area offshore of Hopkins Marine Laboratory in Monterey (Hines and Pearse 1982).

The 1982 United States Fish and Wildlife Service sea otter recovery plan called for the translocation of sea otters away from the central California coast to an area at San Nicholas Island in southern California. At the time, it was considered a reasonable recovery action to help increase the sea otter's range and to insure that a catastrophic event, such as an oil spill, would not imperil the entire otter population. The translocation program, implemented in 1987, was halted in 1990 due to concerns about significant mortality from translocation activities. In 2000 the Fish and Wildlife Service completed a Section 7 consultation under the federal Endangered Species Act, which determined that resumption of the translocation activities under this program would jeopardize the entire southern sea otter population (U.S. Fish and Wildlife Service 2000). In the final version of the recovery plan, released in 2003, the Fish and Wildlife Service recognized that the original intent and purpose of the translocation program had not been met. Part of the current, revised recovery strategy is to allow the number and range of sea otters to increase naturally (U.S. Fish and Wildlife Service 2003). Therefore, it is reasonable to assume that further expansion of the southern sea otter population will occur. The survival of severely depleted abalone populations in southern California could be jeopardized by expansion of the sea otter range and the accompanying increase in sea otter predation on abalones if recovery of these species does not occur before then.

2.1.9.2 Diseases and Parasites

Withering Syndrome

A devastating disease known as withering syndrome (WS) has caused widespread declines among abalone populations (primarily black abalone) at the Channel Islands and along the central California coast. WS has also been reported in red, pink, green and white abalones in captivity. Prior to the first reports of WS in 1985, abalone diseases were seldom reported (CDFG 1993a; Haaker *et al.* 1992).

Signs of WS include atrophy of the foot muscle and gonadal tissues, emaciation, and lethargy. As abalone become progressively weaker, they lose their ability to cling

to substrates and are easily dislodged and battered by waves or eaten by predators and scavengers. WS is known to affect abalone of all sizes.

The causative agent of WS has recently been identified as an intracellular bacterium, *Candidatus Xenohaliotis* californiensis (Friedman *et al.* 2000, 2002; Moore *et al.* 2001). Transmission requires no intermediate host. In addition, the bacteria can survive in seawater for a limited period of time, and contact is not required for transmission to occur. Laboratory and field studies have shown a positive correlation between mortalities in WS-infected abalone and elevated water temperatures (Parker *et al.* 1992; Lafferty and Kuris 1993; Friedman *et al.* 1997; Moore *et al.* 2000).

Currently, both *Candidatus Xenohaliotis* californiensis and the disease WS have been documented in abalone as far north as Point San Pedro (just south of San Francisco). The bacteria, but not signs of WS, has been found at two locations north of San Francisco.

The specific effects of WS and the extent to which these effects are modulated by water temperature appear to vary between abalone species. Overall, these differences are poorly understood. Nearly all studies have examined black or red abalone and information is lacking or mostly lacking for white, pink and green abalones. The effects of WS on each abalone species needs to be identified and considered in the implementation of recovery options.

Withering syndrome may constitute a potentially serious and immediate threat to recovery of all species of abalone in southern California. Depending on potential long-term environmental change, such as changes induced by global warming, populations in central and northern California may also be adversely affected. Thus, WS has the potential to be a limiting factor in the present and future distribution of abalone populations in California.

The discovery of a few large (older) black abalone remaining in WS-affected areas suggests that a small percentage of the population may be naturally resistant to WS. If this resistance is found to be genetically-based, these animals could be employed as broodstock to propagate WS-resistant black abalone.

Sabellid Polychaetes

The California abalone aquaculture industry has been working to eliminate the risk posed by the parasitic sabellid polychaete, *Terebrasabella heterouncinata*, following its inadvertent introduction from South Africa in the late 1980s. This worm lives on the growing edge of abalone shells. Heavy infestations cause disruption in normal shell growth, resulting in deformed, slow-growing, brittle shells.

The State and industry have acted to keep this worm from infesting native gastropod mollusc populations by prohibiting the movement or placement of cultured abalone into state waters, and by implementing sabellid eradication plans for every culture facility. The cooperative containment and eradication efforts appear to have confined sabellids to one location in the wild near one aquaculture outfall. Removal of infested wild gastropod molluscs may have successfully eradicated this introduction (Culver and Kuris, 2000). The Department will continue to allow out-planting of abalone only from certified sabellid-free facilities.

Shell-boring Organisms

Cliona celata californiana is a boring sponge that secretes an acidic substance that etches tiny holes in the abalone shell's surface. A heavy infestation of boring sponges weakens the shell and increases the likelihood of shell damage and death (MacGinitie and MacGinitie 1949; Cox 1962; Hansen 1970). Piddock clams, *Penitella conradi*, and date mussels, *Lithophaga subula*, are boring bivalve molluscs. The piddock clam drills at right angles to the shell's surface, whereas the date mussel secretes acid to dissolve a hole in the shell and may enter at an acute angle. Where boring molluscs are abundant, abalone may have many thickened blister areas in their shells, and may succumb (Cox 1962; Hansen 1970). Polydorid polychaetes burrow into abalone shells primarily near the smallest whorls of the shell apex, in an area known as the protoconch (Hansen 1970). Severe infestations can inhibit growth (Hahn 1989) and promote the formation of distorted, dome-like shells. *Polydora websterii* has been identified as a symbiont of cultured red abalone (McMullen and Thompson 1989). This species is not known to deform shells in wild populations.

2.1.9.3 Environmental Factors

Other sources of natural mortality include environmental factors such as storms (including wave stress, boulder movement and sand scour), increased water temperature, oxygen depletion, salinity variations, and toxic chemicals.

El Niño Events

El Niño/Southern Oscillation (ENSO) climate anomalies occur when the ocean-atmospheric system in the tropical Pacific changes, affecting weather patterns over much of the globe. ENSOs are characterized by heavy rainfall, monsoons, and warm sea-surface temperatures. Along the coast of California, ENSOs depress the thermocline (a temperature differential in the water) and diminish the California Current. Depression of the thermocline away from the upper surface layer reduces primary productivity and adversely affects the food chain in coastal upwelling ecosystems. ENSO-related storms cause mass mortalities of kelp species such as giant kelp, an important abalone food source.

Large-scale disturbances of kelp populations from ENSOs and severe storms seem to follow a regular pattern of occurrence. ENSOs occur every 2 to 10 years. These events are a normal part of the ecosystem, and species have developed strategies that allow them to recover under natural conditions. However, resiliency may be diminished if the species is otherwise depressed and/or if the event is particularly severe or prolonged. Since 1977, the frequency, duration, and intensity of warm-water ENSOs has increased. This prolonged period of greatly-increased environmental variability on a decadal scale may have contributed to the steady decline of abalone populations in southern California (Tegner *et al.* 2001).

Because kelp forest communities are vital to abalone populations, any event that reduces the productivity of these communities may indirectly affect abalone populations associated with them. ENSOs diminish or even exhaust abalone food supplies by inhibiting the production of kelp and other algae. When food is limited, abalone are at a great competitive disadvantage because they are sedentary, passive feeders. In addition to reducing the quantity and quality of the drift kelp that abalone consume,

ENSOs may alter current patterns and thus affect larval dispersal. Also, violent wave action from El Niño storms can kill abalone directly by crushing them during boulder movement or by covering abalones' rocky habitat with sand. Warm water conditions also exacerbate the debilitating effects of WS (Friedman *et al.* 2000, Moore *et al.* 2000, Raimondi *et al.* 2002).

2.1.10 Competition

Sea urchins are major competitors of abalones (Leighton 1968; Shepherd 1973b; Tegner and Levin 1982; Tegner 1989a). The red sea urchin, *Strongylocentrotus franciscanus*, and the purple sea urchin, *Strongylocentrotus purpuratus*, directly compete for food and space with abalones in California. Both abalones and sea urchins feed on drift kelp. Following their release from sea otter predation, invertebrate grazers such as abalones and sea urchins flourished in nearshore waters for nearly a century in southern California (Tegner 1989a, 1989b). During most of this time, the supply of drift algae remained relatively abundant and predictable (Wilson and McPeak 1983). In this alternate, stable state, abalones maintained spatial dominance over sea urchins and abalone populations increased. Since the heavy exploitation of accumulated abalone populations began in the mid-1940s, the equilibrium has shifted in favor of sea urchins (Tegner 1989a). In northern California, large scale commercial take of red sea urchin beginning in 1985 may have increased available substrate and kelp production, to the benefit of red abalone populations (Karpov *et al.* 2001). However, selective harvesting of abalones releases sea urchins from interference competition and tends to accelerate the displacement of abalones by sea urchins (North and Pearse 1970; Shepherd 1973b). In addition, if drift algae becomes limiting, sea urchins can reduce the algal resource to a level below that necessary to maintain abalones (Tegner 1980, 1989a).

Sea urchins are adapted to survive in heavily-grazed habitats because unlike abalone, they have alternate methods of obtaining sustenance (Cox 1962). They actively seek attached kelp, whereas abalones remain in place and passively wait for food to drift their way (Shepherd 1973b; Tegner 1980). Where few predators are present to keep sea urchin populations in check, they can form massive feeding fronts. Motile aggregations of sea urchins can destroy kelp forests by eating almost all the larger, non-microscopic algae in their path (Tegner 1980, 1989a; CDFG CEQA Document 1993). In addition, sea urchins may inhibit kelp recruitment by over-grazing rock surfaces to such an extent that new algal spores cannot attach to the bare rock (Leighton 1966, 1968, 1971; Dean *et al.* 1984; Dayton and Tegner 1989). However, abalone may also derive positive benefits from associations with large sea urchins (Section 2.1.11 Community Associates of Abalone).

Lack of space is the primary cause of competition between different species of abalone (intraspecific competition). Competition between abalone species is limited by the separation of species into different depth ranges and temperature regimes.

2.1.11 Community Associates of Abalone

Abalones live on intertidal and subtidal rocky substrate. Depending on the species, this habitat may include bare rock, surf grass, kelp forest, or deep, sub-canopy-forming kelps. These communities are complex systems where biological and

environmental factors interact. Biological interactions include competition within and among species, predator/prey interactions, disease, and parasite/host interactions. Ocean conditions have been found to shape the dynamics that influence abalone populations (Dayton and Tegner 1984). Kelp forest community dynamics for some abalones are further confounded by human activities such as fishing (Tegner and Dayton 2000) and pollution.

Subtidal abalone are typically closely associated with the kelps that provide food and shelter. Factors that impact kelp abundance may in turn also affect abalone populations. For example, storms can severely reduce kelp beds, thus reducing growth and reproduction. In southern California, giant kelp may be adversely affected by warm, nutrient-depleted water from El Niño events, which may not support kelp maintenance and growth (Gerard 1976; Dayton and Tegner 1984). During El Niño years, red abalone growth rates are reduced (Haaker *et al.* 1998) and reproduction is diminished (Tegner *et al.* 1989; Tegner *et al.* 2001). In northern California, growth and reproduction is linked to seasonal kelp productivity and abundance (Giorgi and DeMartini 1977).

Predator-prey relationships are important factors in defining abalone abundance and distribution. For instance, the sea otter is an important predator that directly affects abalones (Ebert 1968). Where abalones and sea otters co-occur, abalone populations are restricted to small sizes and cryptic habitat (Hines and Pearse, 1982). Where sea otters are absent, an alternative predator-prey relationship occurs in which herbivores, including abalones, are larger and less restricted in their distribution.

Other predator-prey relationships in the kelp community have indirect effects on abalones. Sea otters prey upon other herbivores, such as sea urchins (Estes and Palmisano 1974; Duggins 1980, Van Blaricom and Estes 1988), which compete with abalones for food and space. Sea otters also prey on sea stars, octopuses, and crabs, which all feed on small abalones.

Competition among species is another important factor that shapes abalone populations. The primary abalone competitor is the sea urchin (Section 2.1.9.1 Predation). Adult sea urchins and abalone both eat kelp and therefore may compete particularly when kelp resources are limited (Tegner and Levin 1982; Karpov *et al.* 2001). While adult red abalone and red sea urchins may compete for space (Deacon 1977; Karpov *et al.* 2001), at other life stages there maybe a beneficial relationship. Juvenile abalone shelter under the spine canopy of adult red sea urchins (Ebert 1968; Tegner and Dayton 1977). In northern California, areas with red sea urchins have significantly more juvenile red and flat abalone than areas where sea urchins had been taken by fishermen (Rogers-Bennett and Pearse 2001). Sea urchins appear to be critical for the survival of small abalone in the 5 mm to 20 mm size class in California (Rogers-Bennett and Pearse 2001) and elsewhere (Kojima 1981; Tarr *et al.* 1996; Day and Branch 2002). Sea urchins may also maintain coralline algal pavements appropriate for juvenile abalone settlement (Saito 1981). Although the commercial harvest of sea urchins may reduce competition between adult abalone and sea urchins for kelp resources, it is likely that sea urchin fishing exposes juvenile abalone to predation (Tegner *et al.* 1989). If so, then the sea urchin fishery in southern California may have contributed to recruitment failure in abalone populations by reducing the available habitat for juveniles (Tegner and Dayton 2000).

Ocean conditions, including severe storms, El Niño events, and upwelling, can alter abalone population structure. Severe storms and associated wave action are highly disruptive to community structure, through wave-caused rock movement and sand transport, and reduction of algal food sources. El Niño events can affect abalone growth and reproduction, but their shorter duration may not be as disruptive to community structure. Upwelling benefits populations by increasing nutrient flow and decreasing water temperatures, which are beneficial for kelp growth.

The effects that ocean conditions have on abalone-associated species may also indirectly affect abalones. Ocean conditions may drive sea urchin recruitment events such that during El Niño years, when there is a relaxation of offshore advection of surface waters, larvae are retained and settle nearshore (Ebert *et al.* 1999). After they grow to adulthood, these large, El Niño year-classes of sea urchins may dominate kelp communities (in the absence of human fishing and sea otters). When sea urchin densities are high, storm-related destruction of kelp beds and subsequent food shortages are thought to trigger a switch in sea urchin grazing patterns from drift kelp feeders residing in crevices to destructive grazers that fully consume kelp beds, creating barren areas (Harrold and Pearse 1987) and increasing competition with abalones. Storms can also reverse the structure of these barrens communities back to kelp forests, by eliminating sea urchin aggregations and clearing rock for kelp settlement and re-establishment (Ebeling *et al.* 1985), thus easing competition with abalone.

2.1.12 Abalone Habitat

There are three main abalone habitat types in California: intertidal, subtidal kelp bed, and deep water. The type and availability of these habitat types varies throughout California. Regardless of habitat type or location, abalones require hard substrate (bedrock, boulders, shale shelves, and rock piles) for attachment.

2.1.12.1 Habitat Types

Intertidal Habitat

Intertidal rocky substrate is a significant habitat type for southern black and green abalones and northern red abalone. Intertidal habitats are subject to long periods of drying, high temperatures, intense light, and high wave stress during low tide. The stability of intertidal habitats depends on the extent of rocky substrate, frequency of disturbance, and the presence of sand and loose rock.

Subtidal Kelp Bed Habitat

Subtidal kelp bed areas form the primary habitat of all California abalone species. Kelp beds occur on the rocky substrates that abalones require, and kelp is a major food source of abalones. Kelp prefer cool (less than 20° C), nutrient-rich upwelling areas (Foster and Schiel 1985). The annual bull kelp, *Nereocystis luetkeana*, dominates in northern California and the perennial giant kelps *Macrocystis integrifolia* and *Macrocystis pyrifera* dominate in central and southern California.

Deep Water Habitat

Deep water abalone habitat is rocky substrate found deeper than 24 m (80 ft). Of the seven California abalone species, only the white abalone uses deep water rocky substrate as its primary habitat, and can be found at depths greater than 60 m (200 ft). However, red abalone have been found as deep as 30 m (100 ft) and pink abalone may be found as deep as 36 m (120 ft). Food availability is limited within deep water habitat, as kelp forests are restricted to shallower depths. Some deep offshore reefs may support local kelp beds. Several species of deep-water brown algae are found on deep reefs off southern California, including *Laminaria* sp., *Agarium* sp., and *Pelagophycus* sp. Several of these algae form significant sub-canopies over deep rocky substrate, and provide food to deep-dwelling herbivores.

2.1.12.2 Latitudinal Habitat Variation

Northern California

The northern California coastline is characterized by steep slopes which provide less habitat for abalone than the broader shelves found in central and southern California. Water temperature in northern and central California is cool, typically 8° to 15°C (46° to 59°F). This allows red abalone to occupy shallower depths, from low intertidal to 6 m (20 ft), than in southern California. Bull kelp, *N. luetkeana*, is the dominant algal species.

Not all northern California rocky shores are suitable habitat for red abalone. Most of Del Norte and Humboldt Counties have very few red abalone despite the presence of a rocky shoreline. Several factors may limit abalone populations in these counties, including increased amounts of fresh water, turbidity (which limits algal growth by decreasing light penetration), and sedimentation from large rivers. The shoreline is also more exposed to storm waves and has few of the surge channels that abalones favor.

Central California

Central California has extensive rugged, rocky habitat and high kelp productivity, making it ideal for abalone. Temperatures typically range from 10° to 15°C (50° to 59°F). Central California is dominated by *M. pyrifera*, an annual kelp.

Southern California

Southern California has areas of gently-sloping rocky shores which are favorable for abalone. The northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) help protect much of the mainland from the northwest winds and swells generated by storms. Water temperatures range from 15° to 21°C (59° to 70°F), which is in the optimal temperature range for growth of juvenile red abalone (Leighton 1974). Southern California kelp forests are dominated by *M. pyrifera*.

2.2 Status of the Abalone Stock

The status of California abalones ranges from near extinction (white abalone) to fairly robust populations (northern California red abalone). Status of the stock also varies by location. The status of each abalone species is discussed below.

2.2.1 Red Abalone

2.2.1.1 Northern California Stock

Northern California red abalone populations continue to support a viable fishery, but population and fishery data analyzed in 2001 revealed four trends which are cause for concern:

Concentration of Fishery Effort and Increased Take

Average take and effort estimates for 1998-2000 have increased compared to estimates for 1983-1989, and there has been a substantial concentration of fishery effort in Sonoma and Mendocino Counties. This effort shift has been accompanied by an estimated 25% increase in take. When poaching estimates of 217,000 lb [98 metric tons (t)] are added to the estimated recreational take, the total take exceeds 1.7 million lb (771 t). This level of take approaches the average red abalone harvest in southern California that was unsustainable and preceded fishery collapse (Karpov *et al.* 2000).

Evidence of Poor Recruitment

Recruitment is necessary to ensure replacement of animals removed by the fishery. Recruitment of juvenile abalone measuring less than 30 mm (1.2 in.) is indicative of successful reproduction, while recruitment of high densities of emergent (non-hidden) abalone measuring 100 to 178 mm (4 to 7 in.) is predictive of increases in fishable populations (Karpov *et al.* 1998).

Recruitment to the adult population occurs after successful larval settlement and metamorphosis, and development as juveniles (Tegner *et al.* 1989). Under optimal conditions, recruitment of abalone can be high. High fecundity and local dispersion appear to favor successful juvenile recruitment (Shepherd and Turner 1985, McShane 1992). However, most of the time, recruitment is highly variable regardless of adult abundance. Evidence based on a long time series of data from northern California suggests that successful year classes occur infrequently (Karpov *et al.* 1998, 2001). Large numbers of abalone smaller than 100 mm (4 in.) were last observed between 1986 and 1992 at Van Damme State Marine Conservation Area in Mendocino County (Karpov *et al.* 1998). Since 1992, the abundance of abalone between 50 and 125 mm (2 and 5 in.) has declined substantially at this location (Figure 2-1)(Karpov *et al.* 2001). Recent surveys at four other northern coastal sites (Point Cabrillo State Marine Conservation Area in Mendocino County, Bodega State Marine Reserve, Salt Point State Marine Conservation Area, and Fort Ross State Marine Conservation Area in Sonoma County), revealed few juveniles and emergent recruits, with juveniles least abundant in Sonoma County (Table 2-4). This reduction of juvenile animals suggests poor recruitment over the last decade. Given the slow growth rates of abalone, a successful spawn in any year would not reach the recreational fishery legal size of 178 mm (7 in.) for over a decade.

Declines in Deep Water Abalone

The prohibition of the use of SCUBA and surface supplied air while taking abalone establishes a deep water refuge, because free divers generally do not dive deeper than 8.5 m (28 ft). This deep water refuge for abalone is thought to be

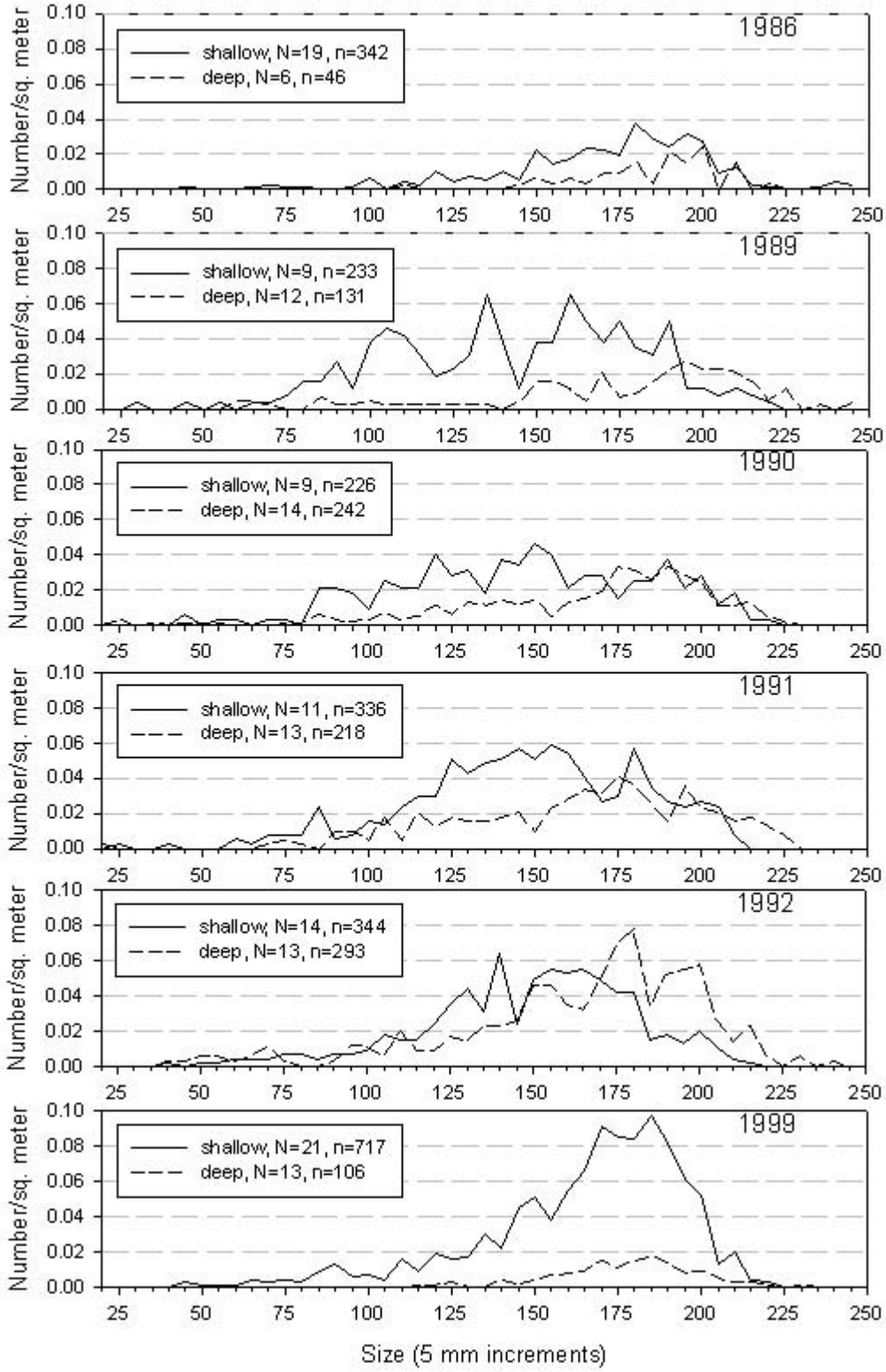

Figure 2-1. Emergent red abalone surveys, Van Damme State Marine Conservation Area, 1986-1999. Shallow = < 8.3 m, Deep = > 8.3 m

Table 2-4. Red abalone population survey at Van Damme, Fort Ross and Salt Point SMCAs, 1986-2000

		Van Damme SMCA				Fort Ross SMCA		Salt Point SMCA	
		1986	1989	1992	1999	1986	1999/00	1986	2000
Emergent	Shallow (<28 ft.)								
	Density (#/m^2)	0.37	0.89	0.76	1.04	0.41	0.58	0.73	1.27
Legals	>175 mm (6.9 in.)	55.3%	24.9%	22.1%	48.4%	69.3%	66.4%		66.7%
Sub-legals	<175 mm (6.9 in.)	44.7%	75.1%	77.9%	51.6%	30.7%	33.6%		33.3%
Juveniles[†]	>50 and <125mm (2.0 in & 4.9 in.)	8.2%	29.6%	17.2%	9.8%	0.5%	1.9%		5.9%
Invasive	<50 mm (2.0 in.)	*	*	16.8%*	6.2%*	*	0.0%	*	2.0%
Emergent	Deep (>28 ft.)								
	Density (#/m^2)	0.14	0.3	0.85	0.14	0.04	0.33	0.29	0.52
Legals	>175 mm (6.9 in.)	76.1%	61.1%	50.2%	61.9%	63.6%	67.9%		78.6%
Sub-legals	<175 mm (6.9 in.)	23.9%	38.9%	49.8%	38.1%	36.4%	32.1%		21.4%
Juveniles[†]	>50 and <125mm (2.0 in & 4.9 in.)	2.2%	12.2%	12.3%	1.9%	2.3%	0.0%		0.0%
Invasive	<50 mm (2.0 in.)	*	*			*	4.6%	S	7.1%

* No invasive surveys conducted in 1986 and 1989 Van Damme SMCA invasive surveys combined shallow and deep transects. [†]Juveniles are included in the Sub-legals category. SMCA = State Marine Conservation Area

important in protecting abalone populations in northern California from overfishing. The absence of a deep water refuge in southern California may have contributed to the decline of abalone populations, because the entire population was accessible to divers (Karpov *et al.* 1998). However, the proportion of the abalone population protected in deep water is not constant. Karpov *et al*. (1998) found that the number of abalone increased significantly at all depths from 1986 to 1992 at Van Damme State Marine Conservation Area in northern California, but surveys in 1999 showed a decline in deep water abalone to the level seen in 1986. Populations of red abalone have declined significantly in deep water at Point Cabrillo State Marine Conservation Area, a protected area adjacent to Van Damme State Marine Conservation Area, possibly as a result of sea urchin competition (Karpov *et al*. 2001). These declines in deep water abalone population levels are a concern since a smaller portion of the overall population is protected by the deep water refuge and thus is more vulnerable to fishing pressure. Figure 2-1 demonstrates the correlation of abundance in the deep water stock to later increases in shallow water stock.

Spatial Depletion

Catch and effort creel data collected by the Department provide evidence for serial depletion by area at heavily fished sites, with increased take of abalone from deeper water and from more remote locations, and a decline in the number of abalone taken per trip. At one heavily-impacted location, Moat Creek in Mendocino County, the distance traveled from access points to take locations doubled for shore-pickers from 1989 to 1994, and from 1995 to 2000. Aerial surveys conducted by the Department between 1975 and 1985 showed that there has been a significant decline in the number of shore-pickers, while diving effort has increased significantly. This could represent a shift from intertidal to subtidal fishing as the nearshore stock becomes depleted. Alternatively, the increased use of, and improvements in, diving gear may have attributed to the shift to subtidal fishing during the same time period.

2.2.1.2 Central and Southern California Stock

Based on long-term studies, the overall trend in red abalone abundance is one of decline in all locations surveyed (Figure 2-2) (Karpov *et al.* 2000).

Populations in key areas in southern California (Santa Rosa Island, Santa Cruz Island, and the California mainland) appear to have been extirpated, with remnant stocks showing little evidence of recovery. The trend in red abalone abundance and density (determined from long-term studies conducted by the Department and the Channel Islands National Park) is one of decline at all locations surveyed, except San Miguel Island where red abalone populations appear to be stable (Karpov *et al.* 2000). During the most recent Department research cruise in 2001, red abalone abundance (measured as the number of abalone encountered by one diver per hour) at Santa Rosa and Santa Cruz Islands was found to range from 0 to 7.6 individuals, and 0 to 1.4 individuals respectively. San Miguel Island is the only location that has a minimum viable population size. However, even at the close of the San Miguel Island fishery, the proportion of the population that was larger than commercial legal size (198 mm; 7.75 in.) was low, indicating that legal-sized stocks were severely depleted.

In the Central California Sea Otter Range, Wendell (1994) showed that the estimated red abalone population size decreased by 84% within six years following the re-introduction of sea otters. Due to the high amount of crevice-type habitat, populations stabilized at these low levels (7% of the initial 1965 estimate) (Wendell 1994). Hines and Pearse (1982) showed that abalone populations in otter-inhabited areas are sustainable at low levels, but with a reduced average size of 75 mm (3 in.), half that of abalone in otter-free areas. Although stable, these populations cannot support a fishery.

In central California north of the Central California Sea Otter Range, and at the Farallon Islands, evidence suggests that abalone stocks are depressed. During a dive survey at James V. Fitzgerald State Marine Park (San Mateo County) in central California, Karpov *et al.* (1997) found densities of red abalone of 0.02 /m^2, which is 1/10 of the lowest density found in heavily fished areas off northern California by Parker *et al.* (1988). At the Farallon Islands, the Department conducted a remotely-operated vehicle survey in 2000 that targeted areas of historic high abalone abundance (based on commercial diver observations). Preliminary results indicate that abalone densities were below 0.2/m^2.

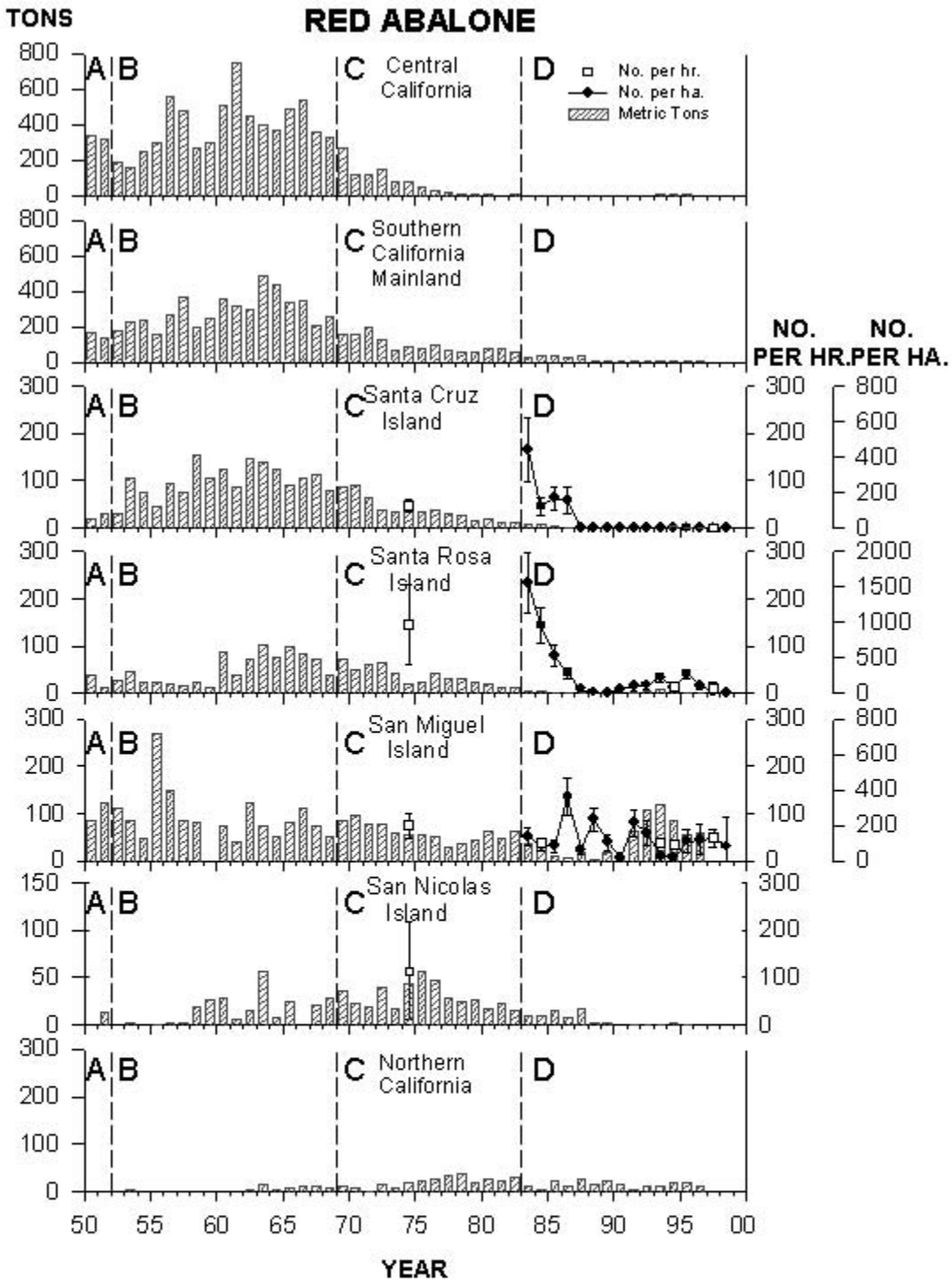

Figure 2-2. Red abalone catch, density, and number per hour from northern, central, and southern California mainland, and four Channel Islands. Catch is divided by landing periods. Catch areas are ordered from top to bottom by accessibility to fishery. Vertical lines around points represent standard error.

2.2.2 Pink Abalone

Pink abalone was once a common species in southern California. The Department's historical commercial landing records for pink abalone show a peak in 1952 at almost 1,508 t (3,325,000 lb) and a decline thereafter to 7 t (15,400 lb) in 1994.

Study sites in the Channel Islands provide the best and most recent data on pink abalone populations. Pink abalone abundances have shown tremendous declines in the Channel Islands since 1985. Anacapa Island currently has the greatest number of pink abalone of the five islands monitored.

2.2.3 Green Abalone

Green abalone was once a common species in southern California, and historically abundant in the warmer parts of the Southern California Bight (San Clemente, Santa Catalina, and Santa Barbara Islands; at Cortez Bank, and along the mainland from the Palos Verdes Peninsula south) (Tegner and Butler 1985a). The Department's historical commercial landing data for green abalone show a peak at 510 t (1,125,000 lb) in 1971, which thereafter plunged precipitously to a low of 0.72 t (1,600 lb) in 1995.

The Department conducted research cruises off San Clemente and Santa Catalina Islands from 1995 to 1999, and in 2000 to survey green abalone. Green abalone were rare at these sites, with densities ranging from 0 to less than 40 abalone per hectare (ab/ha) (0.004/m^2).

2.2.4 Black Abalone

The black abalone was abundant in California until the mid-1980s; it once occurred in such high concentrations that individuals were observed stacked on top of one another. It has been considered a rare species since late 2002.

Density studies of black abalone at four of the Channel Islands (San Miguel, Santa Rosa, Anacapa, and Santa Barbara) since the early 1980s show population declines attributed to WS. In the vicinity of Point Conception (Santa Barbara County), black abalone populations exhibited mortalities of 39% to 97%. At Point Arguello in Santa Barbara County, densities increased from 1992 to late 1993; however, after WS was first observed in 1994, densities started to decline and remained at a low level (1,000 ab/ha, or 0.1/m^2) through November 2000. Densities have now increased to 2,500 ab/ha (0.25/m^2)(CDFG unpublished data), but this is far lower than historic population levels of up to 1,000,000 ab/ha (100/m^2) (Davis 1993).

2.2.5 White Abalone

On 29 May 2001, NOAA Fisheries listed the white abalone as an endangered species under the federal Endangered Species Act (ESA), making this the first marine invertebrate to be listed due to direct human take (Hobday and Tegner 2000). White abalone are susceptible to WS in land-based culturing facilities, but the role of WS in natural population mortality is unknown. Current population estimates indicate that white abalone may have declined by as much as 99% compared to 25 years ago. An abundance estimate based on deep survey data from 1997 (Davis *et al.* 1998) estimated that 1,600 animals (Hobday and Tegner 2000) were spread over the entire geographic range documented for this species.

In comparison, a conservative estimate of baseline white abalone population abundance using commercial landings data from 1969 to1978 is 363,000 animals (Hobday and Tegner 2000). This abundance estimate suggests that the white abalone density in 1969 was approximately 500 ab/ha (0.05 /m^2), assuming no new individuals entered the population during the 10-year peak of the fishery for this species. Remnant populations of adult white abalone remain mostly at depths of greater than 33 m (108 ft), in the deepest portions of their former distribution. Their distribution may be further limited to a narrow strip of habitat along the rock/sand interface of isolated boulders at depth. This may be problematic for population recovery since temperatures at these depths may be unsuitable for larvae. Modern biomass and egg production estimates are also very low (Rogers-Bennett, personal communication).

Despite the closure of the white abalone fishery in 1996, the remaining population may not recover on its own due to natural mortality (primarily predation and old age), and because individual white abalone may be too far apart to ensure successful reproduction (severe Allee effect). Low breeding density and reproductive failure suggest that without significant human intervention, recovery is unlikely.

A captive breeding program is now under way. In 1999, 18 adult broodstock were collected and brought to two culturing facilities. Three of these animals have been successfully spawned, producing more than 100,000 juveniles (McCormick personal communication). The disposition of these abalone will require a comprehensive evaluation, addressing the genetic and disease implications, size, and location of out-planting. Currently there is a prohibition on out-planting abalone to the natural environment from facilities not certified sabellid-free (Section 2.1.9.2 Diseases and Parasites, Sabellid Polychaetes). As a listed species, white abalone recovery is managed by NOAA Fisheries with the assistance of a white abalone recovery team that includes members from the Department.

2.2.6 Pinto Abalone

Pinto abalone were more common in northern California in the 1970s, when they made up 13% of the abalone population (Gotshall *et al.* 1974). Today they are very rare throughout northern California, making up less than 1% of the population (Rogers-Bennett *et al.* 2002). Cox (1962) reported that large numbers could occasionally be found in deeper waters. This species was not a major component of the California commercial or recreational catch.

2.2.7 Flat Abalone

Flat abalone are rare throughout their range in California (McMillen and Phillips 1974). Few studies have documented the abundance of flat abalone, and little is known about this species.

Abundance (density) within the Central California Sea Otter Range is low, but the relative abundance of flat abalone appears to have declined steadily. In the 1970s flat abalone accounted for 31% to 38% of abalone populations (Lowry and Pearse 1973; Cooper *et al.* 1977). Recent surveys revealed that flat abalone comprised only 6% of the total population, which is now dominated by red abalone in deep crevice habitat (Rogers-Bennett *et al.* 2002). In northern California, the relative abundance of flat abalone has always been low, making up less than 5% of the population (Gotshall *et al.*

1974; Rogers-Bennett and Pearse 1998). Due to their small size, flat abalone were not usually targeted by the recreational fishery and are protected from take.

Chapter 3. History and Socio-economics of the Fishery

3.1 Overview of the Abalone Fishery

The abalones native to the western coast of North America have been fished and collected from shore since before recorded history. At a time when the sea otter (a natural predator of abalone) ranged the entire coast of California, aboriginal peoples used intertidal species such as abalone for food, decoration, and trade (Cox 1962). By 1850, however, fur hunters had virtually eliminated sea otters along the California coast, removing one of the area's most voracious abalone predators. The resultant expansion of abalone populations likely contributed to the development of commercial fisheries, which thrived on the abundance of abalones.

Closures occurred early in the commercial fisheries, however. The commercial green and black abalone fisheries along the mainland reached their peaks in 1879 (Cox 1962; Cicin-Sain *et al.* 1977), and by 1913 these fisheries were closed (Edwards 1913; Cox 1962). Over the past century, abalone fisheries have been opened and closed numerous times (Appendix A).

During the past several decades, the abalone fishery south of San Francisco has suffered dramatic declines, resulting in a moratorium on take in both the commercial and recreational fishery in 1997. Closure of this major commercial fishery, which landed more than 2,000 metric tons during the 1950s and 1960s, occurred despite fishery management efforts. The collapse of southern California fisheries was, in part, due to increased pressure from a shift in commercial fishing. As the central California fishery was lost to the recovering sea otter population (see Section 2.1.9.1), fishery effort became focused on southern California instead (Wendell personal communication).

While abalone populations have been serially depleted through intense fishing and poor management, outbreaks of withering syndrome (WS), a devastating abalone disease, decadal climatic water temperature changes, and ENSO-related water temperature changes have also caused stock declines.

3.1.1 History of the Abalone Fishery

3.1.1.1 The Commercial Abalone Fishery

Commercial fishery-dependent data were primarily derived from mandatory landing receipts for 1950 to 1996. Between 1942 and 1996, the trends in total commercial landings for all abalone species were marked by four distinct stages (Figure 3-1):

A. 1942 to 1951: The fishery was characterized by increased landings

B. 1952 to 1968: Landings were relatively stable

C. 1969 to 1982: A rapid decline in landings occurred

D. 1983 to 1996: A period of gradual and steady decline occurred

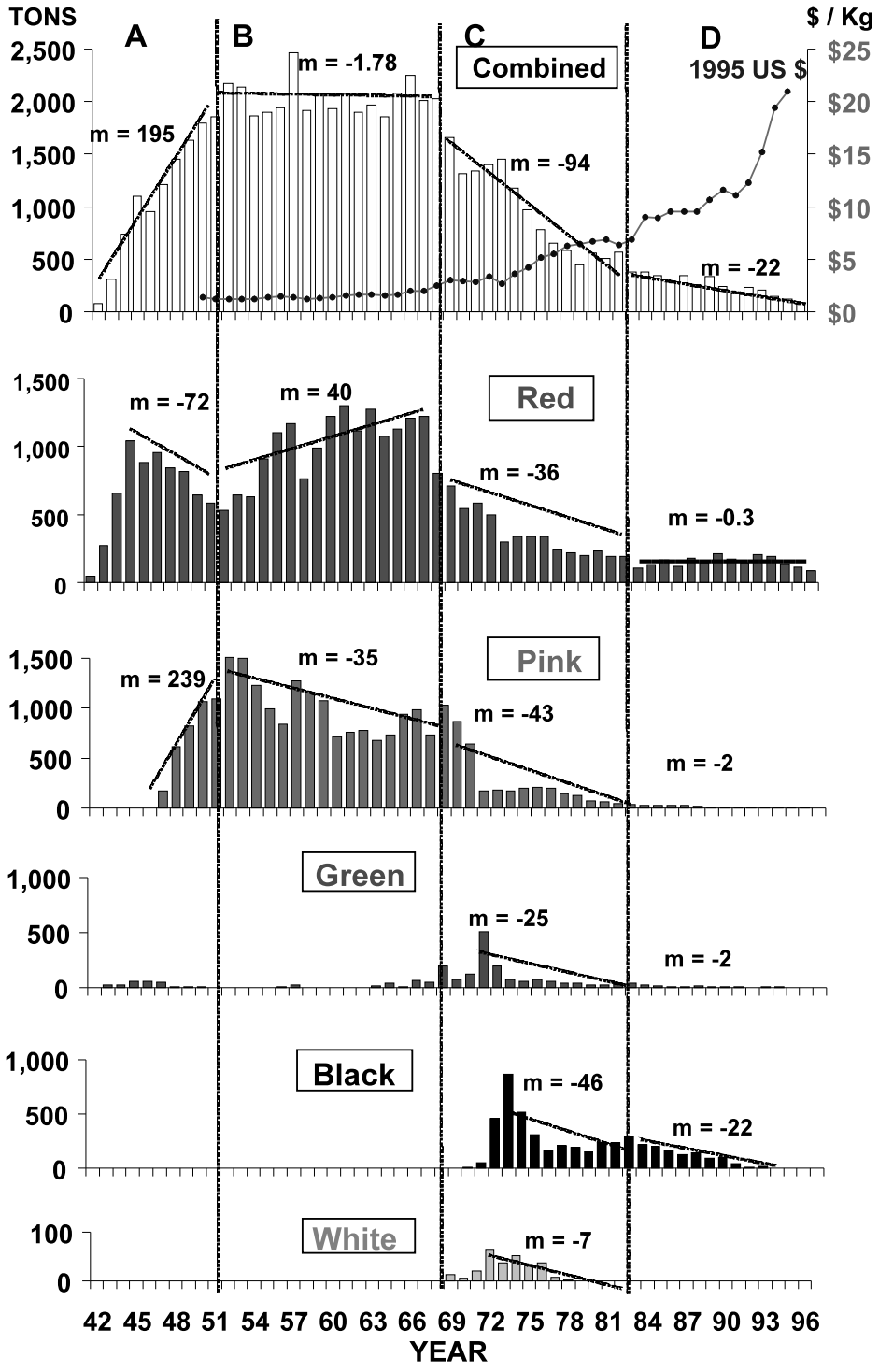

Figure 3-1. Commercial landings (metric tons) of the California abalone fishery (bars), combined (top), and by red, pink, green, black, and white abalones. Landings are divided into periods (A-D) by trends in the total fishery landings, with regression lines (dotted lines) for each period (m=slope, t x year-1). Regressions are provided for individual species where sufficient data exists. The average annual value of all species (US $ per kilogram) is represented by a solid line.

Serial Depletion

The patterns observed in the combined landings mask patterns of the individual species landings. In the California abalone fishery south of San Francisco, apparent stability from 1952 to 1968 was in fact an illusion composed of multiple species landings in multiple fishing areas. When the individual abalone fisheries are divided into components, a pattern of serial decline by species and by area is revealed. Combined landings were bolstered by increases in red abalone landings, which gave the impression of maintained stability in the combined landings during the decline in pink abalone landings. In 1971, there was an abrupt decline in pink abalone landings caused by increases in pink abalone size limits imposed by managers in an effort to protect the population. A spike in green abalone landings in 1971, caused by the lowering of the green abalone size limit, masked the pink abalone landings drop in the combined landings. Around this time, black abalone landings also bolstered the combined landings. Red abalone began to decline during this period (1969-1982), marking the start of intensive commercial fishing of green, black, and white abalones. Landings for these three species rapidly peaked and then declined.

During the last period of the commercial abalone fishery, many commercial divers held both abalone and sea urchin permits. As the availability of abalones decreased, efforts were shifted to the growing sea urchin fishery. Since the abalone fishery was not closed, divers searching for sea urchin continued to land abalone while populations were at extremely reduced levels. Declines in commercial abalone landings were replaced by sea urchin landings, thus maintaining the value of the combined dive fishery at 10 million dollars from 1955 to 1985, while abalones suffered dramatic declines (Dugan and Davis 1993).

Area-specific catch from 1950 for red, pink, and black abalones revealed a spatial trend in catch with higher catches coming from mainland or nearshore islands, shifting over time to more remote areas, with smaller islands declining before larger ones. Two species whose catches did not show a spatial pattern in decline were the green and white abalone, which remained concentrated in a few areas, suggesting they were limited in their spatial distribution prior to exploitation. Declines in catch varied by species and area, but in most cases dropped two orders of magnitude from catches in peak years and areas.

The replacement of one species or sub-species by another, which gives the appearance of stable landings, has occurred in many nearshore marine fisheries, suggesting that the management of species complexes can be problematic (Dugan and Davis 1993; Orensanz *et al*. 1998). Alaskan crustacean fisheries were serially depleted as a succession of species suffered dramatic declines in their landings (Orensanz *et al.* 1998). Similarly, the serial replacement of sub-species has been suggested as a contributor to the collapse of the eastern Atlantic cod fishery (Hutchings and Myers 1994). Replacement of one sub-species of cod by another acted to maintain the illusion of a long period of stability in the cod fishery until a rapid, unforeseen, total collapse occurred when all the sub-species had been fished out.

The regular appearance of red abalone in the commercial landings, as compared to some of the other species, may be a reflection of differences in distribution and vulnerability to take. The more common red abalone has the broadest depth range (Tegner *et al.* 1992; Tutschulte 1976) of any commercially fished abalone.

Pink abalone were the most widely-distributed of the four southern species, and the second most regularly-appearing species in catches. Cox (1962) attributed a portion of the decline in pink abalone during Period B (1952 - 1968) to the combined effects of slow growth and starvation due to reductions in kelp biomass during the 1957-1959 El Niño.

The fisheries for green, black and white abalones, all with narrower depth and geographic distributions, were short lived. Green abalone are a shallow, subtidal species abundant in surf grass beds. This species was rigorously fished during Period C (1969-1982) and thereafter contributed little to the commercial fishery. Black abalone have a wide geographical distribution, but a narrow depth distribution, restricted to the lower and mid-intertidal zone. An added concern for black abalone is the combined effects of fishing and WS (Haaker *et al.* 1992, Alstatt *et al.* 1996). While landing declines occurred prior to the outbreak of this lethal disease, continued take following the outbreak of WS may have further contributed to the potential extinction of this species by removing remaining individuals that may have been resistant to the disease. White abalone have a narrow, deep distribution from 25 to 50 m (82 to 164 ft) on rocky habitat. Davis *et al.*(1998) reported extreme declines in white abalone abundance following commercial and sport exploitation. During extensive surveys in the 1990s at the Channel Islands using deep SCUBA diving and a manned submarine, divers found less than two white abalone per hectare, compared to 2,000 to 10,000 per hectare in the 1970s at comparable depths (Tutschulte 1976). Davis *et al.* (1998) suggest that unless active restoration methods are enacted soon this species may become extinct.

By 1975 there were 383 commercial abalone permits with an annual turnover rate of about 50%. New regulations in 1977 restricted permits to those who held them in 1976, with an additional 5% chosen by lottery from qualified applicants. Minimum landing requirements were instituted as well, with the goal of reducing the number of permitted divers to 200 by the process of attrition. In 1985, legislation mandated a reduction in permits to 100 by attrition (Tegner 1989). At that time, there were 130 permits, a number that remained virtually unchanged until the fishery moratorium in 1997.

Factors Contributing to Management Failure in the Commercial Fishery

A number of factors undermined effective management. Management effort was limited to conventional strategy that primarily focused on size limits to protect stocks (Tegner *et al*. 1992). This strategy was based on egg-per-recruit models that assume several years of spawning success for a significant portion of the abalone population prior to reaching the minimum size for take (Tegner *et al.* 1989), derived from the potential high fecundity of abalone (Giorgi and DeMartini 1977). This management approach did little to ensure the sustainability of abalone resources. Focus on spawning potential ignores the effects of protracted periods of recruitment failure under intense fishing pressure (Sluczanowski 1984). Recruitment of young abalone may not be successful every year (Karpov *et al.* 1998; Rogers-Bennett and Pearse 1998). Karpov *et al.* (1998) reported only one red abalone recruitment event in four years in northern California where animals living in deep water (greater than 8.5 m, or 28 ft) are protected. Likewise, Tegner *et al*. (1989) found a single recruitment peak in a study area on Santa Rosa Island over a five-year period. Another factor may have been the

loss of adult aggregations needed for spawning success (Shepherd and Brown 1993). Low densities can result in fertilization failure in broadcast-spawning invertebrates (Pennington 1985; Levitan *et al.* 1992).

Ultimately, during the final period of decline (1983-1996), reliance on catch-per-unit-of-effort (CPUE) data further delayed closures. CPUE for abalone is a exceedingly poor index of abundance, as has been shown for other spatially-structured fisheries (Orensanz *et al.* 1998). Assumptions for use of CPUE, including the redistribution of the stock and random fishing (Ricker 1975; Gulland 1983), are violated in the abalone fishery as they are in other fisheries for slow-moving, bottom-dwelling invertebrates. CPUE for red and pink abalone increased throughout much of Period D (1983-1996), when red abalone landings remained consistent and pink abalone declined (Figure 3-2). Two factors during this time worked to increase CPUE figures: improvements in locating sites using Loran and Global Positioning Systems (GPS), and increased search time of fishing grounds by abalone and urchin divers in the dual fishery.

Increasing abalone value further delayed conservative management action during the decline (Figure 3-1, Figure 3-2). As the landings declined, the value increased exponentially in response to demands from foreign markets and a growing population of Californians. Increases in value intensified political pressures to continue fishing despite evidence of collapsing stocks. In this case, market forces did not work to stop the fishery as the species declined, and the economics of the dual fishery (abalone and sea urchin) permitted fishing for some abalone species until they neared extinction.

Management also had no mechanism to address factors such as sea otters, pollution, disease, and El Niños (Section 2.1.9.1, Section 2.1.9.2), which contributed to abalone population declines. The degree of relative impacts of each of these factors differed by species and area.

3.1.1.2 The Recreational Abalone Fishery

A final factor in the decline of abalone populations was the added impact of a growing, SCUBA-based recreational fishery in southern California (Karpov and Tegner 1992; Tegner *et al.* 1992). Beginning in the 1970s, this largely unmonitored fishery had a growing impact on abalone stocks on the mainland and in the Channel Islands.

Southern California

Recreational catch and effort have been more difficult to assess than commercial catch and effort due to the lack of a mandatory reporting system. Consequently, historical landings for the southern California recreational abalone fisheries are not well-documented. The commercial passenger diving boat (CPDB) log book system was used in southern California to estimate the number of passengers per dive boat and the total number of abalone landed by each boat. A detailed analysis of CPDB red abalone catch and effort data in southern California is available only for 1978 through 1987 (CDFG 1991, 1993b).

Many of the abalone landings were not identified by species in the log book data. However, those that were identified revealed that green and pink abalones predominated before 1983, with smaller numbers of red, black, and white abalones being taken. From 1986 to 1990 the proportion of pink abalone declined, leaving green

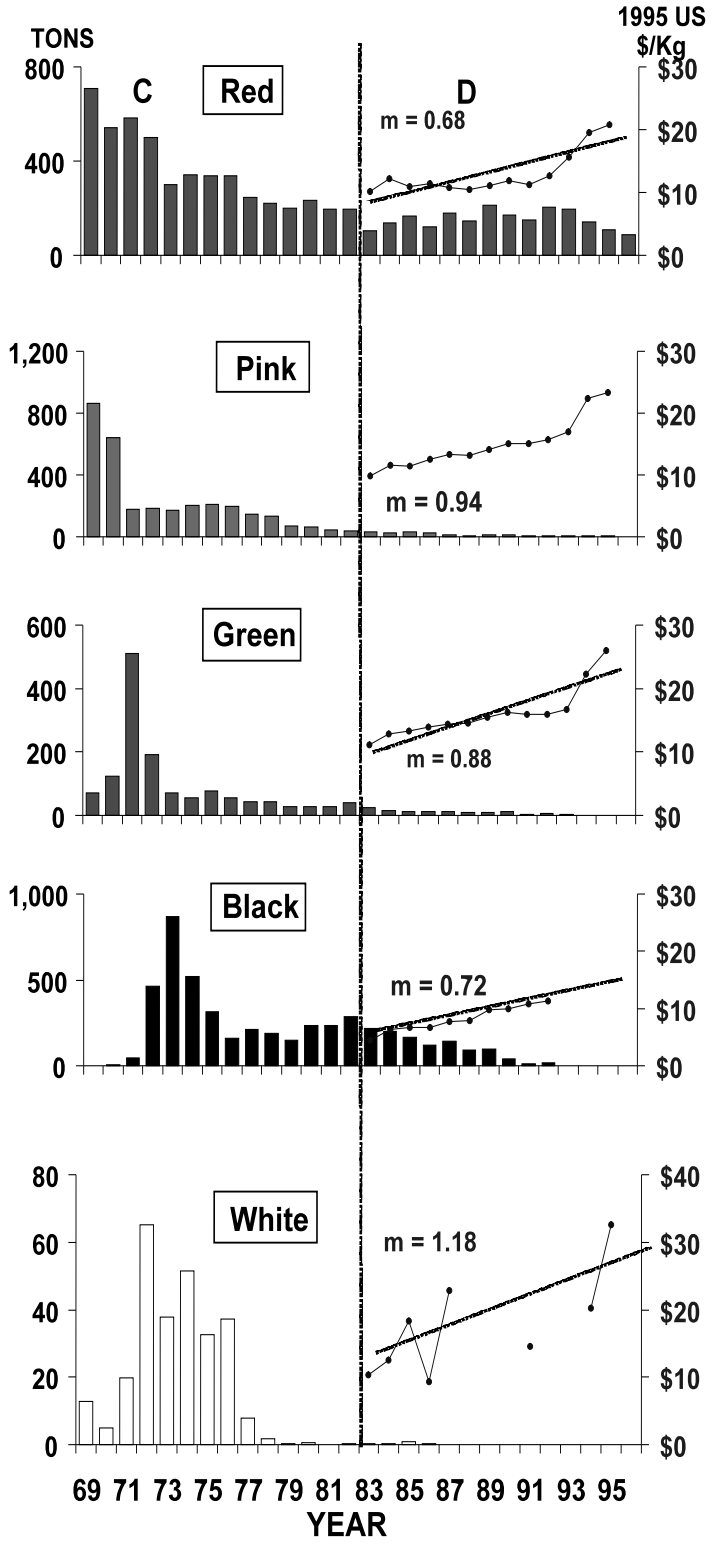

Figure 3-2. Landings for red, pink, green, black, and white abalones (bars): the ex-vessel average value (solid line), with fitted regression lines (dotted line) (m = slope, t x year-1).

abalone as the predominant species. The proportion of red abalone recorded in the logbooks increased, while the black and white abalones disappeared from the logbooks.

This information reflects the nature of the CPDB fishery. The major destination of CPDBs is the Channel Islands. At most of the islands, pink and green abalones occur at depths within the comfort zone of most divers. Red abalone, on the other hand, are commonly found in the cooler waters of relatively remote San Miguel, Santa Rosa and San Nicolas Islands. The opportunity to take red abalone was often dependent upon good weather, which occurs with greater frequency at the islands closer to shore. Thus, there were often more opportunities for divers to take green and pink abalones. The intertidal black abalone, which was common at the Channel Islands, was not usually targeted because it was held in low regard, and was usually inaccessible to boat divers. However, while the fishery was open, shore-pickers harvested black abalone along the southern California coastal mainland. The quantities of black abalone taken by shore-pickers does not appear in any recreational database. White abalone is so rare and occurs so deep that it does not often appear in the recreational catch; however, the data that are available indicates that the recreational fishery landed more than 6,000 white abalone from 1971 to 1979. In the "unidentified abalone" category, landings from the cooler water islands are most likely attributable to red abalone, while unidentified landings from warmer water islands may be attributable to green, pink, and other abalone species.

The steep declines from 1989 to 1990 appear to reflect the reduction in the recreational daily limit from four to two, as well as the shortening of the recreational abalone season from 10 to six months per year. After 1990, the catch increased as divers adjusted to the new regulations. By 1992, red and green abalones made up the largest part of the landings, followed by pink abalone. The number of abalones landed remained at less than ten thousand, which was less than half of the estimated abalone landings prior to the establishment of the 1990 bag limit.

The number of abalone landed per dive boat declined to less than 500 per year after 1990. A slight increase in take occurred in 1989 and was likely an indication of increased effort in anticipation of the regulation changes that were enacted in 1990. The number of boats that landed recreationally-taken abalone varied from 15 to 27, with a low of 11 boats in 1990 when the season and bag limits decreased. The number of CPDBs operating changed little due to the number of alternative target species available to recreational divers.

A reliable measure of the number of sport abalone divers or CPUE for the recreational abalone fishery could not be determined from the CPDB logbook data, because it was not possible to determine if all divers actually targeted abalone, nor could the actual time spent looking for abalone be determined. Additionally, no data is available on the number of shore based or private boat divers.

Northern California

In northern California, creel and telephone surveys have been used to estimate annual recreational harvest level, effort, and CPUE. Combined telephone and field surveys of recreational abalone fishermen were used for selected years between 1977 and 1989 to estimate total catch and effort in northern and central California (Tegner *et*

al. 1992; CDFG 1993b; Karpov personal communication). There was an estimated average take of 685,000 abalone from 235,000 trips (effort days) during 1983 to 1989.

From 1998 to 2000, the average number of abalone fishermen was estimated at 38,000. Preliminary evaluation of the 2000 abalone permit report card program indicates that the abalone take and effort estimates stand at 728,000 abalones taken from 202,000 trips. Sonoma and Mendocino Counties accounted for over 96% of the estimated effort during this time, up from an estimated average of 73% from 1986 to 1989.

Diver and shore-picker catch and effort data from 1995 to 2000 were compared with data from 1989 to 1994 to determine trends in abalone per trip, abalone per hour, returns of undersized abalone per hour, and distance traveled from access point to take point. The result was an indication of site-based (rather than species-based) serial depletion: There was an increased take of abalones from deeper water and from more remote populations at Sonoma County and southern Mendocino County creel survey sites.

3.2 Socio-economic Characteristics of the Fishery

The socio-economic characteristics of the abalone fishery are presented by breaking the fishery into the four major use sectors. The economic value is derived for the two main sectors of the fishery (commercial and recreational) based on the unique characteristics and data that are available to each. Because the data used to calculate the economic value for each sector are different, the values are not comparable between the two.

3.2.1 Commercial Sector

In general, the demand for abalone far exceeds supply (Conte and McBride 1996). Abalone products are marketed as a premium product and command high dollar values in international markets. Japanese Americans dominated the commercial abalone fishery in the early 1900s when abalone were boiled, then dried or canned. Dried abalone sold for approximately $0.20 per pound, and the shells sold for approximately $4 per ton (CDPR 1988). Commercial fishing peaked at an annual harvest of over 2,500 metric tons (t) in 1957. Thereafter about 2,000 t were harvested annually from 1957 to 1969, and commercial abalone landings and abalone abundance continued to decline after 1969. Commercial abalone landings in 1992, 1993, and 1994 were approximately 260, 230, and 140 t, respectively (Conte and McBride 1996).

The 1995 California commercial abalone ex-vessel landings were 118 t valued at $2,515,467 ($2,792,070 in 2000 base year). This is a reduction in total ex-vessel value of the fishery since 1993, when the reported value was $3,154,147 (CDFG 1995b) ($3,601,141 in 2000 base year). Southern California abalone landings represented 73% of the total value in 1995. The remaining 17% came from central California commercial red abalone landings. A more inclusive account of the socio-economic characteristics of the southern and central California abalone commercial fisheries prior to 1997 may be found in the following Department publications: *Final supplemental environmental document: Abalone sport fishing* (CDFG 1993b), *The red abalone (Haliotis rufescens) sport fishery in central and northern California from creel (1975-94),*

aerial (1975-1985), and telephone-based surveys (CDFG 1995a), and *Draft environmental document: Pink, green and white abalone fishery closure* (CDFG 1995b).

3.2.2 Recreational Sector

Since the late 1980s, abalone fishing effort has concentrated in Mendocino and Sonoma counties, which now accounts for 96% of the annual sport effort. This reflects an increase for these counties since 1989 when the average combined annual effort was only 76% (CDFG 2001b). Abalone permit report card returns for the year 2000 show that sport divers residing in Sonoma and Mendocino counties make up 22% of the total abalone trips originating in these two counties. Consequently, 78% of the total abalone trips were made by residents of other counties coming into the local communities and thus bringing an influx of new, or outside, dollars into the local economies.

Travel costs and related expenditures can approximate what abalone sport divers are willing to pay in order to access and enjoy abalone resources. However, this travel-cost approach does not capture or estimate consumer surplus (the value of the activity in excess of the costs to engage in it). Consequently, expenditure information alone may underestimate the true value of the resource to the recreational user. Nonetheless, travel-cost data are often used as a means to estimate the economic value of a resource.

Recreational abalone divers from outside Mendocino and Sonoma counties use a variety of goods and services from local businesses: bed-and-breakfast inns, motels, hotels, lodges, campgrounds, restaurants, dive shops, and boat launches, to name a few. Average direct expenditures by recreational abalone divers for food, lodging, and equipment are calculated at $49 (2000 base year) per trip. These direct expenditures are based on studies by USFWS for average expenditures by recreational pismo clam divers in 1985 (USFWS 1987). Considering that northern California received an estimated 201,614 recreational abalone diving trips in 2000 (CDFG 2001b), these trips may represent as much as $9,879,086 in annual direct expenditures on recreational abalone diving activities (201,614 x $49). Subsequent re-spending by business sectors that cater to the needs of recreational abalone divers results in an economic multiplier effect which, when added to the direct expenditures, yields $17,187,633 (2000 base year) in final output demand for the local economies from recreational abalone fishing.

3.2.3 Non-consumptive Use

While there are undoubtedly socio-economic values related to non-consumptive uses of abalone in California (for example, underwater photography), they have not been quantified and are probably not significant in comparison to the sport and commercial values already discussed. Part of the difficulty in assigning value to these uses is that they are interwoven with the uses of other resources, making it difficult to assign value to any one resource.

3.2.4 Illegal Use: Poaching

Abalone poaching has been a serious concern in California for decades and continues to have a major impact on abalone stocks. Poaching poses a threat to the sustainable management of abalone because it cannot be quantified and has an impact

on both legally-fished and recovering stocks (Daniels and Floren 1998). Also, poaching may accelerate local or total extinction of more severely-depleted populations such as white abalone.

The amount of illegally-taken abalone compared to the legal take is difficult to assess accurately. Department enforcement personnel calculate the percentage of violations during special details, such as abalone checkpoints and other directed details, on an annual basis. However, these contacts are not truly random (checkpoints, for example, are announced in the media ahead of time), thus they cannot be used to accurately estimate illegal take.

Illegal take of abalone is of two general types, sport-related violations and poaching for commercial purposes. The most common sport violations are the taking of over-limits and the under-reporting of catch on the abalone permit report card. The report card is used to record daily diver catch and to provide location of the catch. This information is used to estimate annual recreational catch rates.

The other category of illegal take includes the taking of abalone for commercial purposes, which is currently prohibited in California. This includes poachers who barter or sell their "recreational" catch, and those who engage in large-scale poaching for direct sale to commercial markets. Many of the large-scale poachers are often not observed or contacted in the field. This is due to the unpredictability of how, when and where they conduct their illegal activities.

In 1997, law enforcement officials reported high levels of illegal commercial take prior to the fishery closure (Daniels and Floren 1998). Recent arrests by Department enforcement personnel confirm that illegal commercial activity continues in northern California (Davenport personal communication). The extent of illegal removal of abalone in central and southern California is unknown. As abalone stocks have become depleted, the world price has increased, escalating the impetus to poach (Karpov *et al*. 2000).

The Department expends considerable funding and effort toward enforcement of fishing regulations, including abalone fishing. Department enforcement personnel target high activity periods such as low tides and weekends. Enforcement efforts have been augmented recently by the justice system, which has been levying greater fines and penalties. Improved public education, and the CalTIP (Turn In Poachers) Program, have also acted as deterrents to poaching. In spite of these efforts however, poaching is likely to continue to have an adverse impact on abalone stocks.

Chapter 4. Legal Framework

4.1 Authority and Responsibility

4.1.1 California Department of Fish and Game

The Department's primary authority and responsibility is as a trustee of fish and wildlife resources (FGC §711.7). The Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (FGC §1802). The Department provides expert advice to the Fish and Game Commission, monitors the status of populations, and conducts research. The Department administers and enforces the provisions of the FGC through regulations adopted by the Department or the Commission (FGC §702). The Director and the Commission have the authority to take emergency regulatory action (FGC §7710 and FGC §240, respectively).

4.1.2 Fish and Game Commission

The Commission is responsible for the formulation of general policies of the Department, and functions as a regulatory power. The Commission makes decisions concerning seasons, bag limits, and methods of take for game animals, sport fisheries, and some commercial fisheries. With respect to abalone, the Legislature delegates full management authority to the Commission in a manner consistent with the ARMP (FGC §5520). Prior to adopting regulations, the Commission receives public input in writing and at public hearings, in accordance with the Administrative Procedures Act.

4.2 California State Law

4.2.1 Legislation Mandating the ARMP

Fish and Game Code §5522 mandates the development and implementation of the ARMP, and describes the general framework for this process:

> **FGC §5522. Abalone Recovery and Management Plan.**
> (a) On or before January 1, 2003, the department shall submit to the commission a comprehensive abalone recovery and management plan. The plan shall contain all of the following:
> (1) An explanation of the scientific knowledge regarding the biology, habitat requirements, and threats to abalone.
> (2) A summary of the interim and long-term recovery goals, including a range of alternative interim and long-term conservation and management goals and activities. The department shall report why it prefers the recommended activities.
> (3) Alternatives for allocating harvest between sport and commercial divers if the allocation of the abalone harvest is warranted.
> (4) An estimate of the time and costs required to meet the interim and long-term recovery goals for the species, including available or anticipated funding sources, and an initial projection of the time and costs associated with meeting the final recovery goals. An

implementation schedule shall also be included.

(5) An estimate of the time necessary to meet the interim recovery goals and triggers for review and amendment of strategy.

(6) A description of objective measurable criteria by which to determine whether the goals and objectives of the recovery strategy are being met and procedures for recognition of successful recovery. These criteria and procedures shall include, but not be limited to, the following:

(A) Specified abundance and size frequency distribution criteria for former abalone beds within suitable habitat not dominated by sea otters.

(B) Size frequency distributions exhibiting multiple size classes as necessary to ensure continued recruitment into fishable stock.

(C) The reproductive importance to the entire ecosystem of those areas proposed for reopening to harvest and the potential impact of each reopening on the recovery of abalone population in adjacent areas.

(b) Where appropriate, the recovery and management plan may include the following:

(1) A network of no-take abalone reserves.

(2) A total allowable catch, reflecting the long-term yield each species is capable of sustaining, using the best available science and bearing in mind the ecological importance of the species and the variability of marine ecosystems.

(3) A permanent reduction in harvest.

(c) Funding to prepare the recovery and management plan and any planning and scoping meetings shall be derived from the fees collected for the abalone stamp.

(d) On or before January 1, 2008, and following the adoption of the recovery and management plan by the commission, the department may apply to the commission to reopen sport or commercial fishing in all or any portion of the waters described in Section 5521. If the commission makes a finding that the resource can support additional harvest activities and that these activities are consistent with the abalone recovery plan, all or a portion of the waters described in Section 5521 may be reopened and management measures prescribed and implemented, as appropriate. The commission may close or, where appropriate, may establish no-take marine refuges in any area opened pursuant to this section if it makes a finding that this action is necessary to comply with the abalone management plan.

(e) If the commission determines that commercial fishing is an appropriate management measure, priority for participation in the fishery shall be given to those persons who held a commercial abalone permit during the 1996-97 permit year.

Other FGC sections pertaining to abalone are found in Appendix B. A table listing the location in this document of all FGC §5522 requirements is found in Appendix C.

4.2.2 California Environmental Quality Act (CEQA)

This act requires state agencies with regulatory programs that have the potential to impact the environment to address these potential impacts in an environmental document. Examples include the regulatory programs of the Commission and the Department. The existing regulations for the northern California recreational abalone fishery address CEQA requirements through the environmental document for the recreational fishing regulations. The ARMP, however, does not contain proposed regulatory changes nor does it consider the authorization of actions to be undertaken in the environment. The ARMP functions as an advisory document, making recommendations for possible future actions in the environment. For this reason, the ARMP is not subject to CEQA (Public Resources Code §21102, CEQA Guidelines §15262). The authorization of future actions that are based on ARMP recommendations will be subject to CEQA.

4.2.3 Marine Life Management Act (MLMA)

The MLMA was signed into law and incorporated into the FGC (§7050 to §7090) in January, 1999. The act created state policies, goals, and objectives to govern the conservation, sustainable use and restoration of California's living marine resources. Although many of these have been incorporated into the ARMP, the ARMP is mandated by legislation that preceded the MLMA, and has different goals and objectives from the MLMA. Unlike traditional fishery management plans (FMPs), the ARMP does not include regulations and is therefore not subject to the MLMA provisions governing the preparation of FMPs.

4.2.4 Marine Life Protection Act (MLPA)

The MLPA (FGC §2850 through §2863) was added by statutes in 1999. Its purpose is to develop a network of areas designed to protect the State's marine life, habitats, and ecosystems. The Master Plan for this system will include recommendations for the types of habitat and an identification of species that should be included in these protected areas. Marine Protected Areas as they pertain to abalone recovery and management in this plan are discussed in Section 6.4.2.4.

4.3 Federal Law

Federal laws that relate to abalone resources in California include the Marine Mammal Protection Act (MMPA) and the ESA. For the species in California that fall under these Federal laws, management responsibility lies with the federal government. The Department provides consultation to the federal agency that manages these federally-protected species. The sea otter, an important abalone predator, is protected under both Acts, and managed by the U.S. Fish and Wildlife Service. The white abalone is listed as endangered under the ESA, and its recovery is being managed by NOAA Fisheries.

4.4 Process of Plan Review and Amendment

The ARMP is designed to be flexible and adaptable to a wide range of future conditions, and is intended to function without the need for frequent amendment. However, unforeseen social, economic, environmental, or biological developments may create a situation under which the ARMP does not adequately provide effective management and recovery of abalone stock. Under such circumstances the Commission would amend the ARMP.

An amendment to the ARMP would be required for major changes or controversial actions outside the scope of the ARMP. Examples include changes to management or recovery goals and objectives, or changes to the species addressed by the ARMP.

The process for preparation and adoption of an amended ARMP would be similar to the development and adoption process for the original ARMP, including input from advisory committees, an extended period for public hearings and comment, and peer review. Once a draft plan amendment is completed and submitted to the Commission, it will undergo a public review process.

4.4.1 Changes Based on New Biological Data

This plan is expected to be adaptive. The Commission, at its discretion, may change specific limits and density targets for decision criteria when new data become available. To make such changes the Commission would conduct at least one public hearing with appropriate notice prior to adoption by majority vote. These changes would not require full amendment of the plan itself.

Chapter 5. Overview of Abalone Recovery and Management in the ARMP

Recovery of at-risk abalone species and management of abalone fisheries are separate but continuous and complementary processes in the ARMP. The recovery portion of the plan addresses the seven species in central and southern California (red, pink, green, black, pinto, flat, and white) that currently have severely reduced populations and reduced ranges. The management portion of the plan applies to stock that is considered sustainable for fishing. The management plan will initially apply to the northern California red abalone fishery, but ultimately will apply to any fully recovered species in central and southern California, outside of the Central California Sea Otter Range.

Abalone in California vary in status from populations bordering on extinction (white abalone) to a sustainable population with surplus animals that is still being fished (northern California red abalone). The ultimate goal of recovery is to move species from a perilous condition to a sustainable one with surplus abalone available for fishing. The ultimate goal of management is to maintain sustainable fisheries under a long-term management plan that can be adapted quickly to respond to environmental or population changes.

The primary criteria used to evaluate progress in achieving recovery and management goals involve estimates of recruitment and population abundance (measured by density). For populations with very low densities, evidence of recruitment is used as one of the first indicators that stock is recovering. For a fished stock, recruitment is important to ensure that animals removed from the fishery will be replaced, and is used with density criteria to trigger management actions. Two density levels are integral to both recovery and management as measures of population abundance: minimum viable population size (MVP, 2,000 ab/ha) (Section 6.2.2.1 Criterion 2 - First Density Level (2,000 ab/ha)) and a sustainable fishing density (6,600 ab/ha) (Section 6.2.2.2 Criterion 3 - Fishery Density Level (6,600 ab/ha); Section 7.1.2.1 Criteria for Evaluating Stock). The density levels used are derived from red abalone populations in northern and southern California and published research from other abalone species (Section 6.2.2 Density-based Criteria). Density data for other California abalone species are not available at this time; therefore, red abalone densities are used because they represent the best available data until such time as data can be obtained to refine density levels for each species.

Abalone populations below the MVP (Figure 5-1) are at risk of recruitment failure and face possible extinction. Populations at or above the upper limit of the precautionary area (Figure 5-1) are likely to have sufficient abalone to support a sustainable fishery.

The precautionary area (Figure 5-1) is where recovery and management overlap. The precautionary area is bounded on the lower end by an abalone density that combines the MVP with an additional density buffer (50% of the MVP), and on the upper end by the upper limit of the precautionary area. Populations in the precautionary area are likely to be self-sustaining (experiencing successful reproduction

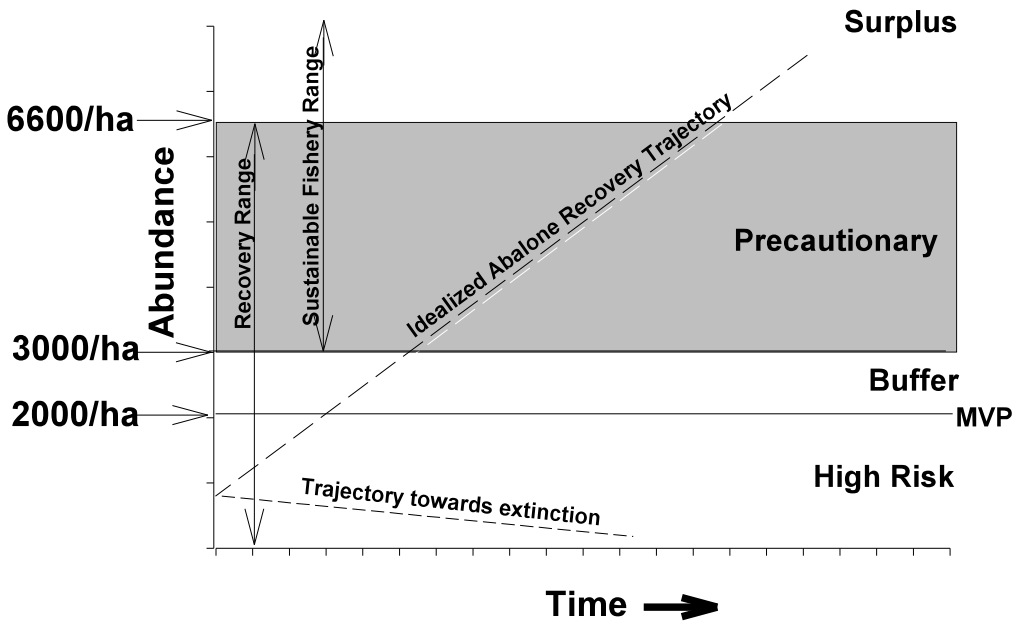

Figure 5-1. Conceptual approach for recovery and management under the ARMP. Note that in the precautionary area, fishing is only allowed in open fisheries that are subject to management under the ARMP. As densities decline, catch levels are progressively reduced. Closed fisheries that are recovering will not be considered for reopening while their abundances are in the precautionary area.
MVP = minimum viable population

and recruitment to survive natural fluctuations in abundance), but excessive fishing mortality could cause these populations to decline. When a fishery closes because of depletion, it is likely near or below the lower end the precautionary area (Figure 5-1). The affected abalone populations are subject to recovery, and no fishing will be proposed for these populations until the sustainable fishery density is reached. Abalone populations that are actively managed as part of a fishery, however, may be fished while their abundance level is in the precautionary area, but with progressively reduced take. The precautionary area thus acts as a buffer between conditions that mandate fishery closure and those that allow fishery reopening; conditions for fishery reopening are set at the sustainable fishery density (6,600 ab/ha) (Section 6.2.2.2 Criterion 3 - Fishery Density Level (6,600 ab/ha)) to ensure that a fishable surplus has been rebuilt.

Progress toward meeting ARMP criteria is measured and evaluated over time at index sites in areas of abalone habitat that have experienced high use in former or current fisheries. Costs associated with assessing recovery and management are minimized by sharing resources among governmental agencies and the private sector, and by alternating efforts between regions.

Because several species in central and southern California are deemed to be at high risk, during the first 7 years of implementation the majority of research will be directed towards recovery. Recovery efforts will initially focus on assessing the relative

risk of extinction, identifying where remnant populations remain, developing recovery techniques, and using these techniques to rebuild populations of at-risk species to self-sustaining levels. An ideal abalone recovery trajectory is represented by the upward diagonal line in Figure 5-1.

Recovery is a stepwise process, where goals must be met sequentially. Once recovery goals are met, a species may be evaluated and considered for a fishery. Recovery success will be evaluated at index sites in recovery areas to determine when critical densities are attained. Before a fishery is considered, range-wide recovery must occur for a species. Range-wide recovery is accomplished when three-quarters of the recovery areas (Section 6.2.1.1 Criterion 1 - Broad Size Distribution Over the Former Abalone Range) have met all the recovery criteria; recovery in a single area alone will not provide adequate insurance against future catastrophic events such as disease, pollution, or the expansion of the sea otter populations.

The management portion of the ARMP establishes guidelines for determining allowable take levels and for closing and reopening fisheries. During the first seven years of ARMP implementation, management of the existing fishery will occur with limited resources under an interim plan that sets a total allowable catch level and uses established criteria to guide regulatory change. However, because the interim plan operates in a data-limited environment, it follows a precautionary approach to setting take. Under the interim plan, fishery closure (zero take) occurs when average densities at eight index sites fall below 3,000 ab/ha (the MVP with a 50% precautionary buffer). If additional resources become available, a long-term management plan may be implemented using zonal management with take allocated through an abalone tag system. The long-term plan allows management with greater precision on a localized basis. The long-term plan would require increased assessment and enforcement, but is more responsive to stock changes and can therefore be less precautionary. Because of the use of zones in the long-term plan, total fishery closure is less likely. However, at least half of the zones must continually have densities above 3,000 ab/ha in order for a fishery to remain open under the long-term plan (Section 7.1.3.4 Closing and Reopening Fisheries).

Marine Protected Areas (MPAs) provide refuge from take for all species, and are important to the recovery and management of individual species such as abalones for several reasons. MPAs are legally established and their protections can be enforced. In contrast, *de facto* refugia and single species moratoria do not provide the same level of protection for a species. A single species or species group moratorium does not convey protection to the ecological niche of the species. For example, the abalone closure from Palos Verdes Point to Dana Point in southern California was ineffective because fisheries for species that interact with abalones remained open. Preventing the take of abalone in areas open to other fisheries is difficult. *De facto* refugia are effective only as long as the characteristics governing the refugia, such as severe sea conditions, cold water, or inaccessability, remain effective. Subtle and sometimes undetectable changes in these characteristics could also change or eliminate the protections *de facto* refugia provide for abalones.

Within MPAs, abalones may be able to develop extensive populations within a complete, natural community that includes local food sources and a complement of predators (sea otters present a special case, as discussed Section 6.5.2 Sea Otters)

and competitors. Such complete populations may provide responsive mechanisms to address acute problems such as disease. For example, when WS was discovered in black abalone, the fishery was not closed because healthy (marketable) individuals could still be found (Section 3.1.1.1 Serial Depletion). Their removal eliminated these abalone from the reproductive population, and deprived the species of its only mechanism to combat the disease.

For these reasons, properly located, well-enforced MPAs should be required under the long term management plan. MPAs are currently being addressed under the Marine Life Protection Act.

The ARMP is meant to be adaptive. A timeline has been established for the first seven years of ARMP implementation. The plan will be reviewed in 2011. Revisions to evaluate success and funding needs and to refocus efforts will be performed when needed. In 2011 the Department and constituents will create a new timeline.

Chapter 6. Abalone Recovery

Chapter 5 defines recovery in the ARMP as rebuilding abalone populations to a self-sustaining level (reproducing successfully to survive natural changes in abundance), and eventually to a condition where a fishery might be considered. Recovery, by this definition, applies to southern California populations, as well as red abalones in central California outside the Central California Sea Otter Range. Recovery of abalone populations will take considerable effort over a long period of time. At least one abalone, the white abalone, is most likely beyond its reproductive capacity to recover on its own, and has been placed on the federal endangered species list.

Of the seven California abalones, five were targeted in the abalone fishery. Two others, pinto and flat, were never a significant part of the fishery, and little is known about them. The recovery portion of this plan will focus primarily on red, pink, green, black, and white abalones. Nevertheless, flat and pinto abalones will be monitored and included in the activities targeting the primary species.

6.1 Goals

The recovery plan addresses three goals (two interim and one long-term):

1. To reverse the decline of abalone populations that are in jeopardy of extinction
2. To establish self-sustaining populations throughout historic ranges
3. To reach sustainable fishery levels in at least three-quarters of former ranges (Section 7.1.2.1 Criteria for Evaluating Stocks)

Recovery activities are limited when populations are at very low levels. Any activity is likely to depend upon the successful completion of previous work, thus recovery activities are consecutive and stepwise. Abalone species with decreased populations and reduced ranges must first be brought to a self-sustaining level, then allowed to rebuild to a population level where a fishery may be considered. Figure 6-1 outlines the concept of this stepwise recovery approach. Periodic assessment of abalone populations will determine the fulfillment of criteria for recovery. Once a particular criterion has been fulfilled, assessments can progress to measuring the fulfillment of the next criterion.

6.2 Criteria for Evaluation of Resource Recovery

Because recovery is a step-wise process, a set of criteria was developed to assess and evaluate the recovery process as it moves from one step to the next. Two types of criteria are used: size-based and density-based. Criterion 1, a size-based criterion, measures size distribution over the former abalone range. Criteria 2 and 3, both density-based criteria, gauge whether densities have reached MVP levels and fishery levels, respectively.

6.2.1 Size Distribution-based Assessment (Timed Surveys)

Abalone size distribution is used to evaluate whether Criterion 1 has been met. Size frequency can provide information about a local population's reproduction and growth. When possible, large amounts of data are collected from appropriate abalone habitat during Department surveys. In addition to Department assessment surveys,

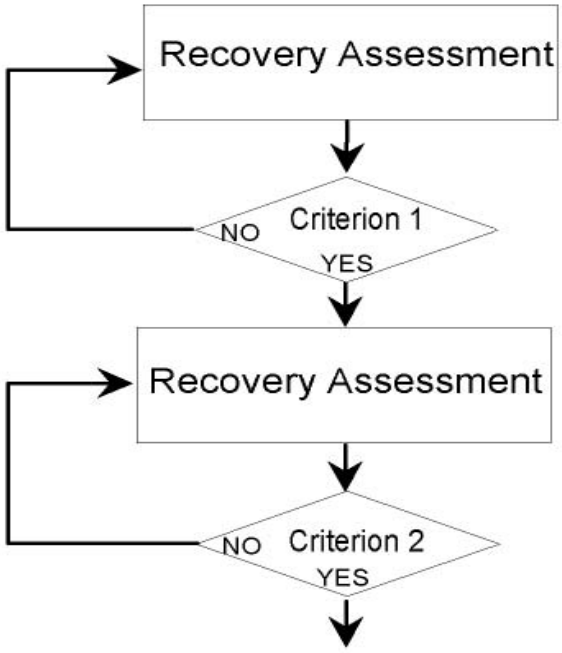

Figure 6-1. Conceptual framework for the recovery approach

size frequency data from a variety of sources can be utilized, such as data gathered at kelp forest monitoring sites within the Channel Islands National Park (CINP). While specific density data for abalone would be useful, conducting detailed, time-consuming, transect-based surveys for rare species is impractical given the lack of available human resources.

Surveying for a defined length of time adds a rough means of comparing many similar surveys. Timed searches are more efficient at finding rare species because they do not require transect set-up and are adaptive, in that searches can be directed at likely habitat without being constrained by transect boundaries. Abalone can be measured in place, providing size frequency data. The location of each dive should be fixed by a Global Positioning System (GPS) unit.

During deep-water remotely operated vehicle (ROV) and submarine searches, a tracking system is commonly employed, thus yielding an estimate of area searched, as well as a count of abalone. Intertidal black abalone searches can be tracked using a GPS unit during surveys. In these instances, density could be obtained as part of a Criterion 1 evaluation.

6.2.1.1 Criterion 1 - Broad Size Distribution Over the Former Abalone Range

Populations are more stable when there are more individuals occupying a broad size range at multiple locations. To evaluate resource conditions using this measure, two categories, intermediate (100 mm to recreational minimum legal size, or RMLS), and large (larger than RMLS), are defined, and each of those categories is further sub-divided into 5 mm groups. When abalone observed during timed surveys (Appendix E Survey Methods) at an index site occupy 90% and 25% of the intermediate and large categories, respectively, then the broad size frequency distribution aspect of Criterion 1 will have been met at that site (Table 6-1 and Section 6.4.1.1 Assessment for Criterion 1). A category smaller than 100 mm is not used, because abalone smaller than 100 mm are usually cryptic and not easily assessed.

Table 6-1. Recovery criteria and Fish and Game block number for recovery areas. Criterion 1 size frequencies are based on past recreational minimum legal size as a break between intermediate and large size ranges. Criteria 2 and 3 are numbers of abalone per hectare.

	Species						
Criteria	Red	Pink	Green	Black	White	Flat	Pinto
Interim							
Size frequency							
Criterion 1:							
Intermediate = 90% Large = 25%	100-178mm >178mm	100-152mm >152mm	100-152mm >152mm	76-127mm >127mm	100-152mm >152mm	76-102mm >102mm	76-102mm >102mm
Emergent Density							
Criterion 2:	2000/ha	2000/ha	2000/ha	2000/ha	2000/ha	2000/ha	2000/ha
Long-term Emergent Density							
Criterion 3:	6600/ha	6600/ha	6600/ha	6600/ha	6600/ha	6600/ha	6600/ha
Recovery areas by Fish and Game block # See also Appendix D	687 689 690 709 710 711 712 709 860 428 455 457 458 464 472	684 685 708 709 719 720 757 761 762 765 829 849 850 860 867 897	684 685 708 719 720 757 761 762 765 829 849 850 860 867	684 689 690 710 711 719 720 757 761 762 765 813 814 829 849 850 860 867	761 762 765 829 849 850 867 871 872 890 897	689 690 860 867	685 687 689 690 708 709 710 711 712 860

Recovery area locations were determined using commercial landing block data and known recreational fishing areas (Appendix D Maps of Historical Commercial and Recreational Abalone Fishing by Fishing Blocks). Key locations, which are smaller areas within a larger recovery area (such as an island) are places where many abalone once occurred. Index sites are selected from key locations, and are where population assessment and recovery activities will be carried out. Index site locations include a mixture of Department-selected locations, and locations where an already established site is monitored by another agency (such as the Channel Islands National Park (CINP) or Catalina Conservancy).

Because the marine environment is dynamic, habitat that once supported abalone may now be incapable of doing so. Alternative index sites may replace those currently selected to take into account changes in the marine environment. Furthermore, sea otter expansion, coastal development, sedimentation, pollution, and disease may act to reduce suitable abalone habitat. If the habitat should become

unsuitable in more than 50% of the recovery areas, then the long-term recovery goal for a fishery cannot be achieved (Section 6.2.2.2 Criterion 3 - Fishery Density Level (6,600 ab/ha)). The interim goal of re-establishing self-sustaining populations becomes the long-term goal.

When size category percentage values (90% intermediate and 25% large) are achieved at one or more index sites, additional timed surveys will be conducted to evaluate the extent of this phase of recovery. If the criterion is only partly met (for instance, if only some of the index sites show evidence of reproduction and growth), timed surveys will continue.

When all the index sites for a species have achieved the size category percentage values, it is likely that the species could then be at or near a self-sustaining level with sufficient reproduction and growth throughout its range, and that there would no longer be any danger of extinction. This situation would fulfill the requirements for Criterion 1, and Criterion 2 would then be addressed.

There remains the possibility, however, that the resource would continue to decline despite enhancement activities (Section 6.4.2 Enhancement Activities). This would be indicated by the continued failure to identify locations with broad size distribution. If this situation occurs, the Department would try to identify the cause(s) of recovery failure, including the role played by withering syndrome (WS). If WS is an influencing factor, the Department may launch an effort to develop WS-resistant broodstock. Formal listing under the federal or state Endangered Species Act (ESA) may be initiated for at-risk species if all enhancement efforts fail.

6.2.2 Density-based Criteria

The density criteria (Criteria 2 and 3) presented here use average density levels derived from red abalone population estimates throughout California, and published research. These density levels are used to identify when recovery has reached MVP and the upper boundary of the recovery range for all species of California abalones (Figure 5-1). As populations recover, future research on individual species may allow refinement of the target densities that more closely reflect individual species population parameters or differences within a species in various regions of the state. Changes to the following target densities based on new data may be adopted by the Commission without full plan amendment pursuant to Section 4.4.1.

6.2.2.1 Criterion 2 - First Density Level (2,000 ab/ha)

When Criterion 1 has been satisfied, emergent density surveys will be conducted in key locations to determine average abalone density.

MVP is the density level that indicates that the population is not at risk for collapse. The MVP used in the ARMP is based on two sources of information: minimum spawning densities determined by Shepherd and Brown (1993), and the density preceding sharp declines of red abalone in southern California (Tegner *et al.* 1989; Karpov *et al.* 1998) (Section 2.1.2.2 Spawning and Fecundity). Shepherd and Brown (1993) found that recruitment started to decline when densities fell below 3,000 ab/ha. Stock collapsed when adult densities fell below 1,000 ab/ha. Comparable densities and consequences were found with red abalone on Santa Rosa Island in southern California. Densities under 1,000 ab/ha were not sustainable and were followed by a collapse of the population (Karpov *et al.* 1998).

An MVP level was therefore established at 2,000 ab/ha for each species based on the best available red abalone density information. The MVP for each species may change as more information on recovering populations is obtained. Satisfaction of Criterion 2 does not trigger consideration of take. Criterion 2 requires that MVP levels be achieved at all key locations in all recovery areas that continue to satisfy Criterion 1 (Section 6.4.1.2 Assessment for Criterion 2).

6.2.2.2 Criterion 3 - Fishery Density Level (6,600 ab/ha)

The attainment of Criterion 3 will directly address the long-term goal of fishery consideration. The targeted emergent abundance to fulfill Criterion 3 is 6,600 ab/ha. This number is based on data from surveys in 1999 and 2000 in the northern California red abalone fishery, which are the best available data for estimating sustainable densities in an ongoing fishery (Section 7.1.2.1 - Criterion 2: Density). Again, this density level may change for each species as more population information is gathered during recovery.

Criterion 3 requires an average emergent density of 6,600 abalone/ha in at least three-quarters of the recovery areas. When the average density of abalone in all index sites within the recovery area reaches 6,600 ab/ha, the area may be considered recovered.

6.3 Fishery Consideration

Once Criterion 3 has been satisfied, an abalone species would no longer be included in recovery and a fishery may be considered. The species would then transition from recovery into management, which is covered in Chapter 7, Abalone Management. Specific details on the fishery consideration parameters are described in Section 7.1.4.1, Planning Process for Fishery Reopening.

6.3.1 Limited Abalone Fishery at Selected Areas at a Reduced Density and Prior to Full Recovery in All Areas (*applies to recovery areas within the moratorium area*)

The Commission may consider abalone (*Haliotis* spp.) fisheries in specific locations that have partially recovered prior to achieving full recovery. This consideration will first be made for red abalone at San Miguel Island using a reduced density criterion. It recognizes that viable abalone populations currently exist, and that a broad size range of abalone is present at San Miguel Island. It also recognizes that densities of abalone appear to be above MVP levels at San Miguel Island, and the fact that no-take reserves implemented after the fishery closure will help to ensure continued abalone populations. Other areas, such as the Farallon Islands, may be considered once data are available to show the acceptable density criterion has been met and the fishery at San Miguel Island proves to be practicable.

The Commission may consider fishing prior to achieving Recovery Criterion 3 (three-quarters of the recovery areas achieving a specified density) in individual areas that show a broad size range and an average abalone density above an established MVP level. The initial abalone density to open a fishery will be developed using sound scientific data and following standard fisheries management guidelines. This number will be based, in particular, on the most recent San Miguel Island abalone density surveys. If populations drop below MVP levels, the fishery will be closed and re-evaluated.

Data collection will continue in any fished area to determine whether populations are stable, increasing, or decreasing. An independent contractor may develop an overall management plan and review data collected each year to make recommendations on any changes to the fishery. Guidelines governing the contractor's responsibilities will be developed jointly by the Department and potential fishery participants with approval by the Commission. Management recommendations made by the contractor will be reviewed by the Department prior to potential Commission action. Cooperative effort for data collection will include fishery participants to maximize the amount of information available.

Strict guidelines for a limited fishery must be implemented to ensure that overall recovery continues in both the fished and unfished areas. Several implementation options will be considered in order to ensure a viable and well-managed fishery. Specific regulations will be developed in consultation with potential fishery participants. The following is a summary of some fisheries management measures that would need to be developed (others measures, in addition to these, may also be necessary):

- Fishery Opening Density Level - This level would be set by the Commission at a level above MVP and would be based upon recent density surveys at proposed harvest areas.
- Total Allowable Catch (TAC) - The TAC would be determined based upon estimates of abalone abundance above minimum legal size. The TAC would be a fraction of this amount to maintain both a sustainable population and an economically viable fishery.
- Recreational and Commercial Allocation - The TAC would be allocated between recreational and commercial take based upon pre-determined criteria established by the Commission. Included in this would be discussions on the number of participants allowed into the fishery. Priority for participation in the commercial fishery shall be given to those persons who held a commercial abalone permit during the 1996-1997 permit year [Title 14, sub-section 5522(e)].
- Regulatory Measures - Specific regulations would be developed cooperatively with potential fishery participants in order to ensure a well-managed fishery. Potential regulatory measures include the following, but would be determined as part of the normal regulatory process:

    - Larger than historic size limits - An equal size limit for commercial and recreational take would be set above the historic size limit. This would help ensure an increased abundance of breeding abalone when reproduction occurs.
    - Restricted seasons - A seasonal fishery may provide for ease of enforcement and allow review of biological survey data to provide management recommendations in the off season. It could also allow for undisturbed reproductive periods.
    - Restricted landing locations - This would help prevent illegal activities by limiting the number of areas where abalone could be landed.
    - Tag requirement for all commercial and recreational abalone taken.

        - By individually marking abalone at point of collection potential illegal take would be limited as all legally taken abalone would be tagged.

Tags could also be used as a source of detailed catch data and be linked individually to specific permittees. Additionally, tag fees could help defray management costs.

- Additional taxes and/or permit fees to support management and enforcement.

6.4 Recovery Activities

Recovery includes assessment and enhancement activities used to hasten the recovery process. Assessment will identify the status of current abalone populations in central and southern California, identify appropriate habitats where enhancement activities can take place, and monitor the success of those activities. The entire stepwise recovery approach with assessment and enhancement activities is shown in the flow chart in Figure 6-2. In the figure, the arrows between assessment and enhancement activities show how the two will join together during recovery. The single alternative approach to recovery, listing under the federal and/or state ESA, is also included in the figure, and discussed further in Section 6.8, Alternative Approaches to Recovery.

6.4.1 Periodic Assessment of Abalone and Essential Habitat

Given the current condition of most abalone populations and the animal's slow growth, long life, and sporadic reproductive characteristics, a great amount of time will be required for populations to achieve a broad size range over a wide area. It would be of little use to conduct expensive surveys (such as band transects) annually for documentation purposes; thus, less frequent surveys will be conducted. Recovery assessment for abalone should be completed within a five-year period for all species. Afterwards, the recovery plan should be re-evaluated using alternatives in Table 9-1.

To help maximize recovery assessments, data from other existing survey programs could be incorporated into the assessments. Data from ongoing, long-term monitoring surveys and general ecological (broad scale) surveys such as the CINP Kelp Forest Monitoring Program and the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) program could be used, as well as information reported by constituents such as former commercial abalone fishermen and recreational divers.

To maximize the efficiency of efforts, two types of assessment surveys will be used. The first type of survey (timed surveys) is very general and quick, and is best for assessing small populations at the beginning of recovery (Criterion 1), while the second type (traditional emergent abalone transect surveys; see Appendix E) is more detailed and takes longer, but is more appropriate for larger populations that are growing towards full recovery (Criterion 2 and Criterion 3).

6.4.1.1 Assessment for Criterion 1

Abalone habitat differences may impose the need for different methods of assessment for some species when addressing Criterion 1:

Intertidal surveys for black abalone - This survey method consists of walking through intertidal habitat at extreme low tide periods, and searching rocky habitat including cracks, ledges, and tide pools.

Subtidal scuba surveys for pink, green, red, white, pinto, and flat abalones - This survey method consists of timed survey techniques as defined in Appendix E, Survey Methods. Timed surveys are used for Criterion 1 evaluation when scuba diving is used.

Additionally, scuba surveys for the Channel Islands marine protected areas (MPAs) and CRANE/PISCO monitoring, which are done on an annual basis at selected sites, will be used to gather data for Criterion 1 and all other criteria during recovery.

ROV and submarine surveys for white abalone - The use of remote viewing equipment and submarine searches precludes the easy measurement of individual abalone, but laser reference points can assist in obtaining sizes for emergent abalone. ROV and submarine surveys are GPS-tracked, thus an estimate of the habitat area covered can be obtained. Even though ROV and submarine surveys provide density measures, they may not be as random as subtidal scuba surveys. Criterion 1 assessments should be conducted every five years, and data to satisfy this criterion should be evaluated for each species. The initial recovery assessment under the ARMP is scheduled for completion in 2006.

6.4.1.2 Assessment for Criterion 2

The recovery assessment at this level will consist of density-based surveys to obtain emergent density estimates as well as size frequency information. Density and size frequency will be used to create a baseline database which will be important in any fishery management model that includes a quota.

As in the assessment for Criterion 1, initial recovery assessment will take place at index sites. When abalone populations at the index sites reach Criterion 2 levels, the recovery assessment will expand to encompass all of the key locations (see Tables 6-3 through 6-8). Once all key locations attain Criterion 2 levels, the second interim goal of establishing self-sustaining populations throughout historic abalone ranges will have been fulfilled.

6.4.1.3 Assessment for Criterion 3

Recovery assessment will be conducted at the index sites. When abalone populations there reach the Criterion 3 levels, the long-term goal of reaching sustainable fishery levels in at least three-quarters of the former range will be met.

6.4.2 Enhancement Activities

A variety of activities are available to assist the recovery of depleted stock. The first step towards the recovery of abalone populations in southern California was the closure of all abalone fishing south of San Francisco Bay. While the closure removes the impact of fishing mortality on abalone, assuming no poaching, it is a passive form of population enhancement. Continuation of the closure until a species has recovered is an underlying tenet of the ARMP. Further steps include a range of activities to prevent extinction of threatened species, assist rebuilding, or increase the recovery rate. Enhancement activities may be the only way to fulfill the interim recovery goals. As populations recover and become self-sustaining, the need for these recovery activities should be re-evaluated.

Recovery activities under the ARMP must not conflict with federal law. Both the federal ESA and the MMPA have provisions that may supersede or impact recovery efforts. ESA-listed species such as white abalone and sea otters are under federal, not state, jurisdiction.

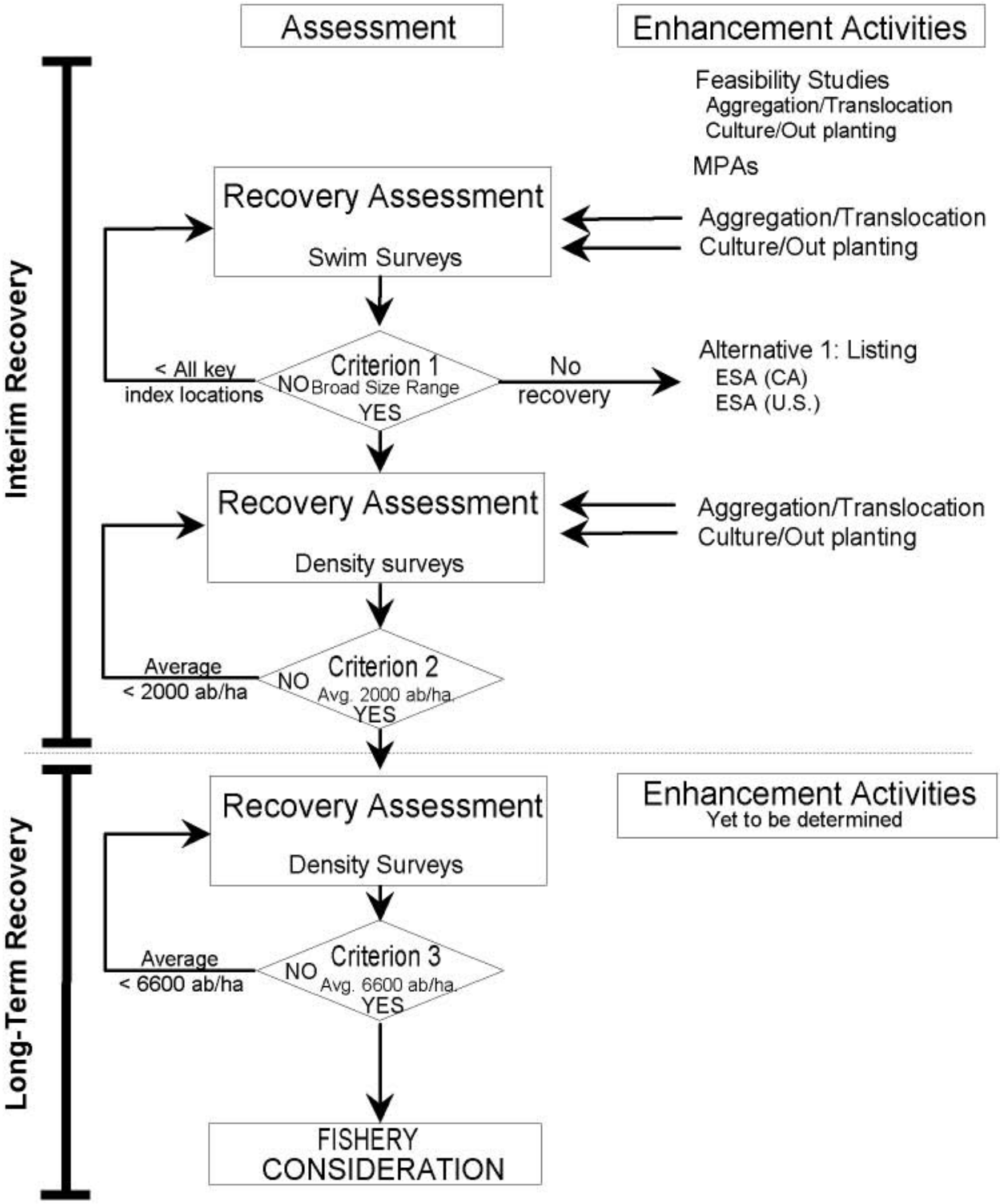

Figure 6-2. Flowchart of the recovery approach

6.4.2.1 Translocation or Aggregation of Adult Animals

Translocation and aggregation of adult abalone are similar recovery techniques. Both involve the placement of abalone in closely aggregated groups in an attempt to bolster successful reproduction, with the end result of increasing local populations. The difference between the two techniques is in the magnitude of distance that abalone are transported to make the groupings. Translocation involves moving individuals away from areas at risk (due to poaching, pollution, etc.), or to distant areas in order to expand the range of the population by re-introduction. Aggregation is the rearranging of abalone within a given area so that they are nearer to each other. This is useful when an area's population is depleted and the remaining animals are spread too far apart for reproduction to occur.

There is evidence that translocation of large abalone could be an effective way to bolster local populations. Tegner (1992) indicated that relocating adult broodstock is one of the few approaches to enhancement that has shown some promise. The study involved green abalone, but may be applicable to other species. In time, these small, aggregated groups could enlarge due to increased reproductive success.

Drawbacks to translocation and aggregation techniques include mortality during collection, transportation and replanting, absence and depletion of the source population, increased vulnerability to poaching, and disease transmission. Tegner (1992) reported a 10% mortality rate associated with transportation and replanting activities. Consideration of these drawbacks will be necessary when selecting sites for translocation and aggregation activities.

6.4.2.2 Larval Out-planting

Larval out-planting releases millions of cultured larvae into optimal habitat areas. Although there is very high mortality of released larvae at the early stages of growth, saturating the habitat with larvae on consecutive occasions may have a positive effect on recovery. An additional benefit is the reduced cost of culture by releasing the abalone early in their development. This type of enhancement has been attempted and shows some promise. Further feasibility studies are necessary to determine if this technique is useful on a large scale. The Department is currently planning larval out-planting feasibility studies using red abalone at the northern Channel Islands. If the technique proves successful, it could be applied to other abalone species. Former commercial abalone fishermen are supportive of this technique and may volunteer time and resources to conduct out-planting.

6.4.2.3 Captive Breeding to Obtain Large Individuals for Out-planting

Tegner (1992) found that translocating large abalone was an effective means of increasing local numbers. However, a disadvantage to this method is the lack of available and sufficient source populations in the wild. Aquaculture offers the ability to grow abalones to large size. Of the California abalones, red and green (Lapota *et al.* 2000) are currently being grown to sizes exceeding 100 mm. Cultured white abalone are currently in the early stages of being grown to large size as a potential source of individuals to increase local populations. Similar work for black abalone has been proposed, particularly for developing a WS-resistant strain.

While out-planting larger individuals offers the advantages of decreased natural predation and an increase in local reproductive potential, these animals are

more likely to be poached (Henderson *et al.* 1988). Thus, it is important to have locations where out-planted abalones can be protected. Cultured abalone may behave differently from naturally-occurring abalone, and may not survive as well as native stock under natural conditions.

The cost of raising abalones to large size is high, but may be the most cost-effective method for rebuilding populations that are at risk of extinction.

6.4.2.4 Establishing Marine Protected Areas

Edwards (1913) was the first to recognize that local declines in abalone could ultimately lead to loss of the resource as a whole. He was visionary in suggesting the establishment of protected reservations to function as breeding centers for abalone at 5 to 10 mile intervals along the coast. MPAs for abalone could only be used in areas that still support minimum viable populations. MPAs, particularly marine reserves where no commercial or recreational take is allowed, are designed to conserve ecosystems and habitat, and reduce threats to fishery sustainability. MPAs would benefit abalone recovery by providing a natural habitat where individuals could form the aggregations necessary for reproduction.

Abalone-related MPAs should be located in remote areas away from population centers in order to reduce take, and the effects of pollution. Remote areas should be selected that would also protect abalone as long as possible from the arrival of potential natural predators, such as sea otters. It is likely that areas meeting this requirement could be found at the southern Channel Islands (San Clemente and Santa Catalina Islands). An MPA at Santa Barbara Island was established in 2003 that may meet this requirement.

A second requirement is effective enforcement. Currently, there are few areas along the southern California mainland where abalone could be enhanced because protection of the abalone cannot be reasonably ensured. However, certain areas have onsite enforcement presence as well as frequent Department enforcement patrols and may meet this requirement.

Once abalone populations reach a self-sustaining level, recovery can move into the long-term phase. MPAs would continue to benefit abalone during the long-term phase by providing protection while the population grows towards fishery sustainability. After recovery, MPAs would continue to provide areas where a complete size range of abalone could thrive in a natural marine environment. These areas would provide a continuous source of reproductive potential in larger older abalone.

Specific areas for MPAs were not originally proposed in this plan because the proposal of MPA sites will take place under the MLPA. A list of criteria for MPA requirements for abalone under the ARMP are listed in Section 7.1.1.3, Marine Protected Areas. A network of MPAs at the Channel Islands National Marine Sanctuary were approved by the Fish and Game Commission and went into effect on April 9, 2003 (Figure 6-3). Of the established MPA sites, ten would provide areas suitable for abalone recovery.

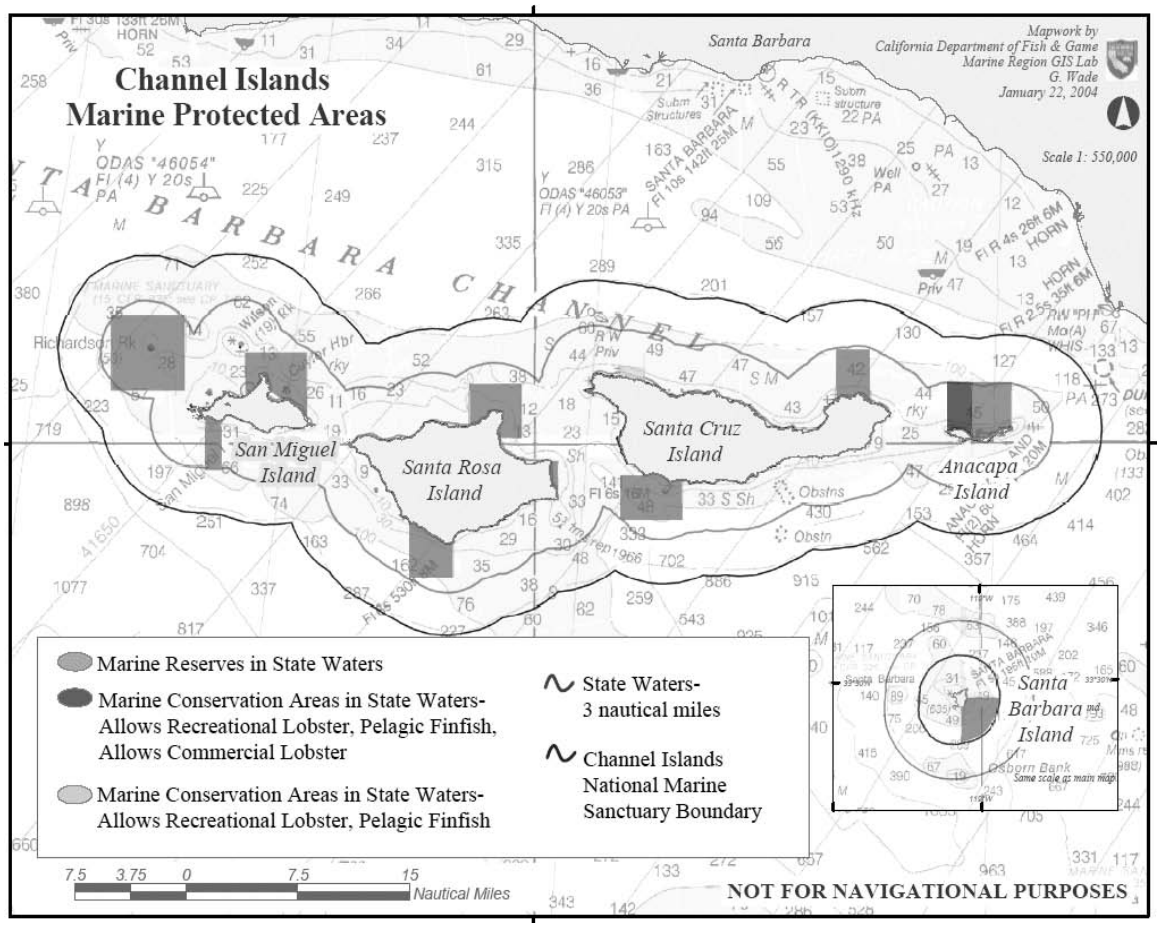

Figure 6-3. Marine Protected Areas in the Channel Islands National Marine Sanctuary

6.4.3 Genetics and Disease Research

Active enhancement of abalone stock will include aggregation, translocation and introduction of aquacultured abalone larvae, seed, or large individuals. Before any of these activities are attempted, certain genetic and disease concerns should be specifically addressed.

6.4.3.1 Genetics Research

In populations with extremely low abundance levels, there is a strong possibility that individuals may be genetically similar. Using these individuals in enhancement programs may result in restricted genetic characteristics (genetic bottlenecks) and cause reduced genetic diversity. A survey of individuals from many locations throughout the species' range should be conducted in order to estimate genetic diversity.

Knowledge of abalone genetics may be applied to genetic tag methods used to evaluate the success rates of out-planting. Genetic markers that may be unique to the Southern California Region could be a useful tool in enforcement of the moratorium.

Enhancement activities such as translocation and out-planting have potential genetic consequences from mixing genotypes of remote populations and introducing cultured strains to natural populations. A part of active enhancement efforts should

include attention to genetic concerns. Samples of individual abalone can be taken non-destructively and stored for future analysis.

Aggregation of abalones is the only activity that would not require genetic evaluation before proceeding, but genetic sampling would still be conducted as part of the overall abalone genetic investigation.

6.4.3.2 Disease Research

Disease, particularly WS, constitutes an important factor which might limit recovery operations in southern California for some species. Aggregating, out-planting and translocating individuals in California must allow for the possible effects of WS. Further research is needed on the effects of WS on each species, and on possible resistance to WS. If resistance is not assured, such recovery operations should not be pursued.

6.5 Challenges to Abalone Recovery

There are a variety of challenges that may hinder abalone recovery. The extent of recovery for each species will depend on the severity of these challenges, which are identified and described below.

6.5.1 Disease

For invertebrates, resistance to disease develops at the level of the population rather than being acquired by individuals through previous exposure. The potential for development of genetically-based resistance at the population level is enhanced by large population size. If a fishery were opened or continued during an acute disease event, the healthy, and possibly most resistant, individuals would be removed by the fishery.

The extent to which WS has played a role in the apparent failure of abalone population recovery since fishery closures is unknown. WS has a strong temperature component, in that elevated sea water temperature stimulates the development of the disease, which can be lethal (Friedman *et al.* 1997, Moore *et al.* 1997). Therefore, the impact of WS will be most apparent following severe El Niños and may increase if global climate change results in increased seawater temperatures. Recovery options must take into consideration the possible effects of this disease.

The Department monitors aquaculture facilities for introduced organisms and disease. There is currently a restriction on out-planting abalone from facilities which have not met certification standards. These standards must be followed in all appropriate enhancement operations.

6.5.2 Sea Otters

Sea otters constitute a potential threat to the recovery of an abalone fishery in the Southern California Region. While sea otters and abalones co-existed along the California coast before 1850, the abalone likely occupied cryptic habitat inaccessible to otters, in crevices and under boulders. The establishment of an abundance of large invertebrates, such as abalone, crabs, sea urchins, and clams, along the Pacific Coast is likely the result of severe declines in sea otters in the 19th century due to fur trade hunting. The loss of the central California red abalone fishery to sea otters in the 1960s

demonstrated the effect that sea otters have on a fishery (Wendell 1994). Similar impacts on abalone fisheries occurred in British Columbia, Canada (Watson and Smith 1996; Watson 2000).

Although the central California fishery for red abalone was eliminated by sea otters, red abalone still exist in cryptic habitat under rocks and in crevices inaccessible to otters, and will likely be self-sustainable at lower population numbers and biomass (Hines and Pearse 1982). The current abalone population in central California is probably at the same level it was prior to human exploitation of sea otters. Although this cryptic population exists within the Central California Sea Otter Range, there are insufficient individuals available to conduct a fishery. If a fishery were allowed, habitat damage may result from moving rocks to search for abalone in cryptic habitat, and additional opportunities would be created for selling illegal take. A fishery based on smaller (cryptic) sizes would put the crevice-dwelling refuge population at risk.

In southern California there is concern that re-colonization by the sea otter would reduce an already depleted resource to even lower levels, possibly to extinction. Southern California populations need focused assessment to identify whether the crevice dwelling individuals are present in sufficient numbers to sustain the resource, if sea otters become a factor.

6.5.3 Other Challenges to Abalone Recovery

For a description of other challenges to abalone recovery, see Section 6.4.2.4, Establishing Marine Protected Areas; Chapter 8, Abalone Enforcement Activities, and Section 2.1.9, Mortality.

6.6 Recovery Approach

Within the overall strategy for abalone recovery, the unique needs of each abalone species must be considered. To facilitate an organized approach, the recovery needs outlined below are sequentially numbered and divided into specific tasks within four recovery categories. Addressing these needs for each species will require the coordination of tasks. Where possible, the needs of multiple species will be addressed simultaneously. All of the recovery plans have similar task elements; however, there are differences in implementation (Table 6-2).

6.6.1 The General Recovery Plan

The recovery tasks are sequentially numbered for ease of identifying specific tasks. Task numbers do not indicate that they must be undertaken in sequential order. Implementation of tasks for each species is outlined Chapter 9, Implementation (Activities, Timelines and Cost) in Table 9-1.

6.6.1.1 Assessment of Habitat and Stock

<u>Exploratory Surveys – Task 1</u>

A primary need at the beginning of the recovery process is to assess the current status of all five species throughout the entire range. Exploratory surveys will be conducted at all key locations. Some of this work has already begun for some species (red, pink, black, and white abalones) but for no species is the assessment complete. Knowing the baseline status of the population is important to define the level of risk

Table 6-2. List of recovery activities with an estimate of field time required to complete the activity

Activity and task	Species	Time	Field time required
Assessment of Habitat and Stock			
Exploratory Surveys (Task 1)	R	I	5 dive days
	P	I	17 dive days (10 primary, 7 secondary*)
	G	I	24 dive days (14 primary, 10 secondary*)
	B	I	30 days low tide sampling
	W	I	40 days split between submersible & ROV
Detail Surveys (Task 2)	P	I	7 dive days
	G	I	15 dive days
	W	I	undetermined
Assessing Recovery (Task 3)	R	L	10 dive days over 5 yr period
	P	L	23 dive days over 5 yr period
	G	L	24 dive days over 5 yr period
	B	L	30 days low tide sampling over 5 yr period
	W	L	40 days submersible / ROV over 5 yr period
Research (enhancement activities)			
Culture (contract or support) (Task 4)	R	I	1 dive day to collect broodstock, 6- 12 mo to receive larvae
	G	L	continuous after feasibility study
	B	L	8 days broodstock collection, est. 7-10 yr culture
	W	I,L	continuous until de-listed
Out-planting Feasibility Studies (Task 5)	R(larval)	I	15 dive days (setup), 10 dive days/yr for 5 yr
	G	I	24 dive days/yr for 4 yr
	B	I	15 days/yr low tide sampling
	W	I, L	10 dive days/yr , 10 days/yr ROV for 5 yr
Aggregation Feasibility Study (Task 6)	P	I	7 dive days (setup), 5 dive days/yr for 4 yr
	G	I	7 dive days (setup), 5 dive days/yr for 4 yr
Translocation Feasibility Study (Task 6)	R	I	10 dive days (setup), 10 dive days/yr for 4 yr
	B	I	20 low tide sampling days/yr. for 4 yr
Aggregation (Task 7)	All	L	undetermined
Translocation (Task 7)	All	L	undetermined
Out-planting (adult, larval) (Task 8)	All	L	undetermined
Research (genetics and disease)			
Estimate Genetic Diversity (Task 9)	All	I	2 yrs. per species to complete lab analysis
Study of Resistance to W S (Task 10)	B	I	Estimated 2 yr
Involvement in Federal White Abalone Recovery Team (Task 11)	W	I, L	continuous until de-listed

Note: R= red, P= pink, G= green, B= black, W= white, I=interim, L=long-term
*see Sections 6.5.2.2 and 6.5.2.3

for survival of the species as well as to determine the level of recovery needed. This information will help prioritize recovery efforts so that species that are at risk of local extinction will receive more effort than those that are not. Exploratory surveys will provide information on current population levels and the location of aggregations. This information will be used to identify areas to conduct recovery activities, and areas to protect.

The exploratory surveys for most species will be accomplished using timed surveys (Tables 6-3 through 6-8). Surveys of deep, remote, offshore locations for white abalone will be conducted using a GPS-tracked submarine and/or ROV. The exploratory survey for black abalone will use an intertidal timed search survey conducted during low tide periods. Survey methodologies are explained in Appendix E, Survey Methods.

These surveys will produce a GPS record of the general distribution of remaining abalone populations and a general habitat description. The generalized stock assessment will also provide the current status of the population at key locations. This information is important for determining the baseline from which recovery will be measured. Decisions on where and what type of recovery activities to employ can be made based on this information.

A collateral benefit of this task is that data obtained from these exploratory surveys would include information on multiple abalone species distributions and habitat, since the depth ranges of these species overlap. Information on other invertebrates, fishes, and plants may be useful in the assessment and management of those species.

Detailed Surveys of Known Abalone Habitat – Task 2

The detailed surveys will expand upon the initial knowledge gained from exploratory surveys by providing precise habitat descriptions, a baseline density estimate, and locations of abalone aggregations. Detailed surveys could be undertaken immediately following the exploratory surveys (Task 1) at particular locations on the same trip.

The detailed surveys will be similar to timed swim surveys, except that a diver tracking device will be employed to map the divers' movements and record habitat and abalone location information (Appendix E Survey Methods).

This task will produce a detailed map of abalone habitat at selected areas. The habitat information will be placed into a geographic information system (GIS) and used to generate habitat and community maps. Suitable areas for potential recovery activities could be identified at index sites or key locations. Identifying specific habitat types is essential for optimizing recovery efforts. The habitat information in the GIS would also be useful for other projects and species assessments.

Assessing Recovery – Task 3

Periodic assessment of any changes in the population is the core research task that will directly evaluate whether recovery criteria and goals have been satisfied. The survey technique used will vary depending on the level of recovery.

Assessment surveys for Criterion 1 will be the timed survey, intertidal walks, and submersible/ROV surveys (Appendix E Survey Methods). Following the achievement of Criterion 1, emergent density transects will be used to assess the achievement of Criterion 2 and Criterion 3. Other types of survey data will be incorporated from existing long-term sites monitored by other organizations and agencies.

This task is crucial for determining the achievement of each recovery criterion. If this task is not completed, there will be no way to determine if a species is recovering or heading towards extinction.

Recovery assessments may sometimes encompass multiple abalone species, because some abalone species occur in the same key recovery locations and have overlapping depth ranges.

6.6.1.2 Research: Enhancement Activities

Develop or Support Existing Culture Programs – Task 4

Since the Department has no facilities for raising abalone, it must encourage abalone aquaculture companies to undertake this work. The Department will provide assistance with broodstock collection, and The Department's Shellfish Health Laboratory will certify facilities, assist with disease issues, and certify individual lots for outplanting (see Tasks 5 and 8).

The Department has already encouraged culture programs for white and green abalones for recovery out-planting. Culture programs for black and red abalones are planned and will be developed in the near future. The current culture programs and the planned black abalone program will raise abalone to adult sizes for out-planting into the natural environment. The planned red abalone culture program will produce larvae for out-planting. The production of adult and larval seed will initially be for small scale out-planting feasibility studies. If the feasibility studies show that the technique is worthwhile, the culture programs will expand operations to produce larger quantities of seed for out-planting. Inherent in the culture of abalone is the collection of wild broodstock. If out-planting activities progress to a larger scale to enhance recovery (Task 8), then formal controls to limit the collection of broodstock from the wild will be instated. Controls on broodstock collection will ensure that broodstock collection areas are not negatively impacted to the extent that recovery is significantly hampered.

In the course of culturing broodstock offspring, it may be necessary to cull a certain percentage of the population to prevent overcrowding and to maintain optimal growth rates. These culled individuals could be used for further research in pathology, larval or juvenile ecology, and other areas that would help increase the success of out-planting.

Feasibility Study for Out-planting – Task 5

The out-planting of adult or larval abalone involves new techniques which must be evaluated before applying them on a larger scale. The Department must also develop protocols and determine locations for out-planting. Finding protected areas or deep areas that might provide *de facto* protection for the out-planted abalone is also important. Results should be evaluated at regular intervals, and if positive results cannot be verified after five years, this technique should be reconsidered. If failure is due in part to WS infection after out-planting, development and out-planting of WS-resistant strains, if possible, will be considered (Section 6.6.1.3 Research: Genetics and Disease Studies, Task 10).

The main product from this task will be a scientifically-based determination of the effectiveness of larval and adult out-planting enhancement techniques. An additional product will be the establishment of localized groups of abalone which may help to increase reproductive success. This task will also provide an out-plant protocol (for both adults and larvae) that could be applied to other abalone recovery efforts.

Feasibility Studies for Aggregation/Translocation – Task 6

In localized areas within index sites, remaining abalone populations may be too dispersed for effective reproduction to occur. "Local areas" are defined as locations where surveys would normally be conducted. Aggregation of remnant abalone may be useful as a means of facilitating reproduction. Aggregation would not require genetic or

disease evaluation of individuals, because individuals would be taken from natural local populations. Aggregation would only be appropriate for intertidal and subtidal SCUBA diving sites. Aggregation feasibility studies will be conducted using pink and green abalones.

The steps for aggregation involve the following:

- Survey area for abalone
- Mark location of abalone
- Evaluate numbers to determine if aggregation is warranted
- Locate appropriate habitat in which to aggregate
- Move abalone
- Tag abalone, if possible
- Determine GPS location
- Post-survey evaluation

A primary concern is keeping abalone that are part of the local unit (in other words, part of a rocky point, cove, or kelp bed) in that area. The number and density of abalone which would trigger an aggregation study needs to be determined.

Translocation involves moving abalones longer distances, such as between islands. Translocation of abalone would be used to re-introduce animals to areas once populated by a high abundance of abalone. Translocation feasibility studies will be completed using red and black abalones. Evaluation of donor and receiving locations should be made before an operation is conducted. Genetic and disease considerations will be addressed prior to any translocation.

The steps for translocation involve the following:

- Determine and evaluate new location, including the presence of abalone, good habitat, food, and protection
- Determine source location, including the presence of sufficient animals
- Move abalone
- Tag abalone, if possible
- Determine GPS location
- Post-survey evaluation

The results of aggregation and translocation should be evaluated at regular intervals. If positive results from the use of these techniques cannot be verified after five years, then the methods of enhancement should be reconsidered.

Aggregation and translocation are probably the only recovery activities that can be done for red, pink, green, and black abalones at the Channel Islands within the next five to seven years. Information obtained might also be applicable to the recovery of other abalone species.

<u>Aggregation or Translocation – Task 7</u>

If the feasibility studies prove that aggregation and translocation are successful recovery activities, the next step is to evaluate following CEQA guidelines and, if appropriate, apply them to a larger recovery area. Based on the exploratory survey information, locations will be identified for either the aggregation or translocation recovery activity. Specific methodology will be determined by the results of the

feasibility studies. The immediate product will be an increase in the number of abalone in an aggregation, followed by successful reproduction and recruitment in areas where this task is applied. If shown to be effective on a large scale, aggregation and translocation are probably the best and most cost-effective recovery activities to use for all abalone.

Out-planting – Task 8

If feasibility studies prove that larval and adult out-planting are successful recovery activities, the next step is to evaluate these activities following CEQA guidelines and, if appropriate, apply them to a larger recovery area. Based on previous survey information, locations will be identified for out-planting. Methodologies determined during the feasibility study will be used to carry out this task on a larger scale in the selected locations. The immediate product will be an increase in the number of abalone in the areas where out-planting occurs.

6.6.1.3 Research: Genetics and Disease Studies

Genetic Study: Estimation of Genetic Diversity – Task 9

A survey to collect genetic material from individuals at many locations within the species range should be conducted to estimate genetic diversity. Such surveys can be conducted without harm to the abalone. Very small tissue samples can be taken from abalone found on the exploratory surveys in Task 1. The equipment needed to conduct genetic testing is available from academic institutions (such as the University of California). Population specialists under contract would evaluate genetic data.

Evaluation of Resistance to WS – Task 10

Although rare and widely dispersed, survivors of some Channel Islands and mainland black abalone populations remained long after most of the population was removed by WS. These individuals may harbor genetic resistance to WS, which will be essential for the development of a black abalone culture and out-planting program.

The Department's Shellfish Health Laboratory will collect a limited number of these animals and compare their ability to resist WS relative to black abalone from north-central California that have not experienced mass mortality. Black abalone that survive the laboratory challenge will be treated with antibiotics to eliminate the WS pathogen, and then conditioned for spawning to produce WS-resistant progeny. This method could also be applied to other species if WS is found to be a critical factor for their recovery.

6.6.2 Recovery Plan Elements for Individual Species

6.6.2.1 Red Abalone

Task 1 - Exploratory Surveys

The majority of the southern California population is currently concentrated at San Miguel Island, which is the western-most of the northern Channel Islands (Figure 63). Exploratory surveys will focus on Santa Rosa and Santa Cruz Islands, where red abalone historically occurred. Surveys will take place within the blocks and key locations listed in Table 6-3.

Task 2 - Detailed Surveys of Known Abalone Habitat

This task is not required for red abalone. Sufficient information is already available.

Task 3 - Assessing Recovery

Assessment surveys will be conducted at index sites and key locations in southern and central California (Table 6-3).

Task 4 - Develop or Support Existing Culture Programs

A certified (sabellid-free) aquaculture facility in southern California will be selected for culturing red abalone larvae for out-planting feasibility studies.

Task 5 - Out-planting Feasibility Study

Red abalone is the best candidate for a feasibility study on larval out-planting because red abalone larvae are readily available from established aquaculture facilities. The out-planting study will be located at Santa Rosa and Santa Cruz Islands.

Task 6 - Aggregation/Translocation Feasibility Studies

Translocation feasibility studies will be conducted at Santa Rosa Island and/or Santa Cruz Island. The source for translocation abalone will be San Miguel Island.

Task 7 - Aggregation or Translocation

These recovery techniques will be employed in the appropriate key locations.

Task 8 - Out-planting

Out-planting will occur in the appropriate key locations.

Task 9 - Genetics

A genetics study will be completed to determine if sub-populations exist.

Table 6-3. Key locations for recovery of **red abalone** in southern and central California

Area	Block no.	Index	Key location
San Miguel Island	690 & 689	X	Crook Point to Cardwell Point
	689 & 690	✓	Bay Point to Harris Point
	690		Harris Point to Otter Harbor
	690	X	Castle Rock (Otter Harbor to Point Bennett)
	690		Point Bennett to Judith Rock
	690	✓	Judith Rock to Crook Point
Santa Rosa Island	689		Talcott Shoal (Tecolote Point to Sandy Point)
	712		Sandy Point to Cluster Point
	711	X	Cluster Point to South Point
	711	✓	South Point to Ford Point
Santa Cruz Island	687	X	West Point to Black Point
	687 & 709		Kinton Point to Posa Anchorage
	709	✓	Gull Island (Laguna Harbor to Morse Point)
San Diego Area	860		La Jolla (Point La Jolla to Bird Rock)
	860		Point Loma (Mission Bay to Rathay Point)
	860	✓	Point Loma (Rathay Point to Ballast Point)
Central California	457	X	SW Farallon Islands
	464	X	Fitzgerald Marine Reserve (San Mateo Co.)

X - Proposed CDFG index recovery site ✓ - External agency monitoring site

6.6.2.2 Pink Abalone

Task 1 - Exploratory Surveys

Areas selected for exploratory surveys in southern California are divided into primary and secondary tiers. The primary areas will encompass the CDFG blocks where most landings occurred for both the recreational and commercial fisheries. The secondary areas will be surveyed at a later date when time, weather, and personnel availability allow. Primary surveys will be conducted at Santa Cruz Island, Anacapa Island, Santa Barbara Island, and Santa Catalina Island; and the mainland at San Diego. Secondary survey areas include San Clemente Island, Cortes Bank, Palos Verdes Peninsula, and Dana Point. The specific areas where surveys will occur are listed as key locations for recovery in Table 6-4.

Task 2 - Detailed Surveys of Known Abalone Habitat

Areas for detailed surveys will be selected based on findings of exploratory surveys at the primary islands. Areas at San Clemente Island will be selected based on past surveys.

Task 3 - Assessing Recovery

Assessment surveys will be conducted at index sites and key locations (Table 6-4).

Task 4 - Develop or Support Existing Culture Programs

There is no existing or planned culture program for pink abalone.

Task 5 - Out-planting Feasibility Study

Because there is no culture program, out-planting cannot be undertaken at this time.

Task 6 - Aggregation/Translocation Feasibility Studies

An aggregation feasibility study will be conducted on the west and south sides of San Clemente Island.

Task 7 - Aggregation or Translocation

These recovery techniques will be employed at the appropriate key locations according to the results of Tasks 1 and 2.

Task 8 - Out-planting

This recovery technique will be employed if a culture program is developed which will supply larvae and/or seed abalone.

Task 9 - Genetics

A genetics study will be completed to determine if sub-populations exist.

Table 6-4. Key locations for recovery of **pink abalone** in southern California

Area	Block no.	Index	Key location
Anacapa Island	684	✓	Bat Ray Cove to West End
	684	✓	West End to East Fish Camp
	684	✓	East Anacapa
Santa Cruz Island	685	✓	Cavern Point to San Pedro Point
	685		San Pedro Point to Sandstone Point
	708	✓	Sandstone Point to Blue Banks
	709		Blue Banks to Laguna Harbor
	709 & 710	✓	Gull Island (Laguna Harbor to Morse Point)
Santa Barbara Island	765	✓	South Side (Sutil Island to Grave Canyon)
	765	X	West Side (Webster Point to Sutil Island)
	765	✓	North Side (Arch Point to Webster Point)
Santa Catalina Island	761		Isthmus Cove Area (Ship Rock, Bird Rock etc.)
	761	✓	Long Point to Blue Cavern Point
	761	✓	Little Harbor to Ben Weston Point
	761		Ben Weston Point to Painted Cliffs
	762	X	Eagle Reef to Stony Point
	762		Stony Point to West End
	762		West End to Ribbon Rock
	762	X	Ribbon Rock to Catalina Head
	762		Avalon to Long Point
San Clemente Island	829		Northwest Harbor to West Cove
	849		Little Flower to White Rock
	849 & 850	X	West Cove south 3 nautical miles
	850		Eel Point north 3 nautical miles
	850	X	Eel Point to Mail Point
	850		Mail Point to Lost Point
	849 & 867		Lost Point to Cove Point
	867	X	China Point to Pyramid Head
Cortez Bank	897		Bishop Rock
Palos Verdes Peninsula	720		Haggerty's to Lunada Bay
	720		Lunada Bay to Abalone Cove
	719		Abalone Cove to Point Fermin
Dana Point	757		Pelican Point to Laguna Main Beach Laguna Main
	757		Beach to Dana Point
San Diego Area	860		La Jolla (Point La Jolla to Bird Rock)
	860		Point Loma (Mission Bay to Rathay Point)
	860	✓	Point Loma (Rathay Point to Ballast Point)

X - Proposed CDFG index recovery site ✓ - External agency monitoring site

6.6.2.3 Green Abalone

Task 1 - Exploratory Surveys

Few areas have been thoroughly evaluated for remaining green abalone populations; however, evidence suggests that populations are at very low levels. The primary survey areas will be centered around the southern Channel Islands: San Clemente Island, Santa Catalina Island, and Santa Barbara Island. Secondary survey areas include Santa Cruz Island, Anacapa Island, Palos Verdes Peninsula, Dana Point, and the San Diego area (Table 6-5).

Task 2 - Detailed Surveys of Known Abalone Habitat

Areas for detailed surveys will be selected based on findings of exploratory surveys at the primary survey islands. Areas at San Clemente Island will be selected based on past surveys.

Task 3 - Assessing Recovery

Assessment surveys will be conducted at index sites and key locations (Table 6-5).

Task 4 - Develop or Support Existing Culture Programs

The culture of green abalone is being conducted by the U.S. Navy and the City of San Diego. The project received grant funding from the California Resources Agency in 2002.

Task 5 - Out-planting Feasibility Study

The Navy project is focused on out-planting large (3 to 4 in.) green abalone in the vicinity of Point Loma.

Task 6 - Aggregation/Translocation Feasibility Studies

An aggregation feasibility study will be conducted at either San Clemente or Santa Catalina Island.

Task 7 - Aggregation or Translocation

These recovery techniques will be employed at the appropriate key locations (Table 6-5).

Task 8 - Out-planting

This recovery technique will be employed at the appropriate key locations (Table 6-5).

Task 9 - Genetics

A genetics study will be completed to determine if sub-populations exist.

Table 6-5. Key locations for recovery of **green abalone** in southern California

Area	Block no.	Index	Key location
Anacapa Island	684	✓	Bat Ray Cove to West End
	684	✓	West End to East Fish Camp
	684	✓	East Anacapa
Santa Cruz Island	685	✓	Cavern Point to San Pedro Point
	685		San Pedro Point to Sandstone Point
	708		Sandstone Point to Blue Banks
Santa Barbara Island	765	✓	South Side (Sutil Island to Grave Canyon)
	765	✓	West Side (Webster Point to Sutil Island)
	765	X	North Side (Arch Point to Webster Point)
Santa Catalina Island	761	X	Isthmus Cove Area (Ship Rock, Bird Rock)
	761	✓	Long Point to Blue Cavern
	761	✓	Point Little Harbor to Ben Weston Point
	761		Ben Weston Point to Painted Cliffs
	762	✓	Eagle Reef to Stony Point
	762	X	Stony Point to West End
	762		West End to Ribbon Rock
	762	X	Ribbon Rock to Catalina Head
	760 & 761		Avalon to Long Point
San Clemente Island	829		Northwest Harbor to West Cove
	849		Little Flower to White Rock
	849 & 850	X	West Cove south 3 nautical miles
	850		Eel Point north 3 nautical miles
	850	X	Eel Point to Mail Point
	850		Mail Point to Lost Point
	849 & 867		Lost Point to Cove Point
	867	X	China Point to Pyramid Head
Palos Verdes Peninsula	720		Haggerty's to Lunada Bay
	720		Lunada Bay to Abalone Cove
	719		Abalone Cove to Point Fermin
Dana Point	757		Pelican Point to Laguna Main Beach
	757		Laguna Main Beach to Dana Point
San Diego Area	860		La Jolla (Point La Jolla to Bird Rock)
	860		Point Loma (Mission Bay to Rathay Point)
	860	✓	Point Loma (Rathay Point to Ballast Point)

X - Proposed CDFG index recovery site ✓ - External agency monitoring site

6.6.2.4 Black Abalone

Task 1 - Exploratory Surveys

Black abalone distribution is relatively well known throughout southern California, including the Channel Islands. This species also occurs in central California, where information about its distribution and abundance is limited. However, surveys in the Monterey/Carmel area in the northern part of central California suggest that a fairly good population remains. Exploratory surveys will be conducted in central California (from San Luis Obispo County to Mendocino County) to determine relative abundances of black abalone, and whether these populations could serve as sources of animals for translocation to depleted areas in southern California.

Task 2 - Detailed Surveys of Known Abalone Habitat

This task is not needed for black abalone because sufficient information is already available.

Task 3 - Assessing Recovery

Surveys will be conducted at index sites and key locations (Table 6-6).

Task 4 - Develop or Support Existing Culture Programs

Currently, black abalone has not been successfully cultured. Developing a culture program for black abalone is important to provide stock for out-planting, and in order to answer questions regarding the effects of, and resistance to, WS.

Task 5 - Out-planting Feasibility Study

Locations for out-planting must be well protected from poaching. Black abalone are accessible and easily seen during low tide periods and thus are very susceptible to poaching. Few (if any) areas on the southern California mainland would be acceptable for enhancement. Areas at the Channel Islands or mainland areas along the central California coast would provide suitable habitat that could be adequately protected.

Task 6 - Aggregation/Translocation Feasibility Studies

Abalone from the northern portion of the central California coast may be translocated to the southern portion of the central California coast.

Task 7 - Aggregation or Translocation

These recovery techniques will be used at the appropriate key locations (Table 6-6).

Task 8 - Out-planting

Black abalone will be out-planted at the appropriate key locations (Table 6-6).

Task 9 - Genetics

A genetics study will be completed to determine if sub-populations exist.

Task 10 - Resistance to WS

Central California black abalone populations will be evaluated for WS resistance.

Table 6-6. Key locations for recovery of **black abalone** in southern California

Area	Block no.	Index	Key location
San Miguel Island	690 & 689		Crook Point to Cardwell Point
	689 & 690	✓	Bay Point to Harris Point
	690	✓	Harris Point to Otter Harbor
	690		Otter Harbor to Point Bennett
	690	✓	Judith Rock to Crook Point
Santa Rosa Island	689	✓	Tecolote Point to Sandy Point
	711	✓	Sandy Point to Cluster Point
	711	✓	Johnson's Lee to Ford Point
	711 & 710		Ford Point to East Point
Anacapa Island	684	✓	Bat Ray Cove to West End
	684		West End to East Fish Camp
Santa Barbara Island	765		Arch Point to Webster Point
	765		Webster Point to Sutil Island
	765		Sutil Island to Sea Lion Rookery
San Nicolas Island	813		All Rocky Intertidal Areas
	814	X	All Rocky Intertidal Areas
Santa Catalina Island	761	X	Long Point to Blue Cavern Cove
	761		Little Harbor to Ben Weston Point
	762	X	Eagle Reef to Stony Point
	762		Stony Point to West End
	762		West End to Ribbon Rock
	762		Ribbon Rock to Catalina Head
San Clemente Island	829	X	Northwest Harbor to West Cove
	849		Little Flower to White Rock
	849 & 850		West Cove south 3 nautical miles
	850	X	Eel Point north 3 nautical miles
	850		Eel Point to Mail Point
	850		Mail Point to Lost Point
	849 & 867		Lost Point to Cove Point
	867		China Point to Pyramid Head
Palos Verdes Peninsula	720		Haggerty's to Lunada Bay
	720		Lunada Bay to Abalone Cove
	719		Abalone Cove to Point Fermin
Dana Point	757		Pelican Point to Laguna Main Beach
	757		Laguna Main Beach to Dana Point
San Diego Area	860		La Jolla (Point La Jolla to Bird Rock)
	860		Point Loma (Mission Bay to Rathay Point)
	860	✓	Point Loma (Rathay Point to Ballast Point)

X - Proposed CDFG index recovery site ✓ - External agency monitoring site

6.6.2.5 White Abalone

White abalone is listed as an endangered species under the federal ESA. Recovery tasks at this time do not involve actual handling of abalone since a special permit is required from NOAA Fisheries.

Task 1 - Exploratory Surveys

White abalone is at an extremely low population level, and most of the recently observed individuals have been large and solitary, which indicates that the population has experienced reproductive failure and is senescent. No recruitment of small individuals was observed during SCUBA or submarine surveys; however, two individuals were observed at Santa Cruz Island (Davis *et al.* 1998). Further exploratory surveys are needed to delineate critical abalone habitat for this species.

Submarine and ROV surveys will take place at Tanner and Cortez Banks due to the greater likelihood of finding white abalone at this location. San Clemente and Santa Barbara Islands will be surveyed due to their proximity to the center of the white abalone distribution area.

Task 2 - Detailed Surveys of Known Abalone Habitat

Data will have already been collected through the video recordings by submersible or ROV surveys during exploratory surveys (Task 1).

Task 3 - Assessing Recovery

Assessment surveys will be conducted at index sites and key locations (Table 6-7).

Task 4 - Develop or Support Existing Culture Programs

Prior to its listing under the ESA, the Department participated in the collection of white abalone for culture, in conjunction with University of California at Santa Barbara, and the Channel Islands Marine Research Institute (CIMRI). A spawn in 2001 produced several hundred thousand progeny which are currently being held at CIMRI until they are at least 100 mm (4 in.) long, at which time they will be out-planted (subject to federal approval). Some of these individuals could also be used to expand the culture program at other facilities. Growing cultured abalone to a large size for out-planting has never been attempted before, and this work should be considered experimental.

While not specifically part of this task, the establishment of alternative culture facilities for growing white abalone would be encouraged. Expanding the culture program would reduce the risk of catastrophic system failure and subsequent loss of the recovery program.

Tasks 5 Through 9

These tasks will not be implemented under the ARMP due to the white abalone's status as a federally listed endangered species. Similar recovery tasks are being conducted under the auspices of the draft federal white abalone recovery plan and the National Marine Fisheries Service. Department personnel are involved in this cooperative effort with the federal government and the private sector.

Task 10 - Evaluation of Resistance to Withering Syndrome

The Department's Shellfish Laboratory may investigate the effects of withering syndrome in white abalone.

Task 11 - Involvement in the Federal White Abalone Recovery Team

Working with this species would involve interaction/participation with the White Abalone Recovery Team, established by NOAA Fisheries. Interaction with NOAA Fisheries on white abalone recovery will establish a direct working relationship with federal agency personnel, which may be useful if other abalone species are listed under the federal ESA.

Table 6-7. Key locations for recovery of **white abalone** in southern California

Area	Block no.	Index	Key location
Santa Cruz Island	685	✓	San Pedro Point to Sandstone Point
Santa Barbara Island	765		Arch Point to Webster Point (Foul Area)
	765	X	Webster Point to Sutil Island
	765		Sutil Island to Grave Canyon
Santa Catalina Island	761	X	Isthmus Cove Area (Ship Rock, Bird Rock)
	761		Long Point to Blue Cavern Point
	762		Eagle Reef to Stony Point
	762		Farnsworth Bank
San Clemente Island	829	X	Northwest Harbor to West Cove
	849		Little Flower to White Rock
	849 & 850	X	West Cove south 3 nautical miles
	850		Eel Point north 3 nautical miles
	850	X	Eel Point to Mail Point
	850		Mail Point to Lost Point
	849 & 867		Lost Point to Cove Point
	867	X	China Point to Pyramid Head
Tanner Bank	872		All Suitable Habitat
	871		All Suitable Habitat
Cortez Bank	890		All Suitable Habitat
	897		All Suitable Habitat

X - Proposed CDFG index recovery site ✓ - External agency monitoring site

6.6.2.6 Pinto Abalone and Flat Abalone

Task 1 - Exploratory Surveys

Exploratory surveys will be completed in conjunction with other exploratory surveys of the five major species.

Task 2 - Detailed Surveys of Known Abalone Habitat

Detailed survey data collected for other species will be used for pinto and flat abalones in areas where they may co-occur.

Task 3 - Assessing Recovery

Assessment surveys will be conducted at index locations (Table 6-8).

Tasks 4 Through 9

These tasks will not be implemented for these species.

Task 10 - Evaluation of Resistance to WS

The Department's Shellfish Laboratory may investigate the effects of withering syndrome in pinto and flat abalones.

Table 6-8. Key locations for recovery of **pinto and flat abalones** in southern California

Area	Block no.	Index	Key location
San Miguel Island pinto and flat abalones	690 & 689	X	Crook Point to Cardwell Point
	689 & 690		Bay Point to Harris Point
	690		Harris Point to Otter Harbor
	690	X	Castle Rock (Otter Harbor to Point Bennett)
	690		Point Bennett to Judith Rock
	690	✓	Judith Rock to Crook Point
Santa Rosa Island pinto abalone	689		Talcott Shoal (Tecolote Point to Sandy Point)
	712		Sandy Point to Cluster Point
	711	X	Cluster Point to South Point
	711	✓	South Point to Ford Point
Santa Cruz Island pinto abalone	685	✓	Cavern Point to San Pedro Point
	685		San Pedro Point to Sandstone Point
	687	X	West Point to Black Point
	687 & 709		Kinton Point to Posa Anchorage
	708	✓	Sandstone Point to Blue Banks
	709	✓	Morse Point to Laguna Harbor (Gull Island)
	709		Albert Anchorage to Laguna Harbor
	709 & 710	✓	Gull Island (Laguna H arbor to Morse Point)
San Diego Area pinto and flat abalones	860		La Jolla (Point La Jolla to Bird Rock)
	860		Point Loma (Mission Bay to Rathay Point)
	860	✓	Point Loma (Rathay Point to Ballast Point)
San Clemente Island flat abalone	867	X	China Point to Pyramid Head

X - Proposed CDFG index recovery site ✓ - External agency monitoring site

6.7 Timelines

There are two timelines in the ARMP, one for the recovery of the abalone resource (presented in this chapter) and one for the implementation of elements of the recovery plan, presented in Section 9.2, Timelines.

Abalone recovery in southern California will probably take many decades. There is doubt whether some species are capable of recovery without human intervention. Many areas where abalone once lived have been without any abalone populations for many years, as a result of local pollution, climatic change, overfishing, and disease. Some of these events continue to occur, making recovery more difficult.

The minimum time for the achievement of Criterion 1 is related to the growth rates of the abalone: faster-growing species will satisfy Criterion 1 more quickly. Red and possibly pink abalones will most likely reach this first level of recovery more quickly than the green, black, and white abalones. The latter two species may take much longer to reach this level because they begin their recovery from very limited populations.

Estimates of time for each species to reach Criterion 1 are given in Table 6-9. The estimates are based on optimum conditions and enhancement activities which would produce the best scenario possible, given the growth rate of each species. The estimates are projections starting from the time recovery activities begin, and do not account for the initial time needed to determine if the recovery activities are worthwhile. Factors such as poaching, El Niños, or other major environmental perturbations will increase the time needed to achieve Criterion 1 levels.

Table 6-9. Estimates for the amount of time for recovery of five species of abalone in southern California. Time estimates for Criterion 1 are based on the estimate of ages at recreational minimum legal sizes.

Species	Criterion 1	Criterion 2	Criterion 3
Red	6-11 yrs [1]	?	?
Pink	14-16 yrs [2]	?	?
Green	14-20 yrs [2]	?	?
Black	20+ yrs [3]	?	?
White	9+ yrs [2]	?	?

[1] Haaker *et al.* 1998
[2] Tutschulte 1976
[3] Haaker *et al.* 1995

For red abalone, the time required to achieve a broad size range may take 6 to 11 years, because the small- and medium-sized abalone will have to come entirely from successful settlement and recruitment every year. This is the absolute minimum time needed to allow newly recruited abalone to grow and fill in the intermediate cohorts of the size distribution. It may take even longer to see increased numbers and size ranges throughout the historic range.

To achieve Criterion 2 and Criterion 3 may take decades, and estimating the time needed to reach them would be purely speculative. Once a species reaches Criterion 1 levels, an estimate of the time necessary to reach the next level of recovery may be possible. Future time estimates for recovery can be added or

revised in the ARMP as recovery progresses and more information becomes available.

6.8 Alternative Approaches to Recovery

During the early stages of resource recovery (before Criterion 1 is met) few alternatives are available (Section 6.2.1.1 Criterion 1 - Broad Size Distribution Over the Former Abalone Range). If early recovery for any given abalone species cannot be demonstrated, the only alternative approach is to propose listing under the federal or state ESA.

Alternately, if recovery progresses successfully, there could be a desire to consider reopening a fishery even though recovery has not reached its goals. Alternate approaches that allow fishing to occur prior to complete recovery (Section 6.2.2.2 Criterion 3 - Fishery Density Level (6,600 ab/ha)) are considered under Section 7.3, Management Alternatives.

6.8.1 Recovery Alternative 1 - Listing of Species That Fail to Recover

If recovery cannot be demonstrated by broadening size ranges or evidence of recruitment throughout a species' former range (Section 6.2.1.1 Criterion 1 - Broad Size Distribution Over the Former Abalone Range), then listing on the state or federal ESA is warranted. Listing would convey extraordinary protection, and perhaps provide further resources to prevent extinction of the species.

Listing under the ESA conveys special protected status to the species at risk, and provides additional resources and funding for further recovery work. Listing endangered abalone species increases public awareness of threats to marine species in general. However, listing under the ESA also increases the possibility of being denied access to the resources and areas occupied by the listed species.

Chapter 7. Abalone Management

7.1 Fishery Management Plan

The management component of the ARMP focuses on the northern California red abalone recreational fishery (Figure 1-1). The concepts described in the plan will be applied to recovered abalone fisheries in the central and southern regions of California outside of the Central California Sea Otter Range. The ARMP recognizes that abalone populations subject to sea otter predation will not support fisheries.

This plan incorporates the basic protective management measures that have been successfully used in northern California, and establishes an adaptive framework for making management decisions in response to changes in stock conditions and fishery patterns. The management plan portion of the ARMP is presented in two phases: an interim plan, which is precautionary and uses available funding and data collection methods, and a long-term plan, which will allow more refined and responsive management, but requires more data. The interim plan will become effective upon plan approval. The long-term plan will continue to be developed, and a timeline for its completion and implementation is presented.

7.1.1 Management Measures

The management measures described here will serve as the basic management program for the current northern California recreational fishery. It will also serve as the basic management program for any future commercial or recreational abalone resource that has recovered.

7.1.1.1 Species-specific Considerations for Management

Management of multiple species of abalone must incorporate species-specific elements in fishery regulation. Size limits, take limits, and management zones, for example, will be based on the biology and status of each species. The use of species-specific elements in fishery regulations is critical and applies to both the interim and long-term management plans. Since 1997, the northern California recreational abalone fishery has been based on red abalone, the only species with abundances that can support a fishery.

7.1.1.2 Gear Restrictions

The prohibition of the use of SCUBA gear and surface-supplied air while taking abalone in northern California established a depth refuge for a part of the red abalone population, because free divers generally do not dive deeper than 28 ft (8.5 m) (Karpov *et al.* 1998).

The required use of a specialized abalone iron to remove abalone reduces damage to the vulnerable foot, thus providing some level of protection. The required possession and use of a caliper-type measuring gauge reduces incidental foot-cutting mortality by ensuring that only legal-sized abalone are removed and kept. These gear restrictions have been mandated in northern California since 1975, and were required in southern California from 1975 until the closure of the fisheries in 1997.

7.1.1.3 Marine Protected Areas

Fish and Game Code §5522(b)(1) provides for a network of no-take abalone reserves, where appropriate. The establishment of marine protected areas (MPAs) to benefit abalone and other resident species may provide an effective way to protect and preserve reproductive populations. Abalone populations in northern California are thought to be protected by a deep water (deeper than 8.4 m, about 28 ft.) *de facto* depth refuge which remains unregulated (Section 2.2.1.1 Northern California Stocks).

Currently, there are five marine protected areas in Humboldt, Mendocino and Sonoma counties (Punta Gorda State Marine Reserve, Gerstle Cove State Marine Conservation Area, Point Cabrillo State Marine Conservation Area, Del Mar Landing State Marine Park, and Bodega State Marine Reserve) that specifically prohibit abalone fishing. Two areas, (Point Cabrillo State Marine Conservation Area in Mendocino County and Bodega State Marine Reserve in Sonoma County) are used as control sites to monitor the effects of the fishery. The remaining areas are inadequate as control sites either because they contain little abalone habitat (such as Punta Gorda State Marine Reserve) or are too small (such as Gerstle Cove State Marine Conservation Area, with less than 0.3 miles coastline).

New MPAs should be established to address the shortcomings of the current MPAs. These shortcomings include lack of consideration for the concept of deep water refuge, and an insufficient range of habitats, which should include shallow and intertidal areas that are currently not well represented. Protecting a wide range of habitats, particularly intertidal areas, could prevent degradation of habitat due to trampling impacts associated with rock picking for abalone (Murray and Denis 1997, Keough and Quinn 1998, Smith 2002). Study areas are needed to increase knowledge of abalone population dynamics, especially:

- Movement between intertidal, shallow, and deep water populations
- Information on source/sink areas and their key features
- The mechanism for replenishment of fished areas
- Information on adult/juvenile abundance relationships

Any newly established protected sites should span a variety of habitat types and depths, because different life history stages may have very different habitat requirements, which could change over time. Establishing a network of MPAs that protect a wide variety of habitats from abalone fishing will give researchers an opportunity to study the spatial dynamics of the abalone fishery, and will help to ensure that productive populations are maintained.

Under the Marine Life Protection Act (FGC §2852), the Fish and Game Commission has developed three designations for the establishment of MPAs to protect and conserve marine life and limit human activities. MPAs appropriate for abalone could fall into any of the three designations: state marine reserves, state marine parks, or state marine conservation areas.

Criteria for MPA development should include or consider, but not be limited to:

- Suitable rocky habitat containing abundant kelp and/or foliose algae
- Presence of sufficient populations to facilitate reproduction. The reproductive biology of abalone suggests that fertilization success is reliant on close proximity, thus high densities of breeding animals could promote reproduction.

- Suitable nursery areas. Nursery grounds have been identified for juvenile abalone: crustose coralline rock habitats in shallow waters which include microhabitats of moveable rock, rock crevices, urchin spine canopy, and kelp holdfasts. Protection of areas with this cryptic habitat may promote juvenile growth and survival until emergence at 50 to 100 mm (approx. 2 to 4 in.) in shell diameter. Areas where invasive surveys find high densities of small abalone (less than 50 mm, or about 2 in.) can be classified as potential nursery areas.
- Oceanographic regimes. The protected lees of major headlands may act as collection points for water and larvae. These areas (for example, the northwest portion of Drakes Bay) may promote the settlement of planktonic larvae, and act as natural nurseries (Ebert *et.al.* 1988).
- Size. Existing MPAs do not provide enough area for large numbers of abalone, nor are they ideal for research regarding population dynamics.
- Accessibility. MPAs need to be accessible to researchers, enforcement personnel, and others with a legitimate interest in resource protection.

Proposed MPA sites should satisfy at least four of the previous criteria.

7.1.1.4 Size Limits

Since 1901, size limits have been a primary tool used to manage abalone. Size limits allow abalone the opportunity to reproduce before becoming vulnerable to the fishery (see Section 2.1.6, Age and Growth, for more information regarding time required to reach minimum legal size).

The minimum legal size for recreationally-taken red abalone is currently 178 mm (7 in.). Fishery models have been used to explore a range of size limits for red abalone. Tegner *et al*. (1989) used yield-per-recruit and egg-per-recruit models to evaluate red abalone size limits, and found that the current recreational size limit is reasonable and conservative.

7.1.1.5 Seasonal Closures

Seasonal closures may be used to protect events such as reproductive periods, or reduce fishing effort and take. The red abalone fishery is closed December through March, and for the month of July. The July closure eliminates effort at a time when take may be high due to calm ocean conditions.

7.1.1.6 Catch Limits

<u>Daily (Bag) Limit</u>

Daily limits are a preferred method of controlling catch in recreational fisheries because they facilitate enforcement efforts. Daily limits prevent concentration of effort and help to distribute the catch throughout the fishing season. Daily limits are also effective in regulating the total fishery catch and a key method of adjusting the total catch to match the total allowable catch (TAC). The current bag limit is three abalone per day.

<u>Annual Limits</u>

Annual limits control total yearly catch by individual fishermen and are another method of adjusting the total fishery catch to match the TAC. If a reduction in total

catch is necessary, however, a reduced annual limit is not as effective as a reduction in daily limit. A reduction in annual limits does not proportionally reduce catch because the annual limit has typically been higher than the average individual catch. Wardens also believe annual limit violations are more difficult to detect than bag limit violations. The annual limit is currently 24 abalone per fisherman.

7.1.1.7 Abalone Take Reporting System

A reporting system for recreational take provides information on individual daily and annual take and the location and date of fishing. In the interim plan, abalone permit report cards are used to report take. In the long-term plan, report cards may be replaced by an abalone tag system (Section 7.1.3.2 New Management Tools).

Abalone permit report cards, commonly known as “punch cards”, were implemented in 2000 to provide information about the recreational fishery and to control annual take. The punch card, which is filled out whenever abalone are taken, provides information about the number, time, date, and location of all abalone taken by fishermen. Until 2002, take was recorded by county. In 2002, 51 discrete sites were added to punch cards to provide specific landing location data.

Punch cards must be returned to the Department by 30 December each year. Data from punch cards are used to identify effort distribution and shifts resulting from local depletion.

7.1.2 Interim Management Plan

The interim management plan is currently used for the recreational red abalone fishery in northern California. This plan uses the available limited resources and data, and must be precautionary. The interim management plan will be used for the northern fishery until the long-term management plan (Section 7.2.1 Northern Management) is developed and implemented.

The interim management plan establishes a fishery-wide adjustable TAC, and a procedure for detecting and closing depleted sites or the entire fishery. The interim plan also provides a method for evaluating the fishery through the use of index sites.

7.1.2.1 Criteria for Evaluating Stock

The interim management plan is based on the best available fishery-dependent and fishery-independent information. A set of stock condition criteria guides the management decision-making process. The criteria include estimates of recruitment, density, catch-per-unit-of-effort (CPUE), and distribution of landings. The target levels for these criteria may be adjusted as better data become available. Criteria are measured at index sites throughout the fishery area (Section 7.1.2.2 Total Allowable Catch).

<u>Criterion 1: Recruitment</u>

Gauging the size frequency of abalone populations may indicate whether large reproductive events have occurred. Size frequency is measured in three size ranges:

1. Less than 100 mm (4 in.)
2. 100 to 177 mm (4 to 7 in.)
3. Greater than 177 mm (7 in.)

Two types of surveys are used to obtain size frequencies and assess recruitment: invasive and emergent. Invasive surveys are used to evaluate juvenile abalone (less than 100 mm) recruitment, but these surveys can be disruptive to the substrate as rocks are overturned and cracks and crevices are examined for small abalone.

Emergent surveys target abalone that are exposed (Tegner *et al*. 1989), and evaluate recruitment of pre-fishery-sized abalone (from 100 to 177 mm) as well as fishery recruitment-sized abalone (greater than 177 mm). Although better population size distribution estimates can be obtained from invasive surveys, they cover much less area than emergent surveys. Therefore, in the data-limited interim plan, emergent surveys are used to assess recruitment densities using size distributions of abalone greater than 100 mm.

A data time series has been collected from Van Damme State Marine Conservation Area that spans a period of strong recruitment. Beginning in 1989, a strong fishery recruitment pulse was detected at Van Damme (Figure 2-1). This recruitment pulse increased the fishable population, which has sustained the local resource over the last decade (Karpov *et al.* 1998). The 1992 fishery recruitment densities from Van Damme were used as the baseline recruitment criterion in the ARMP, because that year's survey provided the most abalone in the size ranges effectively sampled by emergent surveys. Based on the overall 1992 average densities of emergent sub-legal abalone, a density of 4,500 ab/ha in the 100 to 177 mm size range is used to indicate successful recruitment.

Although this density level is higher than typical years, it adds a precautionary measure for increasing or decreasing the TAC. The TAC should not be increased unless there is evidence that a sizeable number of young abalone are present to replace increased catches. Conversely, the TAC might not need to be decreased if there is a sizeable number of abalone present. Because there is uncertainty over what typical levels of recruitment are, this criterion is limited in its use and is applied only in conjunction with the density criterion. No management decisions are based solely on the recruitment criterion. For abalone species that eventually recover and are considered for a fishery, this recruitment measurement will serve as the target until specific data are collected to adjust the appropriate level for each species.

Criterion 2: Density

The interim plan uses two density levels: sustainable fishery and minimum viable population (MVP). The sustainable fishery density is based on estimated densities necessary for a healthy fishery. The MVP level is the threshold below which the population declines.

The sustainable fishery density was estimated from Department surveys conducted between 1999 and 2000 at three fished sites: Van Damme, Fort Ross, and Salt Point State Marine Conservation Areas. An evaluation of deep-water (more than 8.4 m, or 28 ft) density data is used to assess refuge populations (Section 7.1.1.2 Gear Restrictions), while the variation in density across all depths provides an estimate of overall population levels. An average of 6,600 ab/ha was found across all depths, while in refuge (deep) depths, abalone averaged 3,300 ab/ha (Table 7-1). These average densities are used as the best estimate of sustainable densities supporting the ongoing fishery. Surveys conducted in 2003 and 2005 to determine abalone population status confirm these density levels are realistic estimates of abalone densities that can

Table 7-1. Abalone survey summaries, 1999, 2000, 2003 and 2005

	Sustainable density surveys		Population status surveys	
Site	1999-2000 deep density (Abalone/ha)	1999-2000 combined density (Abalone/ha)	2003, 2005 deep density (Abalone/ha)	2003, 2005 combined density (Abalone/ha)
Van Damme	1,400	7,600	5,100	10,700
Salt Point	5,200	8,300	2,800	8,900
Fort Ross	3,200	4,300		
Arena Cove			3,700	5,700
Caspar Cove			5,000	7,500
Averages	3,300	6,600	4,200	8,200

support a fishery (Table 7-1). Van Damme and Salt Point were included in the recent surveys in addition to two new sites at Arena Cove and Caspar Cove. Average densities were higher for the recent surveys compared to 1999-2000. Four more index sites will be surveyed to determine the status of red abalone stocks (See Index Sites in Section 7.1.2.2).

Stocks that fall below the MVP are at risk of collapse (Figure 5.1). A description of how the MVP level was established may be found in Section 6.2.2.1, Criterion 2 - First Density Level (2,000 ab/ha).

Criterion 3: CPUE and Serial Depletion

"CPUE" as used in this section means "the catch obtained per unit of fishing effort"; for example, the number of abalone taken per day. The CPUE and serial depletion criteria are based on the success of fishermen, as determined in creel (fishery-dependent) surveys. The CPUE will be statistically compared to determine if any sites have significantly lower success rates. Because of inter-annual variation in catch success due to ocean conditions, data averaged over several years will be used when making comparisons among sites. Beginning in 2002, abalone permit report cards began providing CPUE information linked to 51 coded areas designated on the cards. When punch card return compliance increases, high-use sites can be determined, and a decision can be made to either augment or replace the CPUE data from the creel surveys with the punch card CPUE data.

Besides CPUE, a measurement of serial depletion at local areas is also used to determine Criterion 3. Serial depletion results when areas are sequentially depleted, beginning at locations close to access points. Serial depletion is reflected in a significant increase in distance that fishermen travel from access points to take locations. Changes in distance traveled over a 4- to 6-year period will be tested for significance against a baseline period from 1990 to 1994. Distances traveled from access points are recorded in creel surveys to the nearest one-fifth nautical mile (CDFG 2001b).

7.1.2.2 Total Allowable Catch

The interim management plan establishes the target TAC at 400,000 abalone per year, based on the projected catch for 2002. Because this TAC was estimated from abalone permit report card returns for a single year (2000), the figure may need to be

revised as more data are accumulated in subsequent surveys (Section 7.1.2.3 Regulation of Actual Catch Levels). The 2002 catch level was projected from the annual and daily limits established by the California Fish and Game Commission in 2001. The limits were intended to reduce the annual catch by 40% from the 2000 level. The interim plan sets this reduced catch level as the TAC in order to conserve stock and protect remaining populations. The TAC can be adjusted based on evidence of recruitment and density conditions at index sites.

Index Sites

In the absence of broad-scale surveys across the fishery range, population conditions at index sites are used as an indicator of stock status in the interim plan. Four heavily fished sites in northern California have been surveyed: Van Damme State Marine Conservation Area and Arena Cove in Mendocino County, and Salt Point State Marine Conservation Area and Fort Ross State Marine Conservation Area in Sonoma County (Figure 7-1). Although the Arena Cove site was not surveyed during the 1999-2000 period for abalone fishery densities, it was surveyed in 2003 and will be included in future assessments.

Because these index sites are heavily fished, they may fall below the MVP level before other sites. Reliance on these sites alone to determine MVP could close the fishery prematurely. Because of this, four moderately fished index sites (Todd's Point and Caspar Cove in Mendocino County, Timber Cove and Ocean Cove in Sonoma County) (Figure 7-1) have been added to the survey protocol. These index sites will be used for assessing fishery-independent criteria used in TAC determination and fishery closure (see *Fishery Closure*, below) in the interim plan. As part of the interim management plan, these index sites will be sampled triennially. These sites will be surveyed more frequently if additional funds and resources become available

Determining TAC Adjustments

The TAC determination table (Table 7-2) is used to adjust the TAC for the fishery, based on changes in average conditions among the index sites. The table describes the combination of criteria that will lead to each of five management actions:

- Increase the TAC
- Maintain the established TAC
- Reduce the TAC
- Close the fishery
- Reopen a closed fishery

The TAC determination table uses two criteria: recruitment and density (at refuge depths and across all depths). References to adjustments in the TAC are from the baseline level of 400,000 abalone per year, or from a revised baseline TAC (Sections 7.1.2.2 Total Allowable Catch, and 7.1.2.3 Regulation of Actual Catch Levels).

Baseline TAC - The baseline TAC will be maintained (Table 7-2, Action 2) as long as densities at the index sites remain within 25% of sustainable fishery densities at refuge depths and all depths (approximately 3,300 and 6,600 ab/ha respectively). This will apply regardless of the prevalence of recruitment because the baseline TAC was established to be effective in the event of a poor recruitment condition.

Figure 7-1. Northern California recreational abalone fishery creel and index survey sites

Table 7-2. Total allowable catch (TAC) adjustment decision table using established criteria. Adjustments to the TAC are from the baseline of 400,000 abalone per year or from revised TAC baselines (Sections 7.1.2.2 and 7.1.2.3)*.

CRITERIA					**ACTION**
Recruitment		**Density (ab/ha) – emergent surveys**			
		Refuge (deep)		All depths	
Yes	AND	More than 4,100	AND	More than 8,300	1) **Increase TAC** by 25% (to maximum of 500,000 ab/yr or 125% of revised TAC)
NA		3,300	AND	6,600	2) **Maintain TAC** (400,000 ab/yr or revised TAC)
No	AND	Less than 2,500	OR	Less than 5,000	3) **Reduce TAC** by 25% increments
NA		NA		Less than 3,000 at all surveyed index sites combined	4) **Close fishery** until stocks are recovered according to recovery criteria **AND** enough data are collected to shift to long-term management plan
NA		More than 3,300	AND	More than 6,600	5) If recovery criteria are also met, **reopen closed fishery** under long-term management plan

* The specific density targets in this table are based upon the best available data at the time of adoption and may be changed without full plan amendment pursuant to Section 4.4.1.
Note: A closed fishery will not be opened unless recovery criteria are met.
NA = Not applicable

Increased TAC - An increase of up to 25% (Table 7-2, Action 1) will be warranted when recruitment is evident and densities at refuge depths and at all depths increase from the sustainable fishery densities by 25% (to more than 4,100 and more than 8,300 ab/ha respectively). An increase beyond 25% would likely result in a bag limit increase to four abalone per day. A bag limit of four has been demonstrated to result in serial depletion in high use and intertidal areas. Given the history of decline in abalone fisheries in southern California and recent concerns about declines in northern California red abalone, a TAC increase greater than 25% is not considered sustainable (see Section 2.2.1.1 Concentration of Fishery Effort and Increased Take). The interim plan operates in a data-limited environment and adjusts take levels with management tools that are crude and that do not account for increases in effort or in the number of fishermen (Section 7.1.2.6). This ceiling value effectively sets the maximum TAC for the interim plan at 25% above the current level (500,000 abalone or 125% of a revised TAC - Sections 7.1.2.2 Total Allowable Catch, and 7.1.2.3 Regulation of Actual Catch Levels).

Reduced TAC - A 25% reduction in TAC will occur if densities decline by 25% from sustainable fishery densities in either refuge depths (to less than 2,500 ab/ha) or all depths (to less than 5,000 ab/ha). If conditions show continued density decline in subsequent 3-year cycles (but have not reached the threshold for fishery closure), then additional 25% reductions in the TAC will be implemented incrementally. If no additional change in density has occurred, no further reduction will be implemented.

Conversely, if densities return to sustainable fishery densities in all depths and refuge depths (6,600 and 3,300 ab/ha respectively), the baseline TAC will be reinstated.

Fishery Closure - The fishery will close when average densities at the surveyed index sites fall below 3,000 ab/ha. This target density for fishery closure is based on the MVP level of 2,000 ab/ha (Criterion 2) with a 50% precautionary buffer. Populations below this level are at a high risk of collapse (Section 6.2.2.1 Criterion 2 - First Density Level (2,000 ab/ha)).

Fisheries that have been closed will be considered for reopening only when recovery criteria are met, and the stock has rebuilt to sustainable fishery densities at refuge depths and all depths (more than 3,300 and more than 6,600 ab/ha respectively). Fisheries will be initially reopened with low TAC levels that can be incrementally increased to former levels over a number of years, depending on stock conditions.

TAC Adjustments in the Event of Site Closures

The interim management plan allows for site closure in the event of localized population declines (Section 7.1.2.4 Site Closure). In the event of a site closure, the TAC will be reduced to address the potential shift in effort to other areas. With discrete area codes from the report cards, an estimate of specific site productivity can be determined and the TAC can be adjusted. However, an adjustment in the TAC would not completely protect areas outside the site closure from effort shift and subsequent population declines.

7.1.2.3 Regulation of Actual Catch Levels

Total allowable catch levels in the interim plan are based on projected catch levels. Altering TAC can only be accomplished using existing management tools, such as daily and annual take limits, and seasonal closures. These tools do not allow for the precise adjustment of TAC.

When TAC is adjusted, projections for daily and annual limits aim to maintain catch levels consistent with the new TAC. For example, a 25% reduction from the baseline TAC could be accomplished with a daily limit of two abalone and an annual limit of 28 abalone (Table 7-3), with a projected take reduction of 24%. Because only certain percent reductions can be accomplished with combinations of daily and annual limits, additional seasonal closures will be used to augment catch reductions if necessary.

Table 7-3. Projected changes (percent) in the baseline total allowable catch (400,000 abalone) with various combinations of daily and annual limits. Projected changes are only shown for annual limits that can be achieved with a given daily limit.

Daily Limit	**Annual limit**											
	8	**9**	**10**	**12**	**15**	**16**	**18**	**21**	**24**	**28**	**30**	**32**
4	-22			-15		+7			+37	+49		+59
3		-59		-44	-32		-10	-5	0		+22	
2	-71		-61	-56		-46	-34		-29	-24	-22	-12

The actual catch will need to be continually monitored and compared to the projected catch (set in accordance with the TAC) to ensure that the desired catch level is not exceeded. For example, the baseline TAC of 400,000 abalone per year represents a 40% reduction to the fishery from year 2000 catch levels. The abalone permit report cards from the year 2002 will be used to determine if the regulatory changes for bag limits (reduced to three abalone per day and 24 abalone per year) achieved the desired 40% reduction in catch. If the TAC is exceeded, then additional take restrictions or seasonal closures will be implemented as part of the Commission's triennial recreational regulation change cycle. If current catch levels estimated from returned abalone permit report cards and random telephone surveys are more than 50,000 below the 400,000 baseline TAC, a new baseline TAC will be calculated by averaging the estimated actual catch for the most current three years.

7.1.2.4 Site Closure

Other than established reserve areas (Section 7.1.1.3 Marine Protected Areas), local sites have not been closed to abalone fishing in northern California to date. However, site closures may be necessary to respond to localized depletion before stock size falls below MVP. Failure to close depleted sites can lead to collapse of local abalone populations (Karpov *et al.* 2000).

Creel Survey Sites

Fishery use is not evenly distributed, and some sites are more or less productive. More productive sites will be monitored annually in fishery-dependent creel surveys to gather information on catch levels and patterns of take. Each creel site that shows indications of stock decline (in other words, lower CPUE or increases in distance traveled) will become a candidate for site closure (see Decision Framework for Site Closures, below). If a creel site is closed, a comparable non-surveyed, high-use site may be established as a new creel site. Any new creel sites will be selected using detailed site-specific report card information (Section 7.2.1.1 Fishery-dependent Data).

Currently, eight fished sites (Figure 7-1) are monitored biennially in creel surveys in northern California. These sites have been monitored since 1975, and were established because they are thought to be among the most highly used locations. Abalone report card returns have verified that these are high-use sites. The Fort Ross Reef area and Van Damme State Marine Conservation Area were the two most heavily used sites according to abalone permit report card data, and Salt Point State Marine Conservation Area was the fourth most heavily used site. Four of the other creel survey sites were in the top 20 most heavily used sites. As more resources become available, additional creel survey sites may be included.

Decision Framework for Site Closures

The site closure criteria presented in Table 7-4 will be used to determine whether sites should be closed due to low density, and whether previously closed (but recovered) sites should be reopened. Two criteria are used in this decision table: density and CPUE/serial depletion.

When a site demonstrates a significant decrease in CPUE or a significant increase in distance traveled from access points to take locations (Criterion 3), density surveys will be conducted to determine if densities are approaching the MVP. Because

Table 7-4. Site closure decision table using established criteria*

CRITERIA				**ACTION**
Density (ab/ha) - emergent			**CPUE and Serial Depletion**	
Refuge (deep)		All Depths		
NA		NA	Significant decrease in CPUE, or increase in distance traveled	Density **surveys** to determine if closure is warranted
NA		Less than 2,500	NA	**Close** affected site and reduce baseline TAC
More than 3,300	AND	More than 6,600	NA	**Reopen** closed site

* The specific density targets in this table are based upon the best available data at the time of adoption and may be changed without full plan amendment pursuant to Section 4.4.1.

CPUE data can be affected by factors other than low population densities, these data are only used as a trigger for density surveys and not for closing a site.

If diver surveys at any site show densities below 2,500 ab/ha (the MVP level of 2,000 ab/ha with a 25% precautionary buffer), that site will be closed to fishing. A 25% precautionary buffer is sufficient for individual sites because precautionary measures do not need to be as great when risking the loss of a single site as opposed to the entire fishery, which has a closure density of 3,000 ab/ha (Section 7.1.2.2 Total Allowable Catch). A lower precautionary buffer for individual sites will prevent unnecessary site closure due to sampling variance.

If diver surveys at a closed site show that sustainable fishery densities (more than 3,300 ab/ha at refuge depths and more than 6,600 ab/ha at all depths) have been reestablished, reopening of that site will be considered. However, no closed site will be reopened unless the entire range of the fishery meets the minimum criteria for an allowable fishery (as established under the recovery guidelines and the TAC adjustment decision process presented in Table 7-2).

Implementation of Site Closures

When a site is closed due to abalone stock declines, enforceable site boundaries (easily recognizable to both the public and enforcement staff) will be defined surrounding the site and its coastal access point. The extent of the closure area will be determined as the area encompassing most of the effort at the site, based on creel survey data. Adjacent areas that can be reached from other access areas will not be included. When transiting a closed site with abalone taken legally outside of that site, all abalone fishing gear must be stowed and not readily accessible for use. Because coastal access points are limited, this restriction will protect abalone at the closed site and limit take in adjacent areas that may have been impacted by fishing.

7.1.2.5 Interim Management Regulatory Time Frame

The interim plan will be implemented upon plan approval. The necessity for regulatory change will be reviewed every 3 years, corresponding with the Commission's recreational fishery regulatory review cycle.

The eight index sites will be surveyed every three years depending upon

available funding to obtain fishery-independent data. The eight high-use sites will be creel surveyed every other year to collect fishery-dependent data.

Adjustments to the TAC will be evaluated every 6 years and implemented with the approval of the Commission. The 6-year period provides an opportunity for catch to stabilize after new regulations are implemented. Regulatory changes that adjust catch levels (to ensure that the TAC is not exceeded) may occur every three years as part of the Commission's regulatory review process. Closure (Section 7.1.2.4 Site Closure) or lowered limits (Section 7.1.1.6 Catch Limits) for high-use sites can occur on 3-year cycles as part of the Commission's regulatory review process.

Fishery closure can occur during any triennial review cycle, or as an emergency action at any time when the condition of the stock is jeopardized.

7.1.2.6 Limitations of the Interim Management Plan

The interim management plan provides a logical decision framework for managing the fishery given limited data availability. However, the interim plan is restricted by the data-limited environment in which it operates, as well as by the imprecise regulatory tools upon which it relies.

The limited data available during the interim plan results in broad spatial and temporal scale management. The data used to determine overall stock conditions provide bases for making fishery-wide management decisions; however, they do not necessarily provide bases for evaluation of conditions at individual sites, and may not be representative of the entire fishery range. In addition, since the TAC applies to the entire fishery range, a large portion of the TAC can potentially be taken from a small number of high-use sites. The ability to close individual sites is meant to compensate for this limitation by providing a mechanism for local management action. However, the ability to close these sites is an all-or-nothing tool which is unable to locally scale down take to maintain site sustainability. Furthermore, the fishery-dependent data used in site closure decisions must be analyzed over a number of years to take into account the data's high variance. As a result, site closure can only be implemented on a 6-year cycle, with possible delays between population impacts and subsequent management actions.

The imprecise methods used to control take in the interim plan (daily and annual limits with the option of seasonal closures) have several disadvantages. These tools do not allow for fine scale TAC adjustments. Although the information provided in Table 7-3 implies that small adjustments can be made, TAC changes must be made in large increments (for example, 25% of the TAC) because current management constraints do not allow finer adjustment. In addition, the tools cannot absolutely limit take, because actual catch levels will depend on ocean conditions as well as the number and behavior of fishermen in any given year. The catch resulting from any set of daily limits, annual limits, and seasonal closures can only be estimated from the previous year's abalone permit report card and creel data, and is an approximation at best. If conditions or fishing behavior differ from the previous year, the projected catch may be exceeded. The actual catch must therefore be periodically compared to the TAC, and may be adjusted with additional regulatory changes. Because further adjustments must occur during subsequent Commission review periods, there is an implicit three-year delay in the review and adjustment process. Finally, the daily and annual take limits are difficult to enforce, which may cause the possible underestimation of both the projected and actual catch.

7.1.2.7 Scenario for No Fishery-independent Monitoring

In the event all fishery-independent index sites are not sampled as scheduled (Chapter 9, Implementation (Activities, Timelines and Costs)), a more precautionary TAC should be established. Relying on fishery-dependent data increases the chance of not detecting actual declines in stock and recruitment. A more precautionary TAC than is currently used would be applied under this scenario. The TAC would be reduced incrementally by 25% (initially, for example, to 300,000 abalone per year) to achieve this more precautionary management. It is still possible that under this scenario, an impending stock collapse would go undetected.

7.1.3 Long-term Management Plan

The long-term plan will use many of the elements of the interim plan including criteria for stock status and TAC. However, to address the limitations of the interim plan, the long-term management plan will also establish management zones and develop new management tools to improve control over local take. These improvements will require increased financial support for survey efforts, management and enforcement, which will move abalone management from a data-limited condition to one that is data-rich, and allow for more refined controls. With increased information, the long-term plan can be less precautionary than the interim plan. Elements of the long-term plan such as zones and increased surveys will be developed and put into use before complete implementation of the plan.

Implementation of the long-term plan is not expected before 2011 and will require resources to support assessment and management that are currently unavailable. Any future reopening of a closed area, including the currently closed central and southern areas of California, should be managed under the long-term plan. Any other approach would require a large precautionary buffer.

7.1.3.1 Zonal Management

Zonal management allows increased flexibility in controlling levels of take within the fishery. The general strategy for zonal management is to divide a resource into regional sub-units that can be managed more effectively than a single unit. A TAC for each zone can be calculated using fishery-independent data or existing take levels derived from abalone permit report card data. Managers have the option to close areas or reduce take as local populations decline, while keeping open those areas with healthy populations. Requirements for effective zonal management include information about the status of the fishery in each zone and effective enforcement.

Zone boundaries will be based on abalone reproductive characteristics, fishing effort, habitat quality, and enforcement considerations. While zone boundaries are not likely to change as characteristics change, they are adaptive and can be changed if needed for more effective management. The number of zones will depend in part on the resources available to adequately monitor them using fishery-independent survey sites. The main sources of data for defining zones will be abalone permit report card summaries, kelp surveys, habitat mapping, and fishery-independent surveys.

7.1.3.2 New Management Tools

Tags

A tag system, similar to that used in wildlife management, could be used to limit the total number of animals taken from a zone and to identify legally taken animals. For abalone management, tags would be issued for a specific zone, as with deer tags, and unused tags and abalone permit report cards would be returned to the Department at the end of the season. Abalone tags would likely be thin, flexible plastic strands which would be threaded through open holes in abalone shells and locked in place. By designating the number of tags issued for each zone when the TAC is established, managers could control the number of abalone removed from a zone. Tags would be conspicuous so that legally taken abalone could be readily distinguished.

A tag system would require additional effort on the part of the Department and the fishermen for administration, distribution, and compliance, and may require lotteries for tags from popular zones. Manufacturing and inventory control of nearly 500,000 tags, coded by zone, would be an added expense.

Zone-based Abalone Permit Report Cards

An alternative to tags may be abalone permit report cards that are only valid for specific zones. By limiting the number of cards issued in a zone, managers would control the TAC for each zone. The advantages of this system are that fishermen would not have to handle and apply tags, and the Department would not have to distribute tags or have them manufactured. However, zone-based report cards do not have the enforcement advantages of tags.

7.1.3.3 Data Sources and Refinements

Information useful to the management of the northern California fishery is obtained from fishery-independent diver surveys at index sites, fishery-dependent creel surveys, permit report card data, and telephone surveys. It is recognized that more and better information is needed to improve fishery management, but current fiscal and personnel limitations prevent improvement.

Diver surveys provide the best scientifically based data for the management of the northern California fishery. These surveys are fishery-independent, and when conducted in a statistically significant manner provide the best indicators of the health of the abalone resource.

Diver surveys can assist in defining the resource and the fishery, including the condition of deep water populations within *de facto* refuges, movement studies, and the condition of abalone populations in general.

In the absence of fishery-independent information, several fishery-dependant surveys have been developed to address specific aspects of the fishery (Section 7.2.4.1 Fishery-dependent Monitoring). Creel surveys, which are on-site surveys of fishermen's take, have been conducted since 1975 and provide the best time series of abalone fishery data available. There are currently eight high-use sites monitored by creel surveys. These surveys can address size distribution of the catch to determine whether an area is being fished down to the legal size, and may be useful in addressing how far fishermen go to find their catch. While these data are useful in determining how many abalone are being taken at a location, they reveal nothing about the non-fished part of the resource. Improvements to creel data collection under the long-term plan include

increasing the frequency of surveys and expanding the surveys to include individuals using vessels.

The abalone permit report card is another source of fishery-dependent data that addresses take throughout the fishery. Over time, it is hoped that a dynamic picture of the catch can be determined by viewing trends in the location of take.

Abalone permit report card data have the advantage of large sample size and wide area coverage, but depend on the accuracy of reporting by fishermen. These data also lack the information on abalone size and precise take location that creel data can provide. They also do not provide information on sub-legal abalone abundance, which can be provided by fishery-independent data. Under the interim system, accurate catch data from abalone permit report cards are needed to monitor how well regulations maintain the total take within the TAC. In a tag-based system, the abalone permit report card, and the telephone interview program would still be useful in providing information on CPUE and catch distribution within a zone. This information is critical to the long-term plan. A primary improvement will be a point-of-sale system that enables the Department to block sales of new abalone permit report cards to fishermen who failed to return their cards the previous year.

7.1.3.4 Closing and Reopening Fisheries

An existing fishery will be closed if half the zones have been closed due to low abalone abundance as established through fishery-independent surveys. This provision may help prevent a repeat of the collapse of the central and southern California abalone fisheries, in which abalone populations were sequentially depleted until populations in all but the most remote island areas had been extirpated.

A fishery may be reopened when 75% of the zones have reached sustainable fishing levels (6,600 ab/ha). Long-term management will provide controls and responses to changes in local stock conditions. This may prevent future stock collapse and reduce the likelihood of closures that would have been made under interim management.

7.1.3.5 Long-term Plan Timeline

Implementation of the long-term plan is targeted for 2011. Before implementation, elements of the long-term plan will be initiated, including analysis of diver, creel, and permit report card surveys. After report card data are analyzed in 2007, zones will be established as outlined in Section 7.1.3.1, Zonal Management. TAC adjustments and possible closures for each zone will be made as described for the whole fishery in the interim plan (Section 7.1.2 Interim Management Plan). An increased number of survey sites will be established if funding is available. Implementation will depend upon the resources available for monitoring, and an evaluation of the usefulness of zones in management.

7.1.4 Reopening of Recovered Fisheries

Fish and Game Code §5522 states that the Department may apply to the Commission for the reopening of recreational or commercial fishing in all or any portion of closed areas if the Commission finds that the resource can support abalone harvest. Under the ARMP, reopening of recovered fisheries should occur under the long-term management plan following a planning process that ensures sufficient resource data are collected for effective management (Section 7.1.3, Long-term Management Plan).

The former central and southern California abalone fisheries are currently closed due to stock collapse. The five species of abalone that were fished in central and southern California (red, pink, green, black, and white abalones) are all in need of recovery at this time. Once the final ARMP recovery criterion is met for a species, reopening of a fishery for that species may be considered. Northern California red abalone currently supports a recreational fishery. In the event that the northern California fishery is closed, reopening following recovery may take place under the guidelines established here.

7.1.4.1 Planning Process for Fishery Reopening

When stock levels at three-quarters of the sites where recovery success is measured meet the management criteria for sustainable fishing densities (6,600 ab/ha), a planning process for fishery reopening will begin.

Fisheries that have been closed should be reopened under the long-term management plan. Therefore, the information required in the long-term management plan should be determined as part of the fishery planning process; this information includes the development of zone boundaries and zone-specific TACs based on stock conditions. An economic assessment will also take place to ensure that there are adequate resources to enforce regulations and assess populations throughout the fishery range.

For fisheries in southern California, additional planning will occur. For example, resource allocation between recreational and commercial fisheries must be determined and a network of no-take reserves should be established prior to reopening any southern California fishery.

The information developed during the planning process will be incorporated into the ARMP through plan revision or amendment under Commission authority prior to reopening any fishery.

7.1.4.2 Application of the Long-term Plan to Reopen Fisheries

When fisheries are reopened, allowed take will be gradually increased over a period of six years, with a 25% increase in fishing per year (in each zone) until the established TACs are met. This allows for a precautionary approach to the reopening of the fishery to ensure effective implementation of management and enforcement efforts needed to protect the stock.

The following sub-sections describe how long-term management components should be applied to reopened abalone fisheries. At this time specific details are premature since recovery to fishery levels may require decades.

<u>Species-specific Management Elements</u>

Before considering the opening of a fishery, the recovery and management criteria must be met for a species. The guidelines of the long-term plan may be used for management of all species. If used, specific regulations such as zone boundaries, size limits, or zonal TACs may vary by species. Each Region may contain fisheries for more than one recovered species, each individually managed.

<u>Zone-based Management</u>

The establishment of fishing zones is important for long-term management. Absent this tool, large precautionary buffers will be necessary. Species-specific zones

should be established within a fishery Region prior to a fishery reopening. Zone boundaries will be based on abalone reproductive characteristics, fishing effort, habitat quality, and enforcement considerations. However, because the Southern California Region and the Central California Region outside of the Central California Sea Otter Range are not currently fished, zone boundaries cannot be based on fishing effort. Therefore, zone boundaries will be determined by abalone distribution, the quantity of abalone habitat, and enforcement considerations.

The long-term plan suggests that in order for a Region to be opened, at least 75% of the future management zones in that Region need to meet the recovery and management criteria. This specification will apply to any reopened fishery regardless of the number of zones established.

Zonal Total Allowable Catch

Under the long-term plan, TACs will need to be established for each zone. In the Southern California Region and Central California Region outside of the Central California Sea Otter Range, TACs cannot be based on former catch levels within a zone, as those levels were not sustainable. As a result, zonal TACs will likely be determined from data on abalone population densities and available abalone habitat. The determination of TACs will therefore require enough data collection (through diver surveys and habitat mapping) in each zone to determine the amount of abalone that can be sustainably fished.

7.1.4.3 Management Regions

Northern California Region

The Northern California Region, which extends from the California-Oregon Border south to San Francisco Bay, will be maintained as a recreational-only fishery (FGC §5521.5). If the Region is closed to fishing in the future under the interim plan, it would be reopened under the long-term plan as a recreational-only fishery. The Department has begun to develop a long-term plan scheduled for completion by 2011 (Chapter 9 Implementation (Activities, Timelines, and Costs)). Since a fishery exists in northern California, catch and other information will be used to determine zonal boundaries and their respective TACs if a closure occurs.

Central California Region

The Central California Region extends from San Francisco Bay to Point Conception, including the Farallon Islands. The area between Point Año Nuevo (San Mateo County) and Point Conception (Santa Barbara County) encompasses the Central California Sea Otter Range, where natural predation has reduced abalone populations to well below minimum legal size. These populations cannot support a fishery. The remaining area of the Central California Region consists of two management zones, the Farallon Islands and the otter-free mainland coast between Point Año Nuevo and the San Francisco Bay entrance.

Two potentially fishable abalone species exist in the Central California Region: red and black abalones. However, the black abalone is at the periphery of the species range in central California, and the risk for population collapse under fishing pressure is high. Therefore, only red abalone will be considered for a fishery in the Central California Region.

If recreational and commercial fisheries for recovered red abalone are reopened in central California, management should be based on models developed for re-opening the southern California red abalone fishery, and the issue of resource allocation should be addressed at that time.

Southern California Region

The Southern California Region extends from Point Conception to the border with Mexico. Although future management of the southern California fisheries will be similar to that in northern and central California, some components of management will vary due to differing abalone distribution and the possibility of a more extensive commercial fishery than the one that may occur in central California. Southern California is also the only Region where more than one species may be fished.

With the exception of pink abalone, abalone depth distributions in the Southern California Region do not mirror those in the Northern and Central California Regions. Depending on the species, the stock is either mostly at refuge depths (red and white abalones) or exclusively at shallow depths (black and green abalones). As a result, *de facto* depth refuges (created by allowing only free-diving) that have been critical in providing protection to a portion of the red abalone stock in the Northern California Region would not work for any species other than pink abalone in the Southern California Region. Therefore, prior to opening a fishery for red, white, black, or green abalones in this Region, a network of reserves should be established in appropriate habitat that provides a level of protection similar to that provided by the depth refuge in the Northern California Region. When this network is in place, all recovery and management criteria have been met, and the fishery planning process has been completed, fisheries that allow the use of scuba or surface-supplied air may be reopened in the Southern California Region.

Because the possibility for a commercial fishery still exists in the Southern California Region, resource allocation between recreational and commercial fisheries will need to be determined for each species under consideration prior to fishery reopening. Ultimately, resource allocation is a political decision that can most readily be addressed when populations have recovered and the number of potential resource users is known.

7.2 Research Protocols - Managing a Sustainable Fishery

The essential fisheries information (EFI) requirements of the management plan, particularly for the decision tables (Tables 7-3 and 7-4), define the main elements of the research plan. Research protocols are divided into northern, central and southern management, and further sub-divided into fishery-dependent and fishery-independent elements. Within these elements, interim and long-term management plan research protocols are described. Northern and Southern California Regions are treated separately due to their different management and research histories. The Central California Region, outside of the Central California Sea Otter Range, falls under the research plan for the Southern California Region. Unlike traditional fishery management strategies, active adaptive management requires more frequent feedback than that provided through a largely passive approach, in order to make adjustments to fishing levels as biological reference points are met (Hilborn and Walters 1992).

7.2.1 Northern Management

Consistent with each fishery management plan developed by the Department since the adoption of the Marine Life Management Act, the northern research protocol section shall identify EFI including relative abundance and size frequency, age and growth, minimum size at maturity, and spawning season. Ongoing and future information to be collected as well as methods to be used will be described. The ARMP suggests continued improvement in fishery monitoring and assessment, as well as collaboration with outside entities in the collection of EFI.

7.2.1.1 Fishery-dependent Data

Interim Management Plan

The interim plan calls for the maintenance of current fishery-dependent information gathering systems. These include recording catch and effort data from abalone permit report cards by location, and estimating total catch and effort for the fishery annually. This post-season estimate will be compared to the TAC to assess the effectiveness of the take regulations in targeting the TAC. There have been about 40,000 report cards issued annually since inception. Return rates since 2000 have been poor, ranging from 18% to 43% of the cards returned each year, despite the legal requirement to do so. It is anticipated that with improved return rates and the ability to randomize sampling, report card information from 51 discrete access points will provide a vastly improved picture of the distribution of abalone catch, effort, and catch success (CPUE) along the fishery coastline and throughout the season. This information will be valuable in assessing the abalone stock in the vicinity of individual access points, and subsequently in directing survey efforts to areas of concern, leading to the possibility of area-specific regulation changes.

At this time, the creel survey is conducted biannually at minus tides (mostly in the spring months) to assess catch, effort, abalone condition, and demographic data (Section 7.1.2.4, Creel Survey Sites; Figure 7-1). This survey can be coordinated with other surveys to obtain independent estimates of effort and take. In the late 1980s, coordinated efforts were undertaken with the federal Marine Recreational Fisheries Statistics Survey to estimate catch and effort prior to the inception of the abalone permit report card (Karpov 1991). Coordination may need to be maintained as an independent check of the reliability of the permit report card database, especially in the initial years of the card's implementation.

One of the unique features of the creel survey is its ability to pinpoint diver and shore-picker catch and effort locations within a 0.2 nautical mile grid in the vicinity of the creel sites. This information is used in a variety of ways, particularly as a criterion in assessing the level of serial depletion at each site, for use in the management decision table.

Long-term Management Plan

Both the creel survey and the permit report card system can be improved to better monitor and allocate abalone catch and effort. Implementation of a zonal management system in the future would require an increased capability of monitoring catch and effort. In the event of the closure of one or more zones, it may be necessary to reduce the total TAC to avoid a shift of effort to the remaining open zones. The abalone permit report card could be linked to a tag system in which a predetermined

number of tags are issued each year, with the total number of tags corresponding to the TAC.

The creel survey could also be improved by use of a stratified random survey during the fishing season to improve the accuracy of the estimated parameters by reducing minus-tide bias and including access points other than the historically surveyed ones.

7.2.1.2 Fishery-independent Data

Fishery-independent data, information collected from sources not connected to the fishery, often provide the most complete information about a resource. Although these data are often more costly and difficult to obtain, they are necessary to effectively manage the fishery. These data will be obtained from the assessment and monitoring of populations at established index sites, from other research agencies such as the Channel Islands National Park (CINP), the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), Cooperative Resources Assessment of Nearshore Ecosystems (CRANE) and others, as well as from programs involving constituents in research activities.

Fixed index transects and broad-scale random transects provide two sampling approaches which have specific advantages and disadvantages. Index transects are better at providing the relative change in variables between sampling periods and can reduce sampling variance and cost, while random (or variable) transects are better at estimating the actual average value of the measured variable over the area (Carr *et al.* 2001). A combination of GPS-based fixed and random transect sites offers the benefits of both approaches and will be incorporated into the state-wide, multi-species sampling program currently being developed.

Constituent involvement may be helpful for certain assessment methods such as timed swims, where the number of abalone counted per minute of diver search time is recorded. This information can be used to detect qualitative population trends over time, but is not a density-based fishery assessment. Timed swims may have particular utility in southern California, where study areas are large and abalone populations are too depleted to effectively assess with traditional area-based methods.

<u>Interim Management Plan</u>

If funding for monitoring index sites is increased, the interim management plan will include monitoring the four previously used index sites and four additional sites in northern California. The index sites will also be sampled at an increased frequency. The basic data collected along transect lines will include the relative abundance (density) and size frequency of emergent abalone as well as sea urchins. Densities of pinto abalone, flat abalone, and purple sea urchins will be recorded. Densities of certain associated organisms, the species and percent cover of algae, and substrate characteristics will also be determined along transect lines. During the interim phase, eight sites (four sites in Mendocino County and four in Sonoma County) will be surveyed on a three-year cycle. At each site, transect placement will be stratified by depth, with the dividing line between shallow and refuge categories at 8.5 m (approximately 28 ft).

If fishery-dependent data at a site indicate a statistically significant decline in CPUE, a fishery-independent survey will be initiated to assess the population. Protocols for transect placement and survey methods will be similar to those at the

index sites. In 2008, a diver survey may be implemented at James V. Fitzgerald State Marine Park in San Mateo County to assess the recovery of depleted populations along this closed section of coastline. If criteria for recovery have been met, the frequency of surveys in this area may be increased in preparation for long-term management.

Long-term Management Plan

The research protocols for this phase of the plan call for the augmentation of interim plan protocols with additional survey sites, which are stratified and randomly sampled during a three-year cycle. The number of additional sites would be a function of future need (for example, according to the number of management zones) and the accompanying cost. However, these additional sites could be surveyed by the Department's pool of research divers. Protocols for transect placement and survey methods will be similar to those used for the index sites. Selection of the sites would be random within particular strata, which might include management zones in the future. Long-term protocols will entail coordination and collaboration with various agencies such as PISCO in order to maximize efficiency and minimize redundancy, and to perform assessments for other managed species.

7.2.2 Central and Southern Management

The recovery of southern California's five abalone species will be monitored by the Department and its collaborators using protocols described in Chapter 6, Abalone Recovery. The Central California Region, outside of the Central California Sea Otter Range, falls under the research plan for the Southern California Region.

In the event of recovery to sustainable fishery population levels at key index sites, these protocols will be changed. Sampling will continue at the same index sites, but will be shifted to density-based sampling, similar in design to the fishery-independent protocols described for the northern California fishery. There will be separate index sites for each species. The much larger habitat area and species diversity of southern California make management monitoring much more challenging than in the northern part of the state. The collection of EFI will be exclusively fishery-independent for the short-term and well into the long-term, due to the absence of fisheries for these species in the foreseeable future.

Reopening closed fisheries requires the implementation of long-term management. An interim management plan for southern California abalone populations will not be needed due to the paucity of manageable populations. Monitoring will be conducted in collaboration with agencies such as CINP and PISCO. At this time it would be premature to design a fishery-dependent monitoring plan without knowledge of the resource allocation system.

7.2.3 Future Research

Future research areas include:

- Improving estimates of abundance, both of the total population and of individual size classes in order to improve calculation of sustainable catch levels
- Obtaining reliable estimates of essential habitat area for use in direct stock size estimates

- Improving knowledge of key population parameters such as growth, mortality and recruitment rates, and defining the stock-recruit relationship for each abalone species, which is essential information for abalone population modeling

As better information becomes available, it will be possible to develop and adjust a system of zone-based decision criteria in the long-term management plan to reflect this improved understanding of abalone population dynamics.

In addition, it may be valuable to determine aggregation indices (patchiness factors) to examine the effect of low densities on abalone behavior and reproduction, and to determine how easily abalone may be taken under these conditions (Post *et al.* 2002). Since fertilization success depends on adequate densities of abalone, maintaining these aggregations may be important to ensure sufficient larval production. More information about the effect of El Niños and other environmental fluctuations on abalone reproduction and disease will aid in developing better fishery management plans. Knowledge of the genetic structure of abalone populations, such as the numbers and size of the individual populations, should be integrated into management models. Additionally, ecological interactions including feeding, spatial, and behavioral relationships should be factored into future abalone management. Future research will include the use of ROV survey techniques in order to extend the survey depth-range and area.

7.2.4 Summary of Past and Current Fishery-dependent Monitoring and Fishery-independent Assessment

7.2.4.1 Fishery-dependent Monitoring

Since 1975, the Department has relied on creel surveys at sites along the northern California coast to obtain estimates of catch and effort. Beginning in 1998, the abalone permit provided managers with the total number of potential abalone harvesters in a given year. With the introduction of the abalone permit report card in 2000, the Department has gained a potentially more accurate means of measuring effort and take by county, month, and day. In the previous southern California fisheries, the commercial passenger dive boat (CPDB) log book system was used to estimate the number of passengers per dive boat and the total number of abalone landed by each boat.

<u>Creel Surveys of Recreational Abalone Fishermen</u>

Creel surveys were initially conducted in 1960 and 1972 in central and northern California and have been conducted on a continual basis since 1975 in Sonoma, Mendocino, and Humboldt Counties (Miller *et al.* 1974; Karpov 1991; Tegner *et al.* 1992). Typical survey information includes size of abalone taken, take per fisherman-day (or take per trip), take per hour, the number of sub-legal abalone returned per fisherman-day, and catch location. These surveys are generally conducted in areas where a high level of effort is expected each year, and a historical time series can thus be created for comparison. Sampling focuses on minus-tide periods in the spring, to maximize encounters with recreational fishermen. Retained abalone are examined for the type and degree of cuts to the foot; this can be used to estimate expected mortality of returned abalone.

Abalone Permit Report Card Returns

In 2000, only about 10,000 permit report cards were returned out of 39,347 sold, despite the regulatory requirement to return cards. Even with this large sample size, returned cards may not be representative of the entire population of abalone fishermen; thus, catch and effort statistics are affected by an unknown degree of bias. Telephone surveys are used to address this bias (see Telephone Surveys, below). Total catch, trips, and CPUE by county and date can be calculated accurately for the first time in the northern California recreational abalone fishery. In addition, a demographic database of fishery participants allows tracking of fishermen's county of residence, and can be used for targeted surveys and questionnaires.

Telephone Surveys

Random telephone surveys of households in central and northern California were used from 1986 through 1989 to estimate the number of abalone trips and abalone caught per household. Sample sizes were small since relatively few households contained abalone fishermen. A database was created from receipts for permit report cards and is used for random telephone surveys targeting abalone fishermen. The random telephone surveys are needed to check for bias in the returned cards and to collect data that are not available from the cards, such as numbers of unsuccessful attempts to catch abalone (Section 7.1.2.1, Criterion 3: CPUE and Serial Depletion).

Commercial Passenger Diving Boat Log Book System

A detailed analysis of CPDB red abalone catch and effort data in southern California is available for 1978 through 1987 (CDFG 1991, 1993b). The CPDB log book information from southern California presents catch and effort data combined for entire boat-loads of fishermen, whereas the northern California recreational fisherman creel survey presents catch and effort data for individuals or small groups of fishermen.

7.2.4.2 Fishery-independent Assessment

Underwater surveys allow the estimation of size-selective, relative and absolute abundance by combining size measurements and abalone counts per unit area with estimates of the extent of habitat. The latter can be derived using side-scan and multi-beam sonar. The tagging of individual abalone in their habitat provides information about age, growth, and movement patterns, while the use of abalone recruitment modules can provide an index of annual recruitment.

There are two main types of area-based underwater survey techniques for counting abalone: emergent and invasive. For both techniques, abalone are counted and measured on either side of a transect line of fixed length and width. Both types of surveys are normally stratified by depth. Invasive surveys are intended to find both cryptic (hidden) and emergent (exposed) juvenile and adult abalone, while non-invasive surveys assess emergent abalone only (Parker *et al.* 1988; Tegner *et al.* 1989). Invasive surveys are performed using flashlights, and involve overturning rocks and other seafloor habitat generally within a 2 x 5 m (7 x 16 ft) transect. Emergent surveys are performed without using flashlights or disturbing the habitat, generally within a 2 x 30 m (7 x 96 ft) transect, and tend to underestimate the number of cryptic, pre-emergent individuals (Parker *et al.* 1988; Tegner *et al.* 1989; Davis *et al.* 1992; Karpov personal communication). In recent years, ROVs have shown promise for emergent surveys, as

technicians use visual records obtained by ROVs to determine abalone counts and size measurements.

Since 1983 CINP has conducted emergent abalone and invertebrate surveys at 16 locations within its borders. Stations were established cooperatively with the Department and other scientists in areas thought to be representative of kelp forest communities on each island. Ten to twelve random, 3 x 20 m (10 x 66 ft) transect surveys have been conducted annually at each station, providing counts of exposed abalone and major invertebrates (Davis 1988, 1989a; Davis *et al.* 1992). Studies conducted at Johnson's Lee on Santa Rosa Island from 1978 to 1982 also included invasive diver surveys to find both cryptic and exposed abalone within a fixed area (Tegner *et al.* 1989).

An alternative to area-based surveys is counting animals per unit of search time underwater, or timed swims. This method has been used in southern California for several decades by the Department in areas where abalone densities are too low for traditional transect-based methods to be practical. In 1999, timed swims were used in northern California in an effort to calibrate them with unit area methods.

7.2.5 Socio-economic Data Needs

Information about the effect of abalone regulations on employment (job loss or creation) is presently non-existent. Expenditures by abalone recreational fishermen have been studied by a number of researchers (CDFG 2001b). Random telephone surveys (Section 7.2.4.1 Fishery-dependent Monitoring) can also be used to provide socio-economic data.

7.2.6 Collaborative Research Efforts

The Department is currently involved in planning a collaborative research initiative known as the Cooperative Research and Assessment of Nearshore Ecosystems. Existing survey efforts by the Department, PISCO and others are to be coordinated to obtain essential data such as density and size frequency of abalone, sea urchins, and other species including nearshore finfish. Surveys will be primarily SCUBA-based at depths from 6 to 20 m (20 to 66 ft), and ROV-based at depths down to 100 m (328 ft), should ROV technology prove practicable in this environment.

7.3 Management Alternatives

The management alternatives presented here modify either the overall management approach or individual components of the management plan. Additional management plan alternatives are presented for determining the TAC, moving the boundaries of the recreational fishery, and allowing some sort of fishing during recovery in the moratorium area. These alternatives were created in response to public comment and peer review.

7.3.1 Alternative 1: Limited Fishing Without Full Achievement of Criterion 3

(*applies to recovery areas within the moratorium area*)

This alternative was suggested by former commercial abalone fishery constituents, to be implemented specifically for red abalone at San Miguel Island (SMI). The alternative allows fishing for a species that has only recovered in part of the Range prior to reaching the recovery Criteria 3 (three-quarters of the recovery areas at 6,600 ab/ha). Areas that are recovered will be considered for this alternative. Areas or

locations in need of recovery would remain closed. For example, only index sites and other key locations within a recovery area that actually have average densities at or above the target density will be eligible for fishing and all other locations would remain closed until populations reach the target density.

Advantages:

- Provides a limited fishing opportunity during recovery process

Disadvantages:

- The Department's preferred alternative follows the legislative intent that the impact of harvest on recovery of "adjacent areas" be considered prior to allowing harvest (recreational or commercial). The Department believes this alternative violates the intent of ARMP code Section §5522 (a)(C) by suggesting these remnant populations be harvested during the recovery process. If any take is allowed on remnant populations recovery may be jeopardized.
- A fishery prior to full recovery is unlikely to be sustainable - providing a short term gain at the cost of future fishing opportunities.
- Allowing fishing prior to recovery elsewhere does not provide "insurance" against further declines. Other natural events, including El Niños, sea otter expansion, and disease may further impact the resource, making the remaining populations more important for recovery.
- Reducing the abalone population by fishing will reduce the reproductive potential of the population in recovered areas, and will reduce the number of available individuals for relocation to nearby key locations and recovering areas.
- This alternative may introduce increased poaching opportunities.
- By allowing take of remnant populations prior to a more robust recovery at multiple areas, this alternative will delay or possibly reverse recovery at depleted areas.

7.3.1.1 Options for Implementing Alternative 1

If the first alternative is selected, strict guidelines for a limited fishery must be implemented to ensure that overall recovery continues until Criterion 3 is reached. Guidelines for a limited fishery should have specific management measures and research protocols (resource monitoring) to ensure fishery sustainability in recovered areas. The following is a summary of the proposed option with advantages and disadvantages to selecting the option. The entire proposal, as submitted to the Department by commercial abalone constituents, is located in Appendix H.

<u>Proposed Management Measures</u>

Management of limited fishing within an existing moratorium will require special regulations and tools in addition to current management. Such a fishery would require detailed planning and allocation of the proper personnel and resources by the Department to manage and enforce fishery regulations prior to the fishery opening. The following management measures are suggested to execute such a fishery:

- A Position Indicating Transponder (PIT) should be required aboard all fishing vessels participating in the fishery. The cost of the PIT and its installation would be borne by the participant
- Only red abalone would be harvested at SMI
- Gear restrictions include the use of hookah gear by commercial participants and SCUBA or breath-hold diving for recreational fishermen. Current restrictions on abalone irons would apply
- A minimum size of 7.75 in. (197 mm) and a maximum size of 8 in. (203 mm) for both commercial and recreational sectors
- A fishing season consisting of three summer months (July, August, September)
- A prohibition on the export of red abalone outside of California
- A trip limit of eight dozen abalone per commercial diver and a maximum of two divers per vessel
- A TAC consisting of a percentage (10% to 20%) of the estimated harvestable population that falls within the slot size limit. The percentage would be set to have a minimal impact on the entire population as a whole and to maintain a sustainable fishery. An initial TAC of 15,000 red abalone is proposed for SMI (Appendix H).

    - The TAC would be managed through an abalone take reporting system that relies on tags that would be attached to the shell of an abalone upon harvest. Each tag will have a tracking number or diver permit number which will associate fishermen to each abalone at landing. Recreational participants would be required to return report slips issued for each tag with similar information.
    - The TAC would be allocated between the commercial and recreational sectors. The proposed recreational sector allocation will be set based on the historic catch ratio between commercial and recreational fisheries or 3,000 abalone, whichever is greater.

- An Individual Quota system for commercial fishermen will be implemented based on the TAC and will be initially allocated to all divers permitted at the time of closure.
- Only two points of landing, Santa Barbara and Halfmoon Bay, will be allowed to better control and account for the TAC.
- To defray the costs of implementation and management, fees or “resource rent” would be levied.

    - For the commercial sector, an additional fee of 10% of the landed value will be collected along with existing landing taxes already required for commercial landings (FGC §8051 and §8051.3). This money would be used to administer the commercial segment of the fishery, and any remaining funds would be deposited in the Fish and Game Preservation Fund for use by the Abalone Resources Restoration and Enhancement Program as defined in FGC §8051.4.
    - For the recreational sector, a flat fee for each tag purchased would be assessed along with the cost of the recreational fishing license and abalone stamp. Proceeds from the tag sales would be used to administer

the fishery. As with the commercial fishery, remaining funds would be deposited in the Abalone Restoration and Preservation Account within the Fish and Game Preservation Fund and used as defined by FGC §7149.9.

Proposed Research Protocols

To establish a limited fishing alternative during recovery, more information is needed on the status of the red abalone resource at SMI. To help fill this knowledge gap, the commercial constituents have proposed setting up monitoring sites in good abalone habitat at SMI. The monitoring sites will conform to CINP Kelp Forest Monitoring protocols. Installation of these sites will be funded through the use of Abalone Resources Restoration and Enhancement Program funds, administered by the Commercial Abalone Advisory Committee (CAAC) under FGC §8051.4.

The proposed monitoring sites at SMI, which will be installed by the California Abalone Association (CAA) using CAAC funds, will be located at Castle Rock, Adams Cove and Crook Point. These three sites will complement three existing monitoring sites at the island, two CINP Kelp Forest Monitoring sites (Hare Rock, Wyckoff Ledge) and an existing site established by the CAA (Tyler Bight). The Adams Cove and Hare Rock sites fall within state marine reserves, and will serve as controls for the other sites which would be open to fishing under this alternative and option.

The six monitoring sites would serve as an anchor to assessing the abalone population at the island as well as other closely associated species. Government agencies and academia would be encouraged to use the sites set up by the CAA as part of a collaborative research effort. Additionally, the research protocols should follow the guidelines of the long term management plan as outlined in Section 7.2.1.2.

Advantages:

- A commercial fishery would be beneficial to the commercial divers and would result in associated economic benefactors
- A recreational fishery would provide resource use to recreational divers and would result in associated economic benefactors
- The state would derive funds from “commercial resource rents,” permit fees, and taxes
- Fishery-dependent data could be obtained and used for management

Disadvantages:

- The option does not provide for refuge by depth, which has been successful in the recreational-only fishery in northern California. Current MPAs may not protect sufficient abalone resources to offset potential overfishing.
- The option suggests resource allocation biased towards commercial users. The allocation of resources between recreational and commercial segments of the fishery needs to be better addressed and equitable.
- The proposed method of resource evaluation (or monitoring) does not meet scientific criteria for evaluation of a resource, because it does not contain randomly selected evaluation survey sites. The ARMP requires robust density surveys at larger areas than CINP-type index sites to gauge whether recovery has first exceeded minimum viable population (2,000 ab/ha) levels and then

sustainable fishery levels. Recovery to either threshold cannot be determined using the proposed methods, or with the proposed limited funding.

- The proposed initial TAC of 15,000 abalone is not scientifically based and calculations for biomass estimation on which it is based are flawed:

    - The initial TAC is based on a biomass estimate of 3 million emergent abalone. This figure is derived by taking the calculated number of abalone harvested in 1997 (30,000 abalone) and applying a raising factor of 1% (the percentage of legal-sized animals found on Department cruise surveys at SMI that year). These surveys were not random and thus cannot be used for abundance estimates.
    - This method of biomass estimation is too simplistic and would not stand up to peer review. For example, it does not allow for the calculation of confidence bounds on an estimate.

- Abalone fisheries are high in commercial and recreational value, and will attract considerable effort in take (legal and illegal) thus increasing the necessity for more enforcement coverage. The increased enforcement is needed on a continuing basis to:

    - Minimize the "gold rush" effect of reopening the fishery
    - Protect MPAs from inadvertent take
    - Assure proper utilization of resource at SMI

- The resulting increased need for enforcement effort at SMI could adversely affect other areas if enforcement resources are not supplemented.
- The ARMP currently provides a minimum level of Department biological staff for implementing and carrying out recovery tasks. Opening a limited fishery prior to full recovery may divert Department resources away from recovery tasks to manage the fishery.
- The proposed "resource rent" is insufficient to cover the increased costs associated with operating a fishery, such as increased enforcement and management needs.
- The proposed season for the fishery may closely precede the reproductive period of red abalone, thus reducing reproductive potential.

7.3.2 Alternative 2: Limited Fishing at Reduced Criterion 3 Density Level and Establishment of New Criterion 4 (*applies to recovery areas within the moratorium area*)

Under this limited fishing alternative, an additional recovery criterion would be created. A target emergent abundance level of 3,000 ab/ha would become Criterion 3, in place of the preferred recovery strategy level of 6,600 ab/ha, which would become Criterion 4 (Figure 7-2, Table 6-1). The other elements regarding Region-wide attainment of Criterion 3 would remain intact (Section 6.2.2.2 Criterion 3 - Fishery Density Level (6,6000 ab/ha)). Following attainment of the alternative Criterion 3, a limited fishery would be considered and the new Criterion 4 (density level 6,600 ab/ha) would be the next target to reach before the long-term recovery goal is met. Under this alternative, the stock assessment for fulfillment of Criterion 4 will have a dual purpose of

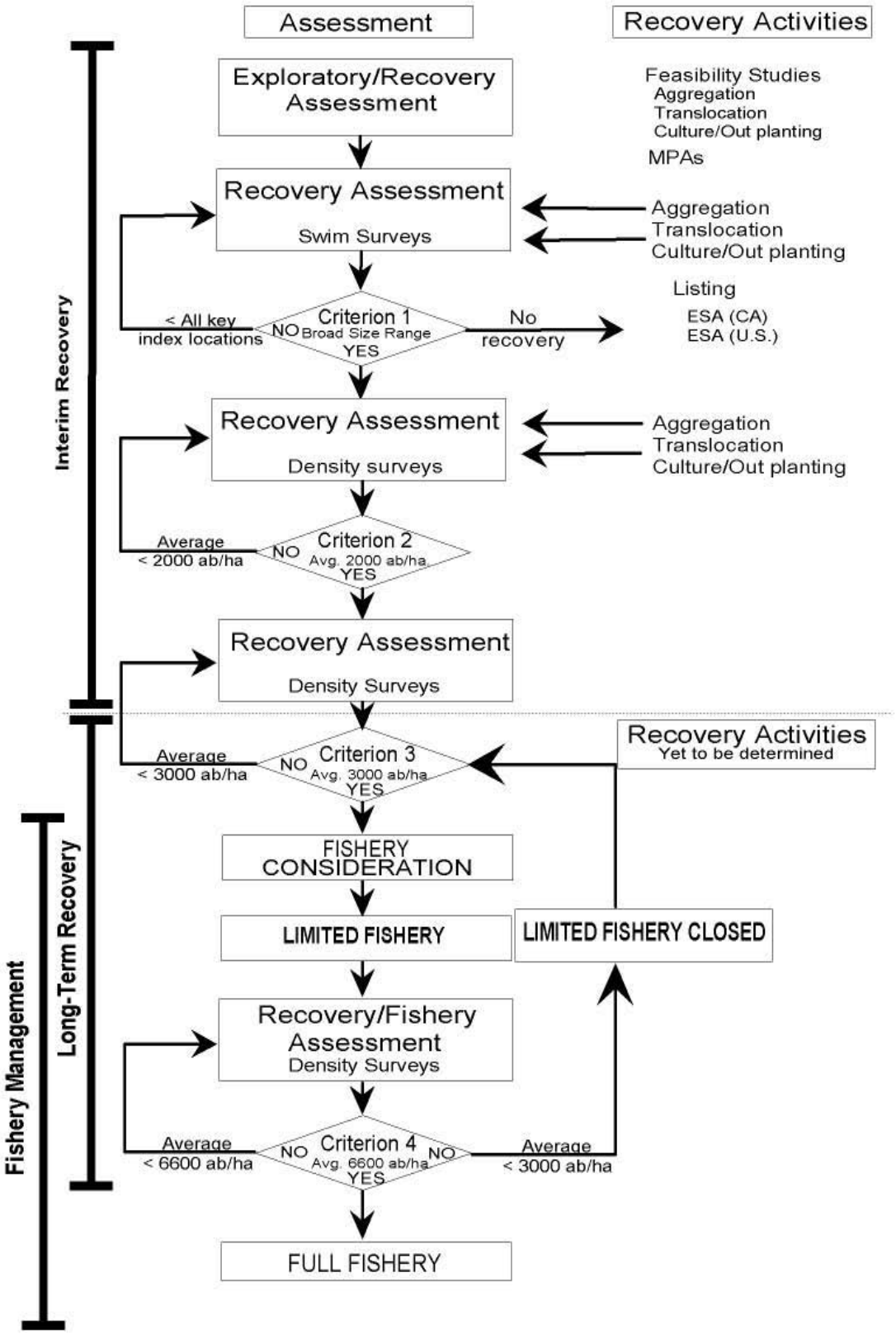

Figure 7-2. The flowchart of the recovery approach revised to reflect a limited fishing alternative

continued assessment for recovery and additionally for managing the limited fishery (Figure 7-2). The assessments will continue to focus on the index sites for each recovery area.

Advantages:

- Provides fishing opportunity sooner than preferred alternative

Disadvantages:

- Reduced density level criterion for reopening fisheries and provides less protection for recovering populations.
- Assessments will have to be done more frequently to ensure that stock densities do not fall below MVP, and will most likely be done on a triennial basis (every three years) rather than every six years as is proposed for the preferred recovery.

7.3.3 Alternative 3: Opening a Limited Fishery for Red Abalone in Areas of Imminent Otter Reoccupation Without Full Achievement of Criterion 3

(*applies to recovery areas within the moratorium area*)

This alternative would allow some form of limited fishery in areas that will soon be reoccupied by sea otters. The premise of this alternative is that all emergent abalone will be lost to otter predation relatively quickly once otters reoccupy an area. With reoccupation, these emergent abalone would no longer contribute to recovery. Allowing fishery access prior to otter occupation may not have a negative impact on recovery that is significantly different from that due to sea otter predation.

This alternative would include specific criteria for implementation to ensure that these areas are not depleted beyond sustainability in the presence of otters. The criteria for consideration of this alternative include:

- The recovery area in question must have at least emergent densities at or above the MVP level (2,000 ab/ha)
- A trigger event verified by the Department of at least 20 otters that have occupied the area either seasonally or permanently
- Fishery control rules that would be specific to that area and would include a level at which to terminate the fishery

Advantages:

- Low prey abundance may increase the rate of sea otter range expansion - a sea otter recovery goal

Disadvantages:

- Opening a fishery in advance of imminent sea otter reoccupation removes primary prey items from a federally endangered sea otter population, which may jeopardize its long term recovery.

- Human take may reduce crevice populations of abalone that are critical to long-term sustainability within sea otter reoccupied habitat

7.3.4 Alternative 4: Immediately Open Closed Areas to Take of Red Abalone

(*applies to recovery areas within the moratorium area*)

Populations of red abalone remain inside and outside of the Central California Sea Otter Range. This alternative would reopen these areas to fishing immediately.

Advantages:

- Will provide short term fishing opportunities

Disadvantages:

- This strategy was not successful in southern California and led to the closure of the fishery
- This alternative would violate the provisions of the Abalone Recovery and Management Act which requires recovery of multiple areas using specific criteria prior to fishery consideration
- When combined with other cumulative impacts such as disease, warm water events, etc., this alternative could drive red abalone populations to extinction.

7.3.5 Alternative 5: Lower the TAC by the Estimated Amount of Illegal Take

An accurate estimate of illegal take could be incorporated directly into the TAC. The TAC would then be reduced by the estimated amount of illegal take.

Advantages:

- This alternative would more effectively ensure that legal and illegal take do not threaten the long-term sustainability of the resource.

Disadvantages:

- There is presently no reliable way to estimate illegal take.
- The recent reduction in take was partially in response to illegal take.

7.3.6 Alternative 6: Immediate and Complete Closure of the Northern California Red Abalone Fishery

In the existing data-moderate environment there is recognized uncertainty regarding the sustainability of the northern California fishery. Application of the precautionary approach and its risk-averse principles would provide time to assess the status of the stock. If the fishery is completely closed, there is an increased likelihood that when the fishery is reopened at some future time, the resource will have achieved a sustainable fishery level.

Advantages:

- Increases the likelihood of a sustainable fishery

Disadvantages:

- If current fishery levels are indeed sustainable, then a fishery closure would cause unnecessary economic loss.

7.3.7 Alternative 7: Allow Future TAC Increases Above Current Maximum Increase of 25%

This alternative would implement the interim plan with potential for TAC increase to levels above the currently proposed maximum 25% increase (if stock conditions warrant such TAC increases). Fishery-dependent and fishery-independent data would be collected as currently specified in the interim plan.

Advantages:

- A larger TAC would allow more abalone to be caught

Disadvantages:

- A TAC increase of greater than 25% of the currently proposed level would approach historical take levels and may not be sustainable
- The interim plan is intended to be precautionary in nature because it relies on less data than the long-term plan and is limited in its ability to control take.
- Allowing a TAC increase of greater than 25% of the currently proposed level would not be precautionary management.

7.3.8 Alternative 8: Limited Abalone Fishery at Selected Areas at a Reduced Density and Prior to Full Recovery in All Areas (*applies to recovery areas within the moratorium area*)

The alternative allows the Commission to consider abalone (*Haliotis* spp.) fisheries in specific locations that have partially recovered prior to achieving full recovery as defined in the ARMP. This alternative would be implemented initially for red abalone at San Miguel Island using a reduced density criterion. It recognizes that viable abalone populations currently exist, and that a broad size range of abalone is present at San Miguel Island. It also recognizes that densities of abalone appear to be above MVP levels at San Miguel Island, and the fact that no-take reserves implemented after the fishery closure will help to ensure continued abalone populations. Other areas, such as the Farallon Islands, may be considered once data are available to show the acceptable density criterion has been met and the fishery at San Miguel Island proves to be practicable.

Alternative 8 allows fishing prior to achieving Recovery Criterion 3 (three-quarters of the recovery areas achieving a specified density). In this alternative, fisheries may be considered in individual areas that show a broad size range and an average abalone density above an established MVP level. The initial abalone density to open a fishery would be developed using sound scientific data and following standard fisheries

management guidelines. This number would be based in particular on the most recent San Miguel Island abalone density surveys. If populations drop below MVP levels, the fishery would be closed and re-evaluated.

Under this option, data collection would continue in the fished area to determine whether populations were stable, increasing, or decreasing. An independent contractor would develop an overall management plan and review data collected each year to make recommendations on any changes to the fishery. Guidelines governing the contractor's responsibilities will be developed jointly by the Department and potential fishery participants with approval by the Commission. Management recommendations made by the contractor would be reviewed by the Department prior to potential Commission action. Cooperative effort for data collection would include fishery participants to maximize the amount of information available.

If this alternative is selected, strict guidelines for a limited fishery must be implemented to ensure that overall recovery continues in both the fished and unfished areas. Several implementation options would be considered in order to ensure a viable and well-managed fishery. Specific regulations would be developed in consultation with potential fishery participants once an option is decided upon. The following is a summary of some fisheries management measures that would need to be developed (others measures, in addition to these, may also be necessary):

- Fishery Opening Density Level - This level would be set by the Commission at a level above MVP and would be based upon recent density surveys at proposed harvest areas.
- Total Allowable Catch (TAC) - The TAC would be determined based upon estimates of abalone abundance above minimum legal size. The TAC would be a fraction of this amount to maintain both a sustainable population and an economically viable fishery.
- Recreational and Commercial Allocation - The TAC would be allocated between recreational and commercial take based upon pre-determined criteria established by the Commission. Included in this would be discussions on the number of participants allowed into the fishery. Priority for participation in the commercial fishery shall be given to those persons who held a commercial abalone permit during the 1996-1997 permit year [Title 14, sub-section 5522(e)]
- Regulatory Measures - Specific regulations would be developed cooperatively with potential fishery participants in order to ensure a well managed fishery. Potential regulatory measures include the following, but would be determined as part of the normal regulatory process:

    - Larger than historic size limits - An equal size limit for commercial and recreational take would be set above the historic size limit. This would help ensure an increased abundance of breeding abalone when reproduction occurs.
    - Restricted seasons - A seasonal fishery may provide for ease of enforcement and allow review of biological survey data to provide management recommendations in the off season. It could also allow for undisturbed reproductive periods.
    - Restricted landing locations - This would help prevent illegal activities by limiting the number of areas where abalone could be landed.

- Tag requirement for all commercial and recreational abalone taken.
    - By individually marking abalone at point of collection potential illegal take would be limited as all legally taken abalone would be tagged. Tags could also be used as a source of detailed catch data and be linked individually to specific permittees. Additionally, tag fees could help defray management costs.
- Additional taxes and/or permit fees to support management and enforcement.

Advantages:

- A commercial fishery would be beneficial to the commercial divers and would result in associated economic benefits
- A recreational fishery would provide resource use to recreational divers and would result in associated economic benefits
- The state would derive funds from permit fees, and taxes
- Fishery-dependent data could be obtained and used for management
- Funding for ongoing enhancement projects will continue and a structure will be developed to efficiently direct those funds
- Monitoring data will direct changes in management and enhancement efforts
- The presence of commercial divers on the fishing grounds may enhance enforcement efforts

Disadvantages:

- This alternative may limit recovery elsewhere by allowing limited harvest during the recovery process
- Reducing the abalone population by fishing may reduce the reproductive potential
- This alternative will increase the enforcement burden on the Department and the resulting increased need for enforcement could adversely affect other areas if enforcement resources are not supplemented
- In order to initiate the assessments necessary to implement the recreational portion of this alternative, the Department would need to divert staff and funding from other priorities. Existing State law also requires the Department to expend dollars to manage the commercial portion of this alternative commensurate with the commercial-related income we receive from the fishery.

Chapter 8. Abalone Enforcement Activities

8.1 Overview

Department enforcement activities are centered around the following major areas:

- Protect areas closed to fishing and ensure compliance with regulations through enforcement and educational activities
- Collaborate with scientific staff in conducting research from enforcement vessels
- Participate in reviews of the effectiveness of proposed recovery and management regulation and plan amendment

"Enforcement" includes both coastal-based enforcement and Special Operations Unit personnel of the Department. In addition to work dedicated directly to abalone, enforcement activities generally directed toward other fisheries and Marine Protected Areas also serve to protect abalone resources. Officers also inform and educate constituents about regulations that protect recovering and managed abalone stock (Section 9.1.4 Enforcement).

8.2 Methods Used by Wardens for Abalone Regulation Enforcement

Enforcement personnel use a variety of methods to assist in tracking illegal take of abalone. The most visible method is patrol of the tidal areas during minus tides by uniformed wardens. During these routine patrols, wardens will check fishing licenses and abalone permit report cards to ensure abalone harvesters are properly licensed, and are correctly filling out the report card. Wardens also check to make sure the person has only their own report card in their possession and are not using a card belonging to someone else.

Various equipment to enhance visual observations is also used by wardens to watch selected areas or persons collecting abalone, including use of video cameras as deemed necessary. This equipment often allows wardens to catch violations that would otherwise go undetected. Aircraft are used in conjunction with wardens on the ground to direct personnel into areas that are not easily observed from shore.

Boat patrols are another way that wardens make contacts or observe divers to check compliance with the abalone regulations. Boats allow wardens access to many areas that are not accessible normally from shore. In addition to smaller boats, occasional patrols are made utilizing the 57-foot patrol boat from San Francisco Bay. This vessel has long range, multi-day capability with a skiff that can be launched to check shallow water areas.

Undercover wardens are used by the Department to discretely observe those persons that have been reported as violators. This unit has been very successful at tracking illegal take of abalone for commercial purposes. Many high profile cases have been successfully prosecuted from the efforts of these wardens. Forfeiture of vehicles, boats and dive gear have resulted from these cases. Several people have been sentenced to state prison terms after being convicted of felony violations by the courts,

stemming from cases made by this unit. Uniformed wardens often work closely with the undercover personnel, exchanging information and tracking the activity of the suspected commercial poachers.

Directed enforcement details are conducted on several occasions both during and after the abalone season. Abalone checkpoints are established several times during the season to educate the public, check compliance with laws and detect violations. In 2001 wardens conducted a special detail throughout California to follow-up on abalone report card purchases that appeared to be in violation of the law. During this detail, some citations were issued for illegal purchase of more than one abalone report card. Additionally, some persons were cited for failure to return the previous year's report card. The Department will continue with these types of details in our attempt to curtail violations of the abalone laws and to increase the percentage of abalone permit report cards returns.

The CalTIP program (phone number:1-888-334-2258) has been very helpful with enforcement efforts related to abalone. With limited personnel available, wardens depend on the public to report violations they observe. While wardens do not expect witnesses to confront violators, good observations of what took place (people and vehicle descriptions along with camping location or direction of travel of the violator) is a great help. Many significant violations are successfully prosecuted each year as a result of the CalTIP program.

8.3 Collaboration Between Management and Enforcement

Enforcement and management personnel typically work separately to achieve their individual mandates from the Department. This is because each group uses its own techniques and methods to solve its particular abalone management problems (that is, law enforcement vs. biological techniques). In some situations however, both groups work together to achieve a common goal. One example is the proposal to change or add new laws to CCR Title 14 sections impacting take and possession of abalone. Another example is working together to review the database of abalone report card purchases. Wardens take an active interest in regulatory proposals, as enforcement of those proposals will impact field wardens. Management personnel strive to ensure that what is being proposed can effectively be achieved by the warden force.

Wardens also work with the biological staff as Department-certified scuba divers. In this capacity, enforcement personnel assist with such things as abalone surveys for density, recruitment and predation problems. Other special requests for assistance from enforcement divers are also met based upon availability of personnel.

Enforcement patrol boats serve as working platforms in many instances for both Department and contracted biological surveys related to abalone. Patrol vessels typically used for this activity are 24-foot rigid-hull inflatables, or the 57-foot patrol boats. These vessels provide mobility and work platforms for biologists in many areas of the coast where they do not have boats available.

Enforcement have a representative that sits as a voting member on the Recreational Abalone Advisory Committee (RAAC). There is also a biologist that is a voting member of the RAAC. Funds obtained from sale of abalone report cards has

been vital to law enforcement in providing equipment and overtime funding to law enforcement personnel, resulting in enhanced field detection and apprehension of abalone violators (Section 9.3.1 Interim Costs (2005 to 2011) and 9.3.3 Funding Sources).

8.4 Enforcement Needs

An electronic database tracking system is needed along with some changes to the abalone report card that will allow wardens to better track who is purchasing the report cards and how many abalone have been taken in a season. A proposal for some change along these lines is being considered by the Department, but funding will be needed to establish and maintain the database and make changes to the report card system. A database that can be accessed at the beginning of the abalone season would be a great benefit to both enforcement and biological staff. The benefit to enforcement is a better tracking system to eliminate persons buying more than one report card and the ability to flag any persons whose license for taking abalone has been revoked by the courts. Biologists would benefit from having real-time information on the identity of report card purchasers, improving the timeliness of catch estimates when linked to returned report cards, providing estimates of the amount of funding available for abalone management, and improving the ability to contact abalone divers and pickers via informational mailings.

Wardens need the ability to electronically record information in the field concerning who has been checked and how many abalone have been taken for the season. This type of tracking system (linked to a master database) would allow more effective enforcement of abalone violators and would lead to a higher percentage of violators being caught and prosecuted.

In the future, enforcement and management will need to work together to develop a reliable database of abalone permit report cards that can be accessed on the front end of the season. That database will provide valuable law enforcement and management information on a timely basis, which will allow shifts in both functions to address noted problems as the season progresses.

8.5 Community Outreach

Public awareness campaigns about the vulnerability of our intertidal and subtidal marine resources to overfishing could be expanded. Examples of activities include educating students at schools, creating Internet website interactive games and activities, and enlisting the participation of community groups, fishermen, and coast watch groups that maintain some form of stewardship (such as close observation of local fishing activities to discourage poaching).

Chapter 9. Implementation (Activities, Timelines, and Cost)

9.1 Activities

Various activities are involved in implementing recovery and management: assessment, research, plan development, regulatory process, and enforcement. These activities will be modified as species recover or as long-term management is implemented.

9.1.1 Assessment

- Collect management-related essential fisheries information (EFI) through creel surveys, abalone permit report card assessment, and diver surveys
- Collect recovery-related data through exploratory and recovery assessment survey
- Conduct cooperative assessments with universities, national parks, NOAA Fisheries, sport fishermen, and former commercial fishermen to increase the scope and efficiency of data collected

Status reports based on assessment data will provide a basis for regulation changes and amendments to the ARMP. The reports will include methodologies and a review process to ensure improvement as new methods are developed. Assessment activities are described in greater detail in Chapter 6, Abalone Recovery, and Chapter 7, Abalone Management.

9.1.2 Research

- Conduct genetics studies on red, pink, and green abalones
- Perform a WS-resistance study for black abalone
- Carry out feasibility studies on red, pink, green, black, and white abalones to determine whether recovery activities will be successful
- Work under federal lead as part of the White Abalone Recovery Team
- Conduct abalone disease and parasite studies
- Conduct cooperative research to enlarge partnerships and funding for recovery- and management-directed activities
- Coordinate funding from sources such as Sea Grant, National Fish and Wildlife Foundation, and others with Department scientists and research partners in order to expand capabilities and expertise

Published, peer-reviewed results from this work will provide the basis for future support of recovery and long-term management activities. Research directed towards developing new assessment methods, disease management, and recovery tools are detailed in Chapter 6, Abalone Recovery, and Chapter 7, Abalone Management.

9.1.3 Plan Development and Regulatory Process

- Review reports on recovery and management activities with constituents including formal advisory groups and the public
- Develop changes to regulations based on research, data, and review
- Develop components of the long-term management plan (zone boundaries, zone-based TAC, and tag system)
- Participate in Commission sport regulation change meetings and present the results from these activities
- Receive comments and suggested modifications for plan amendments
- Engage an advisory panel which includes scientists, environmentalists, sport fishermen, and former commercial fishermen
- Continue working with the RAAC while preparing for regulation and management changes

9.1.4 Enforcement

- Protect areas closed to fishing and ensure compliance with regulations through enforcement and educational activities
- Collaborate with scientific staff in conducting research from enforcement vessels
- Participate in reviews of the effectiveness of proposed recovery and management regulation and plan amendment

9.2 Timelines

A seven-year timeline (from 2005 through 2011) has been developed for implementing interim recovery and management activities (Table 9-1, Table 9-2). Enforcement activities for both recovery and management are continuous and are therefore not listed in the timeline. A future timeline will be suggested to the Commission as part of plan amendments. Timelines beyond 2011 have not been developed, as it is difficult to predict if and when recovery may occur, which recovery methods will be effective, or if long-term management will be implemented. Developing a seven-year timeline also allows flexibility in adapting to changes in recovery and management, and is more realistic given the uncertainties inherent in estimating future costs and staffing needs.

The assessment activities will alternately focus on recovering populations and managed populations in order to minimize cost by allowing sharing of funding, resources, and staff. Assessment activities for recovery will be focused more in odd-numbered years beginning in 2005; assessment activities for management will be focused more in even-numbered years beginning in 2006. Staggering of staff and funding will be applied to other activities as well.

9.2.1 Interim Recovery (2005 to 2011)

Interim recovery activities include assessment, research, plan development, and participating in the regulatory process (Table 9-1).

Assessment will involve exploratory surveys and subsequent recovery assessment. Exploratory surveys for all seven species will be conducted in 2005 and

2007, and will provide the basis for determining future recovery activity needs and where they will be directed. From these data, a status report for southern California abalone will be developed with recommendations for subsequent actions. Recovery assessment will be initiated in 2011.

Research will involve studies on recovery feasibility, disease, and genetics. Recovery feasibility studies for red, pink, green, black, and white abalones will take place between 2006 and 2011; results of these studies will be reported in 2010 and 2011. Disease research on black abalone resistance to WS will take place from 2006 to 2008. Results of the disease research will be compiled in 2009. Genetic research for red abalone will be conducted in 2006 and 2007; similar studies for pink and green abalones will be conducted in 2008 and 2009. Reports from the genetic studies will be generated in 2007 and 2009.

Reports and recommendations on potential plan amendments and new regulations will be presented to the Commission in 2007. These reports will include an evaluation of a proposed network of MPAs needed for abalone recovery (if warranted), and an evaluation of whether black, green or pink abalones should be listed as endangered.

9.2.2 Interim Management (2005 to 2011)

Interim management activities include assessment (collecting and reporting on EFI) and plan development/regulatory change (Table 9-2). An internal, triennial status of the stock report will be initiated in 2006 to evaluate EFI from the previous three years. These reports will determine if site or fishery closure is necessary and if the catch level needs adjustment because the total allowable catch (TAC) has been exceeded. Beginning in 2006, every second triennial report will also evaluate whether a change in TAC is warranted based on stock conditions. Based on these triennial reports, recommendations will be made to the Commission for potential regulatory changes. Beginning in 2008, if resources are available, assessment of EFI will be augmented with stratified, random multi-species dive surveys in preparation for long-term plan implementation. During the interim management period, a planning process for further development of long-term management in northern California will be conducted. The first product will be a report defining the proposed zonal boundaries, their respective TACs, and the projected costs associated with implementation of a tag system. A report that evaluates implementation of long-term management in northern California will be presented to the Commission in 2011.

9.2.3 Interim Enforcement (2005 to 2011)

Interim enforcement activities include routine patrol and intercept. An annual abalone enforcement report is provided to supervisory staff summarizing citations issued and personnel hours and funds used, including overtime and expenditures from the abalone stamp fund. Tidal area patrols during low tides, boat patrols, and undercover wardens are used throughout the abalone season. Directed enforcement details include abalone checkpoints to check compliance with regulations and to educate the public.

In addition to these enforcement activities, enforcement staff participate in fishery-independent surveys by providing vessel support and scuba divers.

Enforcement staff also provide management plan review and assist in drafting regulatory language from an enforcement perspective.

9.3 Costs

Since research, data collection, and regulatory actions are interrelated, these costs are grouped together under the heading of recovery and management, and averaged for activities spanning 2005 to 2011.

Enforcement costs were predicted using levels projected for the fiscal year beginning July 1, 2001.

9.3.1 Interim Costs (2005 to 2011)

Implementation of the interim plan will require a yearly expenditure of $1,443,000, of which $580,000 will be directed to enforcement (Table 9-3). Funds will be acquired from the Department's Preservation Fund, which consists of non-dedicated and dedicated accounts (Section 9.3.3 Funding Sources). Dedicated monies, reserved for expenditure on abalone, are generated from the abalone permit report card fee, previously collected commercial landing taxes, and violation fines. These monies are projected to provide $484,000 for interim expenditures. It is estimated that for the remaining funds required ($959,000), $701,000 can continue to be taken from non-dedicated sources, while new expenditures ($352,000) can be redirected from existing accounts or from sources yet to be identified.

9.3.1.1 Recovery and Management Costs

<u>Staffing Summary for Recovery and Management</u>

- 1.0 Personnel Year (PY) Senior Marine Biologist (southern California)
- 0.5 Personnel Year (PY) Senior Marine Biologist (northern California)
- 2 PYs Associate Marine Biologist (northern and southern California)
- 3 PYs Scientific Aid/Fishery Technician divers
- Dedicated funds = $205,341 Preservation Fund = $134,500

<u>Staffing Summary for Disease Lab</u>

- 0.5 PY Senior Fish Pathologist
- 1.0 PY Senior Lab Assistant
- 0.5 PY Lab Technician II/Animal Pathology
- Dedicated funds = $38,634 Non-dedicated funds = $101,800

<u>EFI Collection</u>

- Creel, abalone permit report card, and index surveys
- Dedicated funds = $50,000 Non-dedicated funds = $18,000

<u>Recovery Assessments</u>

- Non-dedicated funds = $66,000

Table 9-1. Timeline of recovery activities for 2005 to 2011

Year	Southern and central California assessment and research		Plan development and regulatory process	
	Activities	Reports	Reports	Recommendations to the Commission
2005	Exploratory/recovery & detailed assessment surveys, Part 1 of 2 (Tasks 1, 2 & 3)			Adopt ARMP
2006	Initiate genetics study on red abalone (Task 9) Begin feasibility study on recovery activities for pink and green abalones (Tasks 4, 5 & 6) Initiate WS-resistance study for black abalone (Task 10)			
2007	Genetics study completion for red abalone (Task 9) Exploratory/recovery & detailed assessment surveys, Part 2 of 2 (Tasks 1, 2 & 3) Begin feasibility study on recovery activities for red and black abalone (Tasks 4, 5 & 6)	Status of stock recovery and recommendations Report No. 1 Genetic differences and concerns for recovering red abalone populations in southern California	Evaluate listing black, pink, or green abalones as endangered Evaluate proposed network of MPAs	Amend ARMP with state listings as endangered species if warranted Recommendations for abalone MPAs if warranted
2008	Initiate genetics study on pink and green abalones* (Task 9) End WS-resistance study for black abalone (Task 10)			
2009	Genetic study completion for pink and green abalones (Task 9)	Results of WS resistence study Genetic differences and concerns for pink and green abalone populations in southern California		
2010	Approximate end of feasibility study on pink and green abalones (Tasks 4, 5 & 6)	First feasibility report for recovery activities		
2011	Recovery assessment, Part 1 of 2 (Task 3) Approximate end to feasibility study on red and black abalones (Tasks 4, 5 & 6)	Second feasibility report for recovery activities	Proposal of future timeline	Amend ARMP with proposed timeline

*Recovery activities are contingent on additional funds and methods for some species

Table 9-2. Timeline of interim management activities for 2005 to 2011

Year	EFI for northern California		Plan development and regulatory process	
	Activities	Reports	Reports	Recommendations to the Commission
2005	Report card assessment Creel assessment Dive survey, index sites			ARMP adoption
2006	Report card assessment Diver survey, control sites	Status of managed stock triennial Report No. 1		Catch, total allowable catch (TAC) adjustments, and potential site closures **
2007	Report card assessment Creel assessment Dive survey, index site(s)			
2008	Report card assessment Dive survey, index sites Dive survey at stratified random locations added to four index sites*		Evaluation of northern California long-term management Report No. 1	
2009	Report card assessment Creel assessment Dive survey, control sites Dive survey at stratified random locations*	Status of managed stock triennial Report No. 2		Catch adjustments and potential site closures**
2010	Report card assessment Dive survey, index sites Dive survey at stratified random locations*			
2011	Report card assessment Creel assessment Dive survey, index sites Dive survey, stratified random locations*		Evaluation of northern California long- term management Report No. 2 Proposal of future timeline	Amend ARMP; implement long-term management Amend ARMP with proposed timeline

*Initiated only if funding or cooperative multi-species program for an expanded sampling is implemented
**TAC changes can only be made every 6 years , while catch adjustments to meet the TAC can occur triennially

Table 9-3. Summary of costs and funding sources for implementation averaged over 2005 to 2011					
		Dedicated	Non-dedicated	Total	New
Management and Recovery					
Staffing:	General	$205,341	$134,524	$339,865	$0
	Disease lab	$38,634	$101,800	$140,434	$0
Assessments:	Management	$50,000	$18,000	$68,000	$68,000
	Recovery	$0	$66,000	$66,000	$66,000
Research:	Recovery	$30,000	$168,000	$198,000	$198,000
Outreach:	General	$10,000	$20,000	$30,000	$20,000
	Sub-totals	$333,975	$508,324	$842,299	$352,000
Enforcement					
Staffing:	Enforcement Patrol	$50,000	$275,000	$325,000	$50,000
	SOU*	$86,000	$190,000	$276,000	$0
	Subtotals	$136,000	$465,000	$601,000	$50,000
	Totals	$469,975	$973,324	$1,443,299	$402,000

*An uncertain amount listed as non-dedicated funds are actually Special Operations Unit (SOU)-directed fine funds (FGC §12006.6)

Recovery-based Activities

- Research genetics, disease, adult aggregation
- Out-planting
- Dedicated funds = $30,000 Non-dedicated funds = $168,000

Outreach, Publications, and Constituent Involvement

- Dedicated funds = $10,000 Non-dedicated funds = $20,000

9.3.1.2 Enforcement Costs

Enforcement Patrol (Marine and Inland) Staffing Summary

- 3.5 PYs divided among 27 field wardens
- Dedicated funds = $50,000 Non-dedicated funds = $275,000

Special Operations Unit Staffing Summary

- 1.0 PY lieutenant (Dedicated funds = $86,000)
- Additional staff (Non-dedicated funds* = $190,000)

* SOU funding is augmented by a special, dedicated account funded by fines from major violations in addition to dedicated monies taken from sport stamp funds (Section 9.3.3 Funding Sources).

9.3.2 Long-term Costs

Long-term costs for recovery, enforcement, and management are expected to increase, but cannot be realistically predicted. New recovery methods will determine future direction and associated costs. Costs for long-term management will be estimated by 2011, taking into account cost savings associated with multi-species cooperative assessments initiated in 2008. Cooperative assessments are currently being developed with state universities, federal partners, and other constituencies under the Nearshore Fishery Management Plan for finfish. This effort will be enlarged to include invertebrates of management importance such as abalone, sea urchins, sea cucumbers, and algae. Enforcement costs may escalate as MPAs are established and as fisheries re-open in central and southern California. Cost estimates will be part of future management plan amendments beginning in 2011.

9.3.3 Funding Sources

The Department's abalone recovery and management efforts will be supported by either non-dedicated or dedicated funds deposited in the Fish and Game Preservation Fund. Dedicated funds are collected from the recreational fishery's abalone permit report card fees, fines for abalone violations, and previously collected commercial landing taxes. These funds are specifically designated by statute to be spent on the abalone resource. Non-dedicated funds are obtained from general tax revenues, sport and commercial license fees, and federal funds.

The dedicated funds from the abalone permit report card fee, violation fines, and the previously collected commercial landing taxes provide nearly $484,000 per year for the abalone resource. The greatest single source of dedicated abalone funds comes from the recreational fishery in northern California. A recreational fisherman's abalone permit report card fee of $16.00 is collected annually (FGC §7149.8). Sales of these cards currently provide over $500,000 per year. Fees are deposited in an Abalone Restoration and Preservation Account (ARPA) within the Fish and Game Preservation Fund. ARPA expenditures are dedicated to a "Recreational Abalone Management Program" (FGC § 7149.9) to be directed towards research, enforcement, publications, and ARMP development and implementation. At least 15% of these funds are to be used on program activities south of San Francisco. The RAAC was established to make recommendations to the Department's Director on projects and budgets for expenditure of these fees, and on abalone resource management (FGC §7400). In addition to the abalone permit report card fee, fines collected for the illegal take of abalone are a source of funds for management of the abalone fishery. Violation fines are deposited in either the ARPA for general management, recovery, and enforcement use (FGC §12009), or in a separate account for use by the Special Operations Unit (FGC §12006.6). An estimated $10,000 per year from fines are directed to the ARPA. Because the commercial fishery has been closed since 1997, only about $250,000 of unspent landing taxes collected under FGC §8051.3 remain as of 2002. This source could provide about $37,000 per year during the 2005 to 2011 period (FGC §8051.4).

Appendices

Abalone Recovery and Management Plan
December, 2005

Appendix A. Historical Summary of Laws and Regulations Governing the Abalone Fishery in California

A.1 Recreational Fishery

Prior to 1901 there were no state laws that specifically regulated the recreational abalone fishery in California. However, between 1891 and 1911, the County Government Act and the Political Code authorized County Boards of Supervisors to enact local ordinances to protect fish and game. Although some counties may have enacted ordinances to regulate the recreational abalone fishery, many such ordinances exceeded the authority granted by the County Government Act and the Political Code. As these local ordinances were often invalid, they are not included here.

Until 1945, sport fisheries were regulated by the Legislature. Fish and Game laws were included as part of the California Penal Code from 1901 to 1932. Sport fishery regulations were codified in the Fish an Game Code from 1933 to 1945.

Because abalone were not considered “game fish”, no sportfishing license was required for recreational abalone fishing until 1931.

In 1945, the State Legislature granted the Commission the authority to regulate recreational fisheries. These regulations were originally published as General Order No. 21 of the Fish and Game Commission. Since 31 March 1945, orders of the Commission pertaining to the recreational abalone fishery have been published in Title 14, Division 1, Chapter 1 of the California Administrative Code. In 1989, the California Administrative Code was renamed as the California Code of Regulations. The orders of the Commission modify and supersede the provisions of the Fish and Game Code where there is any conflict.

The laws and regulations governing the recreational abalone fishery in California are summarized herein by category. Individual entries remain in effect unless specifically superseded by subsequent revisions. The year in which the law or regulation was enacted, adopted, amended, revised, or repealed is indicated in the left column. However, sportfishing laws enacted by the Legislature or regulations adopted by the Commission generally become effective on March 1, the first day of sport fishing season.

References used to compile this summary include: McCully 1955; Cox 1962; Karpov *et al.* 1993; statutes published in the California Penal Code,1901-1932; and the Fish and Game Code, 1933-1995; and orders of the Commission published in the California Administrative Code, 1945-1988; and the California Code of Regulations, 1989-1995.

A.1.1 Licensing

1931 Sportfishing license required for recreational take, including abalone. Initially, fees were $2.00 for residents, $3.00 for U.S. citizens, and $5.00 for aliens.

1945 Prohibited the sale of abalone taken by the holder of a sport fishing license.

1951 Ocean angling license required for the recreational take of any marine fish, mollusc, or crustacean, commencing with the 1952 sport fishing season.

1966 Required the recreational user to have a valid sport fishing license, on his person or in his immediate possession, while engaged in taking any fish, amphibian, or reptile.

1994 Required recreational users to display valid sportfishing license on outer clothing while engaged in taking aquatic resources, except when diving or snorkeling. Required persons diving from boat or shore to keep licenses aboard their boat, or within 500 yards of shore, respectively.
1998 Required abalone stamp for taking abalone (see annual limit below).

A.1.2 Purpose of Use

1911 Restricted use of abalone to food purposes only.
1949 Permitted the use of black abalone for bait, within 5 miles of Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands.
1953 Permitted the use of black abalone for bait, in the waters surrounding Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands, or use as lobster bait, along the mainland shore.
1955 Repealed provision for use of black abalone for bait, other than in commercial lobster traps.

A.1.3 Species Subject to Take

1933 Prohibited possession of abalone species other than pink, red, black, and green abalones.
1955 All species of abalone may be possessed.
1993 Recreational take of black abalone prohibited until 01 March 1995.
1995 Resumed prohibition of black abalone take until 01 January 1997.
1996 Closure of green, pink, and white fishery.
1997 *22 May*. Emergency 120 day closure of all abalone in southern and central California.
19 Sept. Extended emergency closure.
Closure of fishery for all abalone south of San Francisco.
2000 Only red abalone north of San Francisco Bay may be taken.

A.1.4 Season

1911 Closed, 01 March to 01 July, statewide, for all abalone species.
Possession of abalone prohibited during closed season.
1913 Closed, 01 February to 01 April, statewide, for all abalone species.
1915 Red abalone closed during February, statewide.
Pink, black, and green abalone closed during February, March, and April, statewide.
1921 Pink, black, and red abalone closed 15 January to 15 March, statewide.
1925 Possession of sliced abalone meat permitted during closed season, provided that the abalone was legally taken.
1933 Open 16 March to 14 January statewide, for pink, red, black, and green abalones; laws regulating seasons changed from prohibitive to permissive wording, giving protection to species not named.
1976 North of Yankee Point, open during April, May, June, August, September, October, and November.
South of Yankee Point, open 16 March to 14 January, except that on the northeasterly side of Santa Catalina Island between the extreme westerly end

and the U.S. Government light on the southeasterly end, open only from April 1 to October 1.

1980 Prohibited the take of all invertebrates on the mainland shore within Año Nuevo State Reserve between November 30 and March 16.

1990 South of Yankee Point: open season changed to: March, April, May, June, July, August, and September.
Discontinued April 1 to October 1 special season for the northeasterly side of Santa Catalina Island, between the extreme westerly end and the U.S. Government light on the southeasterly end.

A.1.5 Fishing Hours

1959 Take of abalone permitted between one half hour before sunrise to one half hour after sunset.

A.1.6 Method of Take (Special Gear Provisions)

1913 Prohibited the use of spears to take abalone.

1947 Prohibited the use of gaff hooks, or any device larger than 36 inches long to take abalone.
Diving prohibited: 1) Oregon border to Yankee Point, Monterey County; 2) Malibu Point to Rocky Point (Los Angeles County); and 3) around Santa Catalina Island.

1952 Prohibited the use of any artificial underwater breathing devices to take abalone.

1953 Permitted the use of SCUBA gear to take abalone, in all ocean waters south of Yankee Point, Monterey County.
Restricted methods of take, for abalone to: 1) hand; or 2) devices less than 36 inches long (abalone irons).

1974 Abalone iron dimensions limited to: $\leq$ 36 inches in length; $\geq$ 3/4 inch in width; and 1/16 inch in thickness.
Required radius of curved abalone irons (such as those made from automobile leaf springs or similarly curved material) to be > 18 inches.
Required edges of abalone iron to be rounded and free of sharp edges.
Prohibited the use of knives, screwdrivers and sharp instruments to take abalone.

A.1.7 Measuring Device

1939 Required all individuals to carry a measuring device while taking abalone.

1983 Required measuring device to be U-shaped, with fixed, opposing measuring arms long enough to measure abalone by placing the gauge over the shell.

A.1.8 Replacement of Undersized Abalone and Abalone Not Retained

1939 Required immediate replacement of abalone smaller than the minimum legal size, upon rock from whence detached, by hand.

1954 Required abalone to be returned to the substrate, shell-side up, if not retained.

A.1.9 Abalone Retained

1976 Required all legal-sized abalone detached to be retained.
Required persons to stop detaching abalone when the bag limit is reached.

A.1.10 Minimum Size Limit (inches)

Year	Red	Green	Pink	White	Black	Others
1901*	15	15	15	n/a	15	15
1905*	15	15	15	n/a	12	15
1909*	17	n/a	n/a	n/a	n/a	n/a
1913*	19	18	16	n/a	14	n/a
1917	7	6 ½	6	n/a	5	n/a
1947	7	6 ¼	6	n/a	5	n/a
1949	7	6 ¼	6	n/a	5	n/a
1955	7	6 ¼	6	6	5	6
1968	7	6 ¼	6	6	5	5
1971	7	6 ¼	6	6	5	4
1973	7	6	6	6	5	4

* prior to 1917, lengths were measured by circumference

A.1.11 Bag and Possession Limit

1913 Ten daily, south and east of Santa Barbara County

1915 Ten daily, south of San Luis Obispo County, except in bays not on Santa Catalina Island.

1917 Ten daily, south of San Luis Obispo County, except: 1) bays of Santa Barbara and Ventura Counties; 2) Santa Catalina Island; 3) Point Loma to San Diego breakwater.
Twenty weekly, from Point Santa Cruz to the Carmel River.

1921 Ten daily: 1) from Point Santa Cruz to the Carmel River; 2) south of San Luis Obispo County, except in bays not on Santa Catalina Island; 3) within 20 feet of extreme low tide line: a) Mendocino County to Point Santa Cruz; and b) Carmel River to Santa Barbara County.
Twenty weekly, from Soquel Point to the Carmel River, excluding Point Piños to Seaside, Monterey County.
Ten black abalone daily, from Point Loma to the San Diego breakwater.
No bag limit elsewhere.

1925 Ten daily and 20 weekly in areas where commercial diving was allowed: 1) Point Santa Cruz to the Carmel River; and 2) south of Santa Barbara County, including the Channel Islands, and excluding all bays not on Santa Catalina Island.
Ten daily, within 20 feet of extreme low tide line: 1) Mendocino County to Point Santa Cruz; and 2) Carmel River to Santa Barbara County.
No bag limit north of Sonoma County.

1929 Ten daily and 20 weekly: 1) Humboldt Bay to Sonoma County; and 2) Pigeon Point to Point Santa Cruz.

1931 Ten daily: 1) from Humboldt Bay to Sonoma County; and 2) in waters less than 20 feet deep: a) Mendocino County to Pigeon Point; and b) Carmel River to Ventura County.
Twenty weekly, Humboldt Bay to Sonoma County.
1933 Ten black abalone daily, Point Santa Cruz to Mexico border.
1935 Five daily, in waters less than 20 feet deep, Mendocino County to Pigeon Point.
1937 Ten daily and 20 weekly, Humboldt Bay to the Oregon border.
1941 Ten daily in Marin County.
Five daily in: 1) Mendocino County to Marin County; 2) San Francisco County to Pigeon Point.
1945 Ten daily, all species in the aggregate, statewide.
1947 Ten daily but no more than 5 red abalone, statewide.
1949 Five daily, all species in the aggregate, statewide, except for black abalone taken for use as bait, within 5 miles of Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands (no bag limit).
1973 Permitted possession of up to three bag limits during a multi-day trip (one bag limit per day if two-day trip), provided that a Multi-Day Fishing Trip Declaration has been filed, in accordance with provisions set forth by the Commission.
1976 Four abalone per day, in combination of species, statewide.
Maximum possession limit for multi-day fishing trips reduced to two bag limits.
Required that all legal-sized abalone detached must be retained and that a person must stop detaching abalone when the bag limit is reached.
1990 Two abalone per day, in combination of species, south of Yankee Point, Monterey County.
2002 Three red abalone per day.

A.1.12 Abalone Brought Ashore

1911 Required all abalone landed to be alive and attached to shell.
1947 Prohibited the possession or transportation of abalone removed from the shell, except when being prepared for immediate consumption.
1976 Prohibited undersized abalone from being brought ashore or aboard any boat, placed in any type receiver, kept on the person, or retained in any person's possession or under his control.

A.1.13 Special Abalone Take Closure Areas

1976 Prohibited the take of abalone along the mainland between Palos Verdes Point (Los Angeles County) and Dana Point (Orange County), for a five-year period.
1979 Extended the southern boundary of the mainland abalone closure zone (Palos Verdes Point to Dana Point) to northern boundary of the Doheny Beach Marine Life Refuge.
1981 Renewed the mainland abalone closure between Palos Verdes Point and Dana Point for an additional five-year period.
1986 Renewed the mainland abalone closure between Palos Verdes Point and Dana Point for an additional five-year period.
1992 Renewed the mainland abalone closure between Palos Verdes Point and Dana Point for an additional five-year period.

1996 Closure of green, pink, and white fishery.
1997 May 22. Emergency 120 day closure of all abalone in southern and central California.
Sept 19. Extended emergency closure.
Closure of fishery for all abalone south of San Francisco.

A.1.14 Penalties for Violations

1905 Established fines and/or prison terms for persons found guilty of violating California fishing or hunting laws.
1933 Authorized the Commission to revoke the sportfishing license of any person who has been convicted of three violations of the state's sport fishing laws or regulations.
1968 Amended grounds for sport license revocation to three convictions within a five-year period.
1990 Increased penalties for those convicted of violating recreational abalone take regulations.

A.1.15 Abalone Permit Report Card and annual limit

2000 Required Abalone Permit Report Card for taking abalone. Annual limit 100.
2002 Annual limit 24.

A.1.16 Miscellaneous

1921 Prohibited the sale of abalone taken from waters closed to commercial take (i.e., where only recreational take is permitted).
1939 Required recreational abalone fishermen to obtain proof of legal take prior to transporting legally-taken abalone into districts in which take is prohibited.
1945 Prohibited the sale of abalone taken under a sport fishing license.
1947 Discontinued proof of legal take requirement when legally-taken abalone are transported into districts where take is prohibited.
1997 Established the Recreational Abalone Advisory Committee.

A.2 Commercial Fishery

Prior to 1901 there were no state laws that specifically regulated the abalone fishery in California. Although licensing of commercial fisheries had been in place since 1887, the abalone fishery was exempt until 1909 because it did not involve the use of both boats and nets. Between 1891 and 1911, the County Government Act and the Political Code authorized County Boards of Supervisors to enact local ordinances to protect fish and game. Although some counties may have enacted ordinances to regulate the commercial abalone fishery, many such ordinances exceeded the authority granted by the County Government Act and the Political Code. As these local ordinances were often invalid, they are not included here.

The State Legislature enacts most of the laws governing commercial fisheries in California. Fish and game laws were published as part of the California Penal Code from 1901 to 1932. A separate Fish and Game Code was established in 1933.

In 1939, the Commission was delegated the authority to regulate certain aspects of the commercial fisheries, including those of abalone. These regulations were

originally published as General Order No. 21 of the Fish and Game Commission. Since March 31, 1945, orders of the Commission pertaining to the commercial abalone fishery have been published as Section 100 of Title 14, Division 1, Chapter 1 of the California Administrative Code. In 1989, the California Administrative Code was renamed as the California Code of Regulations. Generally, the regulations adopted by the Commission have closed "loopholes" in the Fish and Game Code, streamlined enforcement, and provided for issuance and revocation of commercial permits. The orders of the Commission modify and supercede provisions of the Fish and Game Code where there is any conflict.

The laws and regulations governing the commercial abalone fishery in California are summarized herein by category. Individual entries remain in effect unless specifically superseded by subsequent revisions. The year in which the law or regulation was enacted, adopted, amended, revised, or repealed is indicated in the left column. The actual effective dates of the laws or regulations have been omitted in order to keep this list to a reasonable length.

References used to compile this summary include: McCully 1955; Cox 1962; Karpov et al. 1993; statutes published in the California Penal Code (1901-1932) and the Fish and Game Code (1933-1995); and orders of the Commission published in the California Administrative Code (1945-1988) and the California Code of Regulations (1989-1995).

A.2.1 Licensing

1909 Required commercial fishing license to take abalone for profit; fee for citizens $2.50, aliens $10.00.

1913 Commercial fishing license fee changed to $10.00 for all.

1939 Established revocable permits for commercial abalone take, to be issued under Commission rules and regulations.
Transfer of abalone permits prohibited.
Required tender boats to display permit numbers.

1943 Commercial abalone permits issued only to those using full deep-sea diving gear.

1946 Provided for master abalone permits to be issued to the diver and crew as a unit, and supplemental permits to each crew member.
Provided for revocation of all permits (boat, diver and crew) if any diver, boat, or crew member was convicted of violating any fishing laws.
Prohibited renewal of revoked permits for a one-year period.

1954 Discontinued issuance of master abalone permits.
Abalone permits issued to each individual participant, for each abalone season.

1955 Assessed special abalone boat registration fee of $40 per year, in addition to the general boat registration fee of $10.00.

1959 Repealed special abalone boat registration fee.

1969 Fee of $100 assessed for each abalone permit, beginning with the 1970 fishing season.

1972 Introduced separate permits for abalone divers and crew members.
Diving permits issued only to those who had previously held a diving permit or had passed a proficiency test administered by the Department.

Crew member permits issued to persons who did not qualify for the diving permit. The holder of a crew member permit was authorized to assist a diver, but not engage in diving to take abalone.

1976 Limited entry system imposed upon the abalone fishery: 1) restricted all 1977 season permit renewals to those who possessed valid permits during the 1976 season; 2) limited the number of new entrants to 5%, to be selected by lottery from a pool of qualified applicants.
New applicant qualifications were based upon demonstration of proficiency and minimum of 3 years prior experience as diver or crew member.
Subsequent permit renewals to be contingent upon the minimum number or weight of landings made during the previous calendar year; those who have failed to meet minimum landing requirement were allowed to appeal to the Commission for exemption.
Increased the abalone diver permit fee to $200 and established a fee of $100 for the abalone crew member permit.

1986 Increased the abalone diver permit fee to $250 for the 1987 season and abolished the fee for the crew member permit.

1990 Increased the abalone diver permit fee to $330 for the 1991 season.
New entrants into the abalone fishery permitted only upon surrender of two existing permits.
Established new target limit of 70 abalone diving permits.

1992 Re-instituted a fee for the abalone crew member permit ($33) for the 1993 season.

A.2.2 Minimum Landing Requirement

1976 Required permit holder to land a minimum of 10,000 pounds of abalone, or make at least 20 landings of abalone per calendar year, in order to renew their abalone permit.

1979 Minimum landing requirement amended to 6,000 pounds of abalone or at least 20 landings (of at least 2 dozen abalone - i.e., 480 abalone) per calendar year.

1990 Minimum landing requirement amended to 1,200 pounds or 320 abalone per calendar year.

A.2.3 Use of Diving Gear

1907 Prohibited use of diving gear to take abalone statewide.

1909 All restrictions on diving gear to take abalone repealed statewide.

1913 Diving prohibited south and east of Santa Barbara County.

1915 Diving prohibited south of San Luis Obispo County.

1917 Diving prohibited: 1) from Point Santa Cruz (Santa Cruz County) to the Carmel River (Monterey County), except between a) Point Santa Cruz and Soquel Point (Santa Cruz County); and b) Point Piños and Seaside (Monterey County); and 2) in all waters south of Santa Luis Obispo County, except the west side of Santa Catalina Island, from Southeast Rock to the extreme westerly end of the island.

1921 Diving prohibited: 1) from Point Santa Cruz to Soquel Point; 2) from Point Piños to Seaside; and 3) all around Santa Catalina Island.

1925 Removed diving prohibitions along Santa Barbara County, excluding the Channel Islands.

1929 Diving prohibited: 1) Humboldt Bay (Humboldt County) to Sonoma County; 2) Pigeon Point (San Mateo County) to Point Santa Cruz (Santa Cruz County) (this section of coastline was reassigned to the Monterey Bay district.

1937 Diving prohibited from Mendocino County to Pigeon Point.

1939 Removed diving prohibition around San Miguel, Santa Rosa, and Santa Cruz Islands.

1941 Diving prohibited at Channel Islands off Santa Barbara County (San Miguel, Santa Rosa, and Santa Cruz Islands).

1943 Removed diving prohibitions: 1) south of Santa Barbara County and islands south of San Luis Obispo County, except Santa Catalina Island; 2) from Mendocino County to Pigeon Point, in water deeper than 20 feet.

1945 Diving prohibited: 1) Oregon border to Humboldt Bay; 2) Mendocino County to Point Lobos (San Francisco County); 3) Malibu Point to Rocky Point (Los Angeles County).

Diving permitted only in waters over 20 feet deep: 1) from Point Lobos to Pigeon Point; 2) Carmel River to San Simeon; 3) Cambria State Park to Malibu Point; 4) Rocky Point to the Mexican border.

1947 Diving prohibited, from Carmel River to Yankee Point (Monterey County).

Removed diving prohibition around Santa Catalina Island, in waters over 20 feet deep.

1949 Diving prohibited on the northeastern side of Santa Catalina Island, from the extreme westerly end of the island to Southeast Rock.

1955 Diving prohibited along the mainland, from Gaviota Creek (Santa Barbara County) to the northern city limit of San Diego.

Prohibited abalone boats or divers from operating in waters less than 20 feet deep or 150 feet from shore along the mainland: 1) Point Lobos to Pigeon Point; 2) Yankee Point to Gaviota Creek; and 3) northern city limit of San Diego to the Mexican border.

Diving permitted, in waters over 20 feet deep, along the shores of the Farallon Islands and Channel Islands (except the northeastern side of Santa Catalina Island).

1957 Removed diving prohibitions along the mainland, in waters over 20 feet deep: 1) Gaviota Creek to Malibu Point; and 2) Rocky Point to northern city limit of San Diego.

Replaced the 150 foot distance from shore restriction with the 20-foot depth restriction: 1) Point Lobos to Pigeon Point; 2) Carmel River to San Simeon; 3) Cambria State Park to Gaviota Creek; 3) northern city limit of San Diego to the Mexican border; and 4) southwestern side of Santa Catalina Island, from the extreme west end to Southeast Rock.

Re-instituted the diving closure between San Simeon and Cambria State Park.

1984 Permitted the use of diving gear to take abalone only in those areas where commercial take was allowed.

1990 Limited the use of diving apparatus (to take abalone) to those types approved by the Commission.
Permitted the use of diving gear to take abalone only while the diver is submerged.

A.2.4 Special Commercial Abalone Closure Areas

1907 Take of all shellfish, including abalone, prohibited between Point Piños and Seaside (Monterey Bay Shellfish Refuge, Monterey County).
1913 Take of black abalone prohibited south and east of Santa Barbara County.
1915 Take of black abalone prohibited south of San Luis Obispo County.
1917 Removed black abalone closure south of San Luis Obispo County.
1921 Take prohibited: 1) between Point Bacon and Pico Creek (San Luis Obispo County); and 2) inside a line 20 feet beyond extreme low tide in: a) Mendocino County to Point Santa Cruz (Santa Cruz County); b) Carmel River (Monterey County) to Point Bacon; and c) Pico Creek to Santa Barbara County.
Monterey Bay Shellfish Refuge, between Point Piños and Seaside, closed to diving.
1925 Take prohibited inside a line 20 feet beyond extreme low tide along the mainland, within Santa Barbara County.
1929 Removed closure along the mainland, between Point Bacon and Pico Creek.
The section of coastline between Pigeon Point (San Mateo County) and Point Santa Cruz was reassigned to a commercial take closure district.
Take prohibited inside a line 20 feet beyond extreme low tide, from Humboldt Bay to Sonoma County (this section was also closed to diving).
1931 Changed the commercial take exclusion zone to waters less than 20 feet deep: 1) Mendocino County to Pigeon Point; 2) Carmel River to Ventura County.
1937 Take prohibited from San Simeon Pier to south boundary of Cambria State Park (San Luis Obispo County).
1943 Take prohibited in waters less than 20 feet deep, south of Santa Barbara County and about the Channel Islands south of San Luis Obispo County.
1949 Take prohibited: 1) in all waters less than 20 feet deep; 2) Oregon border to Point Lobos (San Francisco County); 3) Pigeon Point to Yankee Point (Monterey County); 4) San Simeon Pier to Cambria State Park; 5) Malibu Point to Rocky Point (Los Angeles County).
Black abalone take prohibited along the mainland.
1953 Removed black abalone take closure along the mainland, for use as bait in lobster traps.
1955 Take prohibited along mainland coast from Gaviota Creek (Santa Barbara County) to northern city limit of San Diego (effective only until September 11, 1957).
Take prohibited within 150 feet of land and in waters less than 20 feet deep, along the mainland: 1) Point Lobos to Pigeon Point; 2) Carmel River to Gaviota Creek; and 3) northern city limit of San Diego to Mexican border.
Removed closure area between San Simeon Pier and Cambria State Park.
Black abalone take prohibited along the mainland: 1) Point Lobos to Pigeon

Point; 2) Carmel River to Gaviota Creek; and 3) northern city limit of San Diego to the Mexican border.

1957 Removed take closure along mainland coast: 1) from Gaviota Creek to Malibu Point; and 2) Rocky Point to northern city limit of San Diego, except for that of black abalone.
Reinstated take closure between San Simeon Pier and Cambria State Park.

1970 Removed take closure zone inshore of the 20-foot isobath, within one mile of shore at San Nicolas and San Miguel Islands.

1974 Removed take closure zone inshore of the 20-foot isobath, within one mile of shore at San Clemente Island.
Included provision for the re-closure of waters less than 20 feet deep, at San Nicolas, San Clemente, and San Miguel Islands or parts thereof, if the Director finds that the taking of abalone will endanger the resource.

1976 Black abalone take prohibited within one mile of shore at Santa Cruz and Anacapa Islands.
Take prohibited along the mainland between Palos Verdes Point (Los Angeles County) to Dana Point (Orange County), for a period of five years.

1979 Palos Verdes to Dana Point closure zone extended southward to northern boundary of Doheny Beach Marine Life Refuge (Orange County).

1981 Palos Verdes to Doheny Beach closure extended for an additional five-year period.

1984 Removed take closure between San Simeon Pier and Cambria State Park.
Removed take closure zone inshore of the 20-foot isobath, within one mile of shore at Anacapa, Santa Barbara, and Santa Cruz Islands.

1986 Palos Verdes to Doheny Beach closure extended for an additional five-year period.

1990 Removed take closure zone inshore of the 20-foot isobath, between Point Lobos and Pigeon Point, except within the James V. Fitzgerald Marine Reserve (San Mateo County).
Removed take closure within the James V. Fitzgerald Marine Reserve, in waters deeper than 20 feet.
Reinstated take closure inshore of the 20-foot isobath, within one mile of shore at Anacapa and Santa Barbara Islands.
Included provision for the re-closure of take areas, if the Director makes a written finding that the taking of abalone will endanger the resource therein.
Black abalone take, within one mile of shore of Anacapa, Santa Barbara, and Santa Cruz Islands scheduled for closure from January 1, 1991 through January 1, 1994.
Black abalone take along the mainland scheduled for closure beginning January 1, 1994.
Black abalone take, within one mile of shore of Anacapa, Santa Barbara, and Santa Cruz Islands scheduled for closure from January 1, 1994 through January 1, 1997.

1991 Palos Verdes to Doheny Beach abalone closure extended for an additional five-year period.

1993 Amended black abalone closure along the mainland scheduled to begin January 1, 1994 to include all areas where this species is found, and added January 1, 1997 as the sunset date.
Effective date of statewide black abalone closure amended to August 2, 1993 by the Commission.
Amended black abalone closure date for Anacapa, Santa Barbara, and Santa Cruz Islands, to January 1, 1997.
1996 Closure of green, pink, and white fishery.
1997 May 22. Emergency 120 day closure of all abalone in southern and central California.
Sept 19. Extended emergency closure.
Closure of fishery for all abalone south of San Francisco.

A.2.5 Special Gear Provisions (Devices for Taking Abalone)

1913 Use of spears prohibited.
1939 Required divers to carry a measuring device, to gauge whether abalone are legal to take.
1947 Prohibited the use of gaff hooks to take abalone.
Prohibited the use of any device larger than 36" long (except diving equipment) to take abalone.
1952 Prohibited the use of SCUBA to take abalone.
1954 Required divers to use: surface-supplied air, pumped from the diver's boat through a 100-foot air line; two baskets for gathering abalone; and a measuring device when commercially taking abalone.
1990 Restricted the type of diving apparatus that may be used to take abalone for commercial purposes (required approval by the Commission to use).

A.2.6 Species Subject to Take

1909 Only red abalone may be possessed.
1911 Possession of all abalone species permitted.
1913 Take of black abalone prohibited south and east of Santa Barbara County.
1915 Take of black abalone prohibited south of San Luis Obispo County.
1917 Removed black abalone closure south of San Luis Obispo County.
1933 Prohibited the possession of species other than pink, red, black, and green abalones.
1949 Prohibited the take of black abalone along the mainland.
1953 Removed black abalone take closure along the mainland, for use as bait in lobster traps.
1955 Permitted the take of species other than red, green, black, or pink abalones.
Prohibited the take of black abalone along the mainland: 1) Point Lobos to Pigeon Point; 2) Carmel River to Gaviota Creek; and 3) northern city limit of San Diego to the Mexican border.
1957 Named only red, pink, green, and black abalones as species that may be taken.
1976 Prohibited the take of black abalone within one mile of shore at Santa Cruz and Anacapa Islands.

1990 Black abalone take, within one mile of shore of Anacapa, Santa Barbara, and Santa Cruz Islands scheduled for closure from January 1, 1991 through January 1, 1994.
Black abalone take along the mainland scheduled for closure beginning January 1, 1994.
Black abalone take, within one mile of shore of Anacapa, Santa Barbara, and Santa Cruz Islands scheduled for closure from January 1, 1994 through January 1, 1997.

1993 Amended black abalone closure along the mainland scheduled to begin January 1, 1994 to include all areas where this species is found, and added January 1, 1997 as the sunset date.
Effective date of statewide black abalone closure amended to August 2, 1993 by the Commission.
Amended black abalone closure date for Anacapa, Santa Barbara, and Santa Cruz Islands, to January 1, 1997.

1997 Moratorium on the take of all abalone south of San Francisco Bay including the Farallon Islands.

A.2.7 Open Season

1911 Closed from March 1 to July 1. Stats

1913 Closed from February 1 to April 30.

1915 Red abalone closure during February.
Pink, black, and green abalone closure during February, March, and April.

1921 Red, pink, black, and green abalone closure from January 15 to March 15.

1933 Laws regulating seasons changed from prohibitive to permissive wording, giving protection to species not named.
Permitted the take of red, pink, black, and green abalones from March 16 to January 14.

1949 Permitted the take of black abalone at any time, only if used as bait within 5 miles of Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands only.

1953 Permitted the take of black abalone at any time, for use as bait in the waters surrounding Anacapa, Santa Cruz, Santa Rosa, San Nicolas, and San Miguel Islands, and for use as lobster bait along the mainland shore.

1955 Amended the open season regulation to include all abalone species.
Permitted the take of black abalone during the commercial lobster season only, for use as lobster bait, within one mile of Anacapa, Santa Cruz, Santa Rosa, Santa Barbara, San Nicolas, San Clemente, and San Miguel Islands.

1957 Permitted the take of red, pink, black, and green abalones during the open season.

1970 Amended the season regulation to prohibit the take of pink, green, red, and black abalones during the months of February and August.

1976 Amended the season closure regulation to include all abalone species.

1990 Added one additional month (January) to the season closure period.

A.2.8 Fishing Hours

1974 Prohibited the commercial take of abalone from one-half hour before sunset to one-half hour before sunrise.

A.2.9 Minimum Size Limit

1901 Size measured around edge of abalone shell.
Statewide, all species, 15".
1905 Statewide, black abalone, 12"; all other species, 15".
1909 Statewide, red abalone, 17" around edge of shell.
1911 Statewide, reds 17"; greens 16"; pinks 14"; and blacks 12".
1913 Statewide, reds 19"; greens 18"; pinks 16"; and blacks 14".
1917 Measurement method changed to greatest diameter.
Statewide, reds 7"; greens 6½"; pinks 6"; and blacks 5".
1921 Red abalone, 8": 1) from Mendocino County to Point Santa Cruz (Santa Cruz County); and 2) from the Carmel River (Monterey County) to Santa Barbara County.
1929 Red abalone, 8", from Humboldt Bay (Humboldt County) to Sonoma County.
Red abalone, 7", between Pigeon Point to Point Santa Cruz (Santa Cruz County).
1939 Statewide, 8", all species; required that all undersized abalone be replaced on the rock by hand, and must not be sent to the surface.
1943 Red abalone, 8": 1) Humboldt Bay to Sonoma County; 2) Carmel River to Mexican border, including the Channel Islands.
Green abalone, 7¼": Carmel River to Mexican border, including the Channel Islands.
All abalone, 8": between Mendocino County and Pigeon Point.
In all other districts: reds, 7"; greens, 6½"; pinks, 6"; and blacks, 5".
Commission regulations on minimum size limits conformed to those in the Fish and Game Code.
1945 All species, 8" in: 1) Point Lobos (San Francisco County) to Pigeon Point; 2) Carmel River to Mexican border, including the Channel Islands.
1947 Statewide: reds, 8"; greens, 7¼"; pinks, and blacks, 6".
1949 Black abalone size limit of 6" continued by the Commission.
Black abalone taken for lobster bait (permitted at Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands), 5".
1950 Statewide: black abalone, 5", including those taken for use as lobster bait.
1955 Statewide: reds, 8"; greens, 7¼"; blacks, 5"; all other species, 6".
1959 Red abalone minimum size increased to 7¾".
1969 Red abalone, 7¾"; green, 7½"; pink and white, 6"; black, 5".
1970 Pink and white abalone, increased to 6¼".
1971 Decreased minimum size for pinto, threaded, and flat abalone to 4".
1972 Decreased minimum size for green abalone to 7".
1974 Increased minimum size for black abalone to 5¾".
1984 Provided alternate minimum size limits, to become operative only if the number of abalone permits issued was reduced to 100 or fewer: Red abalone, 7½"; green, 6¾"; white, 6¼"; pink, 6"; black, 5¾"; all other species, 4".

1990 Repealed alternate minimum size limits established in 1984, which were to become effective only if the number of abalone permits issued was reduced to 100 or fewer.

A.2.10 Landing Limit

1949 No limit imposed upon black abalone taken and used as bait, within 5 miles of shore, of Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands

1953 No limit imposed upon black abalone taken for use as bait in the waters surrounding Anacapa, Santa Cruz, Santa Rosa, San Nicolas, and San Miguel Islands, or those taken for use as lobster bait along the mainland shore.

1955 No limit imposed upon black abalone taken for use as lobster bait within one mile of Anacapa, Santa Cruz, Santa Cruz, Santa Rosa, Santa Barbara, San Nicolas, San Clemente, and San Miguel Islands.

1974 Limited the number of black abalone that can be possessed aboard a commercial permit holder's boat to 20 dozen (240 abalone).

1990 Imposed a daily landing limit of 84 (7 dozen) abalone of each species, per permittee, or total of 168 abalone per vessel, between Point Lobos and Pigeon Point.

In all other districts where commercial take is permitted: daily limit of 180 (15 dozen) abalone of each species, per permittee, or 360 abalone per vessel 15 dozen (180 abalone) of each species per day.

A.2.11 Possession and Condition at Landing

1911 Required all abalone to be landed (brought ashore) alive and attached to shell.

1925 Permitted possession of abalone in sliced condition during the closed season, provided that the abalone were taken by legal means.

1955 Prohibited the transportation of black abalone, taken for use as bait in lobster traps, to the mainland or to Santa Catalina Island.

1967 Repealed provisions allowing the possession of abalone in sliced condition during the closed season.

Prohibited the transportation or possession of abalone detached from shells unless the meat has been prepared for immediate consumption or has been commercially processed.

1976 Prohibited the possession of black abalone aboard any boat within one mile of shore at Santa Cruz and Anacapa Islands, except in specified areas and conditions.

A.2.12 Uses

1911 Restricted use of abalone to food purposes only.

1949 Permitted the use of black abalone for bait, within 5 miles of shore, of Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands only.

1953 Permitted the use of black abalone for bait in the waters surrounding Anacapa, Santa Cruz, Santa Rosa, San Nicolas, and San Miguel Islands, and for use as lobster bait along the mainland shore.

1955 Permitted use of black abalone as bait in lobster traps, within one mile of Anacapa, Santa Cruz, Santa Barbara, Santa Rosa, San Nicolas, San Miguel,

and San Clemente Islands, only during the commercial lobster season.
Repealed provision for use of black abalone for bait, other than in commercial lobster traps. [§801.5]

1979 Restricted use of abalone to food purposes only.
Repealed provision allowing the use of black abalone for lobster bait during the commercial lobster season.

A.2.13 Processing Methods

1915 Drying prohibited.
1970 Permitted drying of all abalone, except for black abalone.
Prohibited the canning and drying of black abalone.
1971 Drying of black abalone permitted.

A.2.14 Exportation of Abalone Products

1913 Prohibited out-of-state exportation of: 1) fresh or dry abalone meat; 2) canned abalone, packed in tins larger than one pint; and 3) abalone shells, except articles manufactured from them.
1915 Permitted out-of-state exportation of canned abalone meats, in containers smaller than one pint.
1917 Prohibited out-of-state exportation of canned abalone meats.
1941 Permitted out-of-state exportation of abalone meal or chowder, made from trimmings by a reduction process.
Required exported chowder to be packed in No. 10 size cans or larger.
1947 Discontinued requirement on size of can in which abalone chowder may be shipped out of state.
1953 Permitted out-of-state exportation of abalone trimmings when ground, canned, or frozen, or made into meal or chowder.
1967 Temporarily inactivated ban on out-of state exportation of abalone meat.
1971 Repealed all restrictions upon out-of-state abalone exportation.

A.2 15 Landing (Privilege) Taxes

1917 Required wholesale shellfish dealers to pay a privilege tax of 2½ cents for each 100 pounds (i.e., $0.00025 per pound) of any fish, other than salmon, purchased, received, or taken.
1953 Increased privilege tax rate to 5 cents per 100 pounds (i.e., $0.0005 per pound).
1971 Adjusted privilege tax for all mollusks and crustaceans, except squid and crab, to $0.01 per pound.
1978 Adjusted privilege tax for all mollusks and crustaceans, except squid and crab, to $0.0125 per pound.
1990 Assessed an additional tax of $0.195 per pound of abalone landed, to fund abalone enhancement and restoration projects.

A.2.16 Penalties for Violations

1972 Established grounds for abalone permit suspension for persons charged with abalone season, possession/transportation, or size limit violations.

1990 Increased penalties for those convicted of illegal abalone take, including permanent revocation of the person's commercial fishing license and any commercial fishing permits, and loss of sport fishing privileges.

A.2.17 The Commission's Regulatory Authority

1939 Authorized the Commission to regulate the abalone permit process.

1949 The Legislature repealed the Commission's authority to close waters greater than 20 feet deep: 1) Point Lobos to Pigeon Point; 2) Yankee Point to Mexican border, except: a) all bays along the mainland, south of Point Rincon (Ventura County); b) seaward side of Santa Catalina Island, from Southeast Rock to the westerly point of the island.

1972 Authorized the Commission to hold hearings to decide whether the Department should suspend commercial abalone permits of persons charged with season, size limit, illegal possession, or transportation violations.

1979 Authorized the Commission to: 1) close or open areas, for up to two years, to commercial take, when necessary to prevent overuse or to rehabilitate abalone resources, provided that the area closed is also closed to the sport taking of abalone (operative date, March 1,1992); and 2) establish the number of commercial abalone diving permits to be issued each annual season, as necessary to protect the resource.

1990 Authorized the Commission to regulate the type of diving apparatus that can be used to take abalone for commercial purposes.

1999 Commission given responsibility to develop a recovery and management plan for abalone.

A.2.18 Miscellaneous

1939 Required unuseable dark-meated abalone rejected by divers to be replaced by hand upon the rock from whence it was taken.

1945 Prohibited the sale of abalone taken by a holder of a sport fishing license.

1983 Made it unlawful for any person to knowingly purchase, for the purpose of resale, any abalone taken illegally from California waters.

Appendix B. Excerpts from Legal Documents Relating to Abalone

B.1 California State Constitution

B.1.1 Provision for Fish and Game Commission

Art. IV, Sec. 20. (a) The Legislature may provide for division of the State into fish and game districts and may protect fish and game in districts or parts of districts.
(b) There is a Fish and Game Commission of 5 members appointed by the Governor and approved by the Senate, a majority of the membership concurring, for 6-year terms and until their successors are appointed and qualified. Appointment to fill a vacancy is for the unexpired portion of the term. The Legislature may delegate to the Commission such powers relating to the protection and propagation of fish and game as the Legislature sees fit. A member of the Commission may be removed by concurrent resolution adopted by each house, a majority of the membership concurring.

B.1.2 Fish and Game Preservation Fund - Public Finance

Art. XVI, Sec. 9. Money collected under any state law relating to the protection or propagation of fish and game shall be used for activities relating thereto.

B.1.3 The Right of the People to Fish in State Waters

Art. I, Sec. 25. The people shall have the right to fish upon and from the public lands of the State and in the waters thereof, excepting upon lands set aside for fish hatcheries, and no land owned by the State shall ever be sold or transferred without reserving in the people the absolute right to fish thereupon; and no law shall ever be passed making it a crime for the people to enter upon the public lands within this State for the purpose of fishing in any water containing fish that have been planted therein by the State; provided, that the Legislature may by statute, provide for the season when and the conditions under which the different species of fish may be taken.

B.2. California Fish and Game Code

B.2.1 California Fish and Game Commission

§45. "Fish"

"Fish" means wild fish, mollusks, crustaceans, invertebrates, amphibians, including any part, spawn, or ova thereof.

§200. Commission's Power To Regulate Taking of Fish & Game

There is hereby delegated to the commission the power to regulate the taking or possession of birds, mammals, fish, amphibia, and reptiles to the extent and in the manner prescribed in this article.
No power is delegated to the commission by this article to regulate the taking, possessing, processing, or use of fish, amphibia, kelp, or other aquatic plants for commercial purposes, and no provision of this code relating or applying thereto, nor any regulation of the commission made pursuant to such provision, shall be affected by this article or any regulation made under this article.

§202. Exercise of Powers

The commission shall exercise its powers under this article by regulations made and promulgated pursuant to this article. Regulations adopted pursuant to this article shall not be subject to the time periods for the adoption, amendment, or repeal of regulations prescribed in Sections 11343.4, 11346.4, and 11346.8, and 11347.1 of the Government Code.

§203.1. Adopting of Regulations - Criteria

When adopting regulations pursuant to Section 203, the commission shall consider populations, habitat, food supplies, the welfare of individual animals, and other pertinent facts and testimony.

§205. Fish and Reptiles Regulations

Any regulation of the commission pursuant to this article which relates to fish, amphibia, and reptiles, may apply to all or any areas, districts, or portion thereof, at the discretion of the commission, and may do any or all of the following as to any or all species or subspecies:

(a) Establish, extend, shorten, or abolish open seasons and closed seasons.

(b) Establish, change, or abolish bag limits, possession limits, and size limits.

(c) Establish and change areas or territorial limits for their taking.

(d) Prescribe the manner and the means of taking.

§206. Fish, Amphibia and Reptiles Regulations Meetings

(a) In addition to, or in conjunction with, other regular or special meetings the commission shall, at least every three years, hold meetings in the first 10 days of August, October, November, and December for the purpose of considering and adopting revisions to regulations relating to fish, amphibians, and reptiles. The commission shall alternate the locations of the August and December meetings between Los Angeles or Long Beach and Sacramento, and the October and November meetings between San Diego and Redding or Red Bluff.

(b) At the August meeting, the commission shall receive recommendations for regulations from its own members and staff, the department, other public agencies, and the public.

(c) At the October and November meetings, the commission shall devote time for open public discussion of proposed regulations presented at the August meeting. The department shall participate in this discussion by reviewing and presenting its findings regarding each regulation proposed by the public and by responding to objections raised pertaining to its proposed regulations. After considering the public discussion, the commission shall announce, prior to adjournment of the November meeting, the regulations it intends to add, amend, or repeal relating to fish, amphibia, and reptiles.

(d) At the December meeting, the commission may choose to hear additional public discussion regarding the regulations it intends to adopt. At, or within 20 days after, the meeting, the commission shall add, amend, or repeal regulations relating to any recommendation received at the August meeting regarding fish, amphibia, and reptiles it deems necessary to preserve, properly utilize, and maintain each species or subspecies.

(e) Within 45 days after adoption, the department shall publish and distribute regulations adopted pursuant to this section.

§209. Meeting Notification

(a) The commission shall determine and give notice of the date and location of the first meeting required to be held during a year by Sections 206, 207, and 208 at least 60 days prior to that first meeting. The commission shall give notice of any change in the date or location of that first meeting at least 30 days prior to the meeting date.
(b) The commission shall cause to be published the notice required in subdivision (a) in each newspaper of general circulation, as defined in Section 6000 of the Government Code, with an average daily circulation of 50,000 or more.
(c) The commission shall set the dates of its meetings in order to provide maximum time for public review of proposed regulations consistent with the proper management of the species or subspecies affected. All meetings required by Sections 206, 207, and 208 shall be open to the public and, to the extent feasible, held in state facilities.

§210. Regulations; Distribution

(a) The commission shall provide copies of the regulations added, amended, or repealed pursuant to subdivision (e) of Section 206, subdivision (e) of Section 207, and subdivision (d) of Section 208 to each county clerk, each district attorney, and each judge of the superior court in the state.
(b) The commission and the department may do anything that is deemed necessary and proper to publicize and distribute regulations so that persons likely to be affected will be informed of them. The failure of the commission to provide any notice of its regulations, other than by filing them in accordance with Section 215, shall not impair the validity of the regulations.
(c) The department or the license agent may give a copy of the current applicable published regulations to each person issued a license at the time the license is issued.
(d) Notwithstanding any other provision of law, the commission and the department may contract with private entities to print regulations and other regulatory and public information. Printing contracts authorized by this subdivision and for which no state funds are expended are not subject to Chapter 2 (commencing with Section 10290) of Part 2 of Division 2 of the Public Contract Code, except for Article 2 (commencing with Section 10295) of Chapter 2.

§211. Advertising Specifications

(a) Material printed pursuant to subdivision (d) of Section 210 that contains advertisements shall meet all specifications prescribed by the department. The printed material shall not contain advertisements for tobacco products, alcohol, firearms and devices prohibited pursuant to Sections 12020, 12220, and 12280 of the Penal Code, or firearms not authorized by the commission as a legal method of sport-hunting, political statements, solicitations for membership in organizations, or any other statement, solicitation, or product advertisement that is in conflict with the purposes for which the material is produced, as determined by the commission. The printing contract shall include criteria to ensure that the public information provided in the publication is easy to reference, read, and understand.

(b) Neither the department nor the commission shall contract with private entities to print the materials described in subdivision (d) of Section 210 if the letting of those contracts will result in the elimination of civil service positions.

§215. Regulations; Filing and Effect

Every regulation of the commission made pursuant to this article shall be filed with the Secretary of State, and shall become effective at the time specified therein, but not sooner than the date of the filing.

§218. Regulations; Review by Court

Any regulation of the commission made pursuant to this article shall be subject to review in accordance with law by any court of competent jurisdiction.

§219. Regulations vs. Code Section

Any regulation adopted pursuant to this article may supersede any section of this code designated by number in the regulation, but shall do so only to the extent specifically provided in the regulation. A regulation which is adopted pursuant to this section shall be valid only to the extent that it makes additions, deletions, or changes to this code under one of the following circumstances:

(a) The regulation is necessary for the protection of fish, wildlife, and other natural resources under the jurisdiction of the commission.

(b) The commission determines that an emergency exists or will exist unless the action is taken. An emergency exists if there is an immediate threat to the public health, safety, and welfare, or to the population or habitat of any species.

A regulation which is adopted pursuant to this section shall be supported by written findings adopted by the commission at the time of the adoption of the regulation setting forth the basis for the regulation. A regulation adopted pursuant to this section shall remain in effect for not more than 12 months from its effective date.

§220. Regulations; Effective Periods

(a) Any regulation of the commission added or amended pursuant to this article shall remain in effect for the period specified therein or until superseded by subsequent regulation of the commission or by statute.

(b) Notwithstanding this article, the commission may add, amend, or repeal regulations at any regular or special meeting if facts are presented to the commission which were not presented at the time the original regulations were adopted and if the commission determines that those regulations added, amended, or repealed are necessary to provide proper utilization, protection, or conservation of fish and wildlife species or subspecies.

B.2.2 California Department of Fish and Game

B.2.2.1 Organization and General Functions

§711. Adequate Funding - Legislative Intent

It is the intent of the Legislature to ensure adequate funding from appropriate sources for the department. To this end, the Legislature finds and declares that:

(a) The costs of nongame fish and wildlife programs and free hunting and fishing license programs shall be provided annually in the Budget Act by appropriating money from the General Fund and sources other than the Fish and Game Preservation Fund to the department for these purposes.

(b) The costs of commercial fishing programs shall be provided out of revenues from commercial fishing taxes, license fees, and other revenues, from reimbursement and federal funds received for commercial fishing programs, and other funds appropriated by the Legislature for this purpose.

(c) The costs of hunting and sportfishing programs shall be provided out of hunting and sportfishing revenues and reimbursements and federal funds received for hunting and sportfishing programs, and other funds appropriated by the Legislature for this purpose. These revenues, reimbursements, and federal funds shall not be used to support commercial fishing programs, free hunting and fishing license programs, or nongame fish and wildlife programs.

(d) The costs of managing lands managed by the department and the costs of wildlife management programs shall be supplemented out of revenues in the Native Species Conservation and Enhancement Account in the Fish and Game Preservation Fund.

(e) The department shall conduct, or contract for, a review, at least every five years, of its programs to ensure consistency with this section.

(f) Hunting, sportfishing, and sport ocean fishing license fees shall be adjusted annually to an amount equal to that computed pursuant to Section 713. However, a substantial increase in the aggregate of hunting and sportfishing programs shall be reflected by appropriate amendments to the sections of this code that establish the base sport license fee levels. The inflationary index provided in Section 713 may not be used to accommodate a substantial increase in the aggregate of hunting and sportfishing programs.

For purposes of this article, "substantial increase" means an increase in excess of 5 percent of the Fish and Game Preservation Fund portion of the department's current year support budget, excluding cost-of living increases provided for salaries, staff benefits, and operating expenses.

§1700. Policy - To Encourage Conservation, Etc. of Living Resources

It is hereby declared to be the policy of the state to encourage the conservation, maintenance, and utilization of the living resources of the ocean and other waters under the jurisdiction and influence of the state for the benefit of all the citizens of the state and to promote the development of local fisheries and distant-water fisheries based in California in harmony with international law respecting fishing and the conservation of the living resources of the oceans and other waters under the jurisdiction and influence of the state. This policy shall include all of the following objectives:

(a) The maintenance of sufficient populations of all species of aquatic organisms to insure their continued existence.
(b) The recognition of the importance of the aesthetic, educational, scientific, and nonextractive recreational uses of the living resources of the California Current.
(c) The maintenance of a sufficient resource to support a reasonable sport use, where a species is the object of sport fishing, taking into consideration the necessity of regulating individual sport fishery bag limits to the quantity that is sufficient to provide a satisfying sport.
(d) The growth of local commercial fisheries, consistent with aesthetic, educational, scientific, and recreational uses of such living resources, the utilization of unused resources, taking into consideration the necessity of regulating the catch within the limits of maximum sustainable yields, and the development of distant-water and overseas fishery enterprises.
(e) The management, on a basis of adequate scientific information promptly promulgated for public scrutiny, of the fisheries under the state's jurisdiction, and the participation in the management of other fisheries in which California fishermen are engaged, with the objective of maximizing the sustained harvest.
(f) The development of commercial aquaculture.

B.2.2.2 Recreational Fishing

§5520. Abalone Management; Legislative Intent
It is the intent of the Legislature that the commission undertake management of abalone in a manner consistent with the abalone recovery and management plan submitted pursuant to Section 5522.

§5521. Moratorium on Taking, Possessing or Landing Abalone; Areas Affected
A moratorium is imposed on the taking, possessing, or landing of abalone (genus Haliotis) for commercial or recreational purposes in ocean waters of the state south of a line drawn due west magnetic from the center of the mouth of the San Francisco Bay, including all islands offshore the mainland of California, including, but not limited to, the Farallon Islands and the Southern California Channel Islands. It is unlawful to take, possess, or land abalone for commercial or recreational purposes in those ocean waters while the moratorium is in effect.

§5521.5. Unlawful to Take Abalone for Commercial Purposes; Districts Affected
(a) In addition to the moratorium imposed by Section 5521, and notwithstanding any other provision of law, it is unlawful to take abalone for commercial purposes in District 6, 7, 16, 17, or 19A, in District 10 north of Point Lobos, or in District 20 between Southeast Rock and the extreme westerly end of Santa Catalina Island.
(b) There shall be a rebuttable presumption, affecting the burden of producing evidence, that a person who is required to obtain a license pursuant to Section 7145 and who takes or possesses more than 12 individual abalone or takes abalone in excess of the annual bag limit possesses the abalone for commercial purposes.

§5521.6. Registered Aquaculturist May Collect Abalone for Broodstock
Notwithstanding Sections 5521 and 5521.5, a registered aquaculturist may collect abalone for broodstock, in accordance with subdivision (b) of Section 15301.

§5522. Abalone Recovery and Management Plan
(a) On or before January 1, 2003, the department shall submit to the commission a comprehensive abalone recovery and management plan. The plan shall contain all of the following:
(1) An explanation of the scientific knowledge regarding the biology, habitat requirements, and threats to abalone.
(2) A summary of the interim and long-term recovery goals, including a range of alternative interim and long-term conservation and management goals and activities. The department shall report why it prefers the recommended activities.
(3) Alternatives for allocating harvest between sport and commercial divers if the allocation of the abalone harvest is warranted.
(4) An estimate of the time and costs required to meet the interim and long-term recovery goals for the species, including available or anticipated funding sources, and an initial projection of the time and costs associated with meeting the final recovery goals. An implementation schedule shall also be included.
(5) An estimate of the time necessary to meet the interim recovery goals and triggers for review and amendment of strategy.
(6) A description of objective measurable criteria by which to determine whether the goals and objectives of the recovery strategy are being met and procedures for recognition of successful recovery. These criteria and procedures shall include, but not be limited to, the following:
(A) Specified abundance and size frequency distribution criteria for former abalone beds within suitable habitat not dominated by sea otters.
(B) Size frequency distributions exhibiting multiple size classes as necessary to ensure continued recruitment into fishable stock.
(C) The reproductive importance to the entire ecosystem of those areas proposed for reopening to harvest and the potential impact of each reopening on the recovery of abalone population in adjacent areas.
(b) Where appropriate, the recovery and management plan may include the following:
(1) A network of no-take abalone reserves.
(2) A total allowable catch, reflecting the long-term yield each species is capable of sustaining, using the best available science and bearing in mind the ecological importance of the species and the variability of marine ecosystems.
(3) A permanent reduction in harvest.
(c) Funding to prepare the recovery and management plan and any planning and scoping meetings shall be derived from the fees collected for the abalone stamp.
(d) On or before January 1, 2008, and following the adoption of the recovery and management plan by the commission, the department may apply to the commission to reopen sport or commercial fishing in all or any portion of the waters described in Section 5521. If the commission makes a finding that the resource can support additional harvest activities and that these activities are consistent with the abalone recovery plan, all or a portion of the waters described in Section 5521 may be reopened

and management measures prescribed and implemented, as appropriate. The commission may close or, where appropriate, may establish no-take marine refuges in any area opened pursuant to this section if it makes a finding that this action is necessary to comply with the abalone management plan.
(e) If the commission determines that commercial fishing is an appropriate management measure, priority for participation in the fishery shall be given to those persons who held a commercial abalone permit during the 1996-97 permit year.

§7100. Applications of Provisions
The provisions of this part apply to the taking and possession of fish for any purpose other than commercial.

§7120. Possession of Bag Limit
It is unlawful for any person to possess more than one daily bag limit of any fish taken under a license issued pursuant to Section 714 or Article 3 (commencing with Section 7145) unless authorized by regulations adopted by the commission pursuant to Section 206.

§7121. Sell or Purchase Fish
Except as otherwise provided by this code or by regulation, it is unlawful to sell or purchase any fish or amphibia taken in, or brought into, the waters of the state, or brought ashore at any point in the state.
It is unlawful to buy, sell, or possess in any place of business where fish are bought, sold, or processed, any fish or amphibia taken on any boat, barge, or vessel which carries sport fishermen, except those fish may be possessed in such a place only for the purposes of canning or smoking under regulations adopted by the commission.

§7145. License Requirements
(a) Except as otherwise provided in this article, every person 16 years of age or older who takes any fish, reptile, or amphibia for any purpose other than profit shall first obtain a license for that purpose and shall have that license on his or her person or in his or her immediate possession or where otherwise specifically required by law or regulation to be kept when engaged in carrying out any activity authorized by the license. In the case of a person diving from a boat, the license may be kept in the boat, or in the case of a person diving from the shore, the license may be kept within 500 yards on the shore.
(b) This section does not apply to an owner of real property, or the owner's invitee, who takes fish for purposes other than profit from a lake or pond that is wholly enclosed by that owner's real property and that is located offstream and not hydrologically connected to any permanent or intermittent waterway of the state.
This subdivision does not, and shall not be construed to, authorize the introduction, migration, stocking, or transfer of aquatic species, prohibited species, or any other nonnative or exotic species into state waters or waterways. This subdivision does not supersede or otherwise affect any provision of law that governs aquaculture, including, but not limited to, the operation of trout farms, the operation of other enterprises for profit, or any activity that is an adjunct to or a feature of, or that is operated in

conjunction with, any other enterprise operated for profit, including private parks or recreation areas.

§7400. Recreational Abalone Advisory Committee; Membership

(a) The director shall appoint a Recreational Abalone Advisory Committee consisting of nine members who shall serve without compensation. The members of the advisory committee shall be selected as follows:

(1) Six members who are not officers or employees of the department. The six members shall be residents of California and meet the following requirements:

(A) Two members shall reside north of the southern boundary line of Marin County and a line extending due east from the easternmost point of Marin County located in San Pablo Bay. The two members shall be selected from nominations submitted by the Northern California Shellfish Assessment Program or by individuals or organizations that actively participate in the recreational abalone fishery, except that not more than one of the members selected shall be an active or former commercial abalone diver or involved in commercial seafood processing or marketing.

(B) Two members shall reside south of the southern boundary line of Marin County and a line extending due east from the easternmost and north of the boundary between Santa Barbara and San Luis Obispo Counties and aline extending due east from the easternmost point in that boundary line. The two members shall be selected from nominations submitted by the Central California Council of Divers, the Southern California Shellfish Assessment Program, the Northern California Shellfish Assessment Program, or by individuals or organizations that actively participate in the recreational abalone fishery, except that not more than one of the members selected shall be an active or former commercial abalone diver or involved in commercial seafood processing or marketing.

(C) Two members shall reside south of the boundary between Santa Barbara and San Luis Obispo Counties and a line extending due east from the easternmost point in that boundary line. The two members shall be selected from nominations submitted by the Greater Los Angeles Council of Divers, the San Diego Council of Divers, the Channel Islands Council of Divers, the Southern California Shellfish Assessment Program, or by individuals or organizations that actively participate in the recreational abalone fishery, except that not more than one of the members selected shall be an active or former commercial abalone diver or involved in commercial seafood processing or marketing.

(2) One member shall represent the department in enforcement activities and shall be selected from personnel in the Wildlife Protection Division.

(3) Two members shall be marine scientists who are or have been involved in abalone research at universities, state universities, or in state or federal programs. Not more than one of the persons shall be an officer or employee of the department.

(b) No member shall be involved in or profit from the culture for sale (commercial aquaculture) of abalone.

(c) The advisory committee shall meet at least once each calendar year to review proposals and recommend to the director projects and budgets for the expenditure of fees received pursuant to Section7149.8. The committee may review progress reports and the results of projects funded under this article and make recommendations to the director regarding abalone resource management.

§8300. - 8314. *(Repealed by Statutes 1997)*

B.2.2.3 Fines and Penalties

§12009. Abalone-related Violations - Punishment

(a) Notwithstanding Section 12000, and except as provided in Section 12006.6, the punishment for a violation of any provision of Section 5521 or 5521.5, or any regulation adopted pursuant thereto, or of Section 7121 involving abalone, is a fine of not less than fifteen thousand dollars ($15,000) or more than forty thousand dollars ($40,000) and imprisonment in the county jail for a period not to exceed one year. The court shall permanently revoke any commercial fishing license, commercial fishing permit, or sport fishing license issued by the department. Any vessel, diving or other fishing gear or apparatus, or vehicle used in the commission of an offense punishable under this section, may be seized and may be ordered forfeited by the court pursuant to subdivision (c) of Section 12157. Notwithstanding any other provision of law, the commercial license of any person arrested for a violation punishable under this section may not be sold, transferred, loaned, or leased, or used as security for any financial transaction until disposition of the charges is final.
(b) Notwithstanding any other provision of law, the money collected from any fine or forfeiture imposed or collected for the taking of abalone for any purpose other than for profit in violation of this article or any other provision of law shall be deposited as follows:

(1) One-half in the Abalone Restoration and Preservation Account.
(2) One-half in the county treasury of the county in which the violation occurred.

§12009.1. Abalone - Unlawful Possession - Penalties [Renumbered from 8311]

(a) Notwithstanding Section 12000, and in addition to Section 12009, if any person is convicted of a violation of a regulation permitting the taking of abalone under a sport fishing or sport ocean fishing license issued pursuant to Article 3 (commencing with Section 7145) of Chapter 1 of Part 2, and that person had more than seven times the number of abalone permitted to be possessed under those regulations, that person shall be fined not less than five times the prevailing market value of the abalone.
(b) In addition to the fine, upon a conviction punishable under this section, the court shall order the department to revoke, and the department shall revoke, the person's sport fishing or sport ocean fishing license for one year.
(c) If the court finds that the person convicted of a violation punishable under this section had more than seven times the number of abalone permitted, had more than seven undersized abalone, or had more than seven abalone removed from the shell, or has had his or her fishing privileges revoked pursuant to subdivision (b) for three separate convictions punishable under this section, the court shall order the department to permanently revoke, and the department shall permanently revoke, the person's sport fishing or sport ocean fishing license. A person whose sport fishing privilege is revoked pursuant to this section shall not be eligible for any license or permit, including, but not limited to, a commercial fishing license, to take or possess fish in this state for life.

(d) This section shall remain in effect only until January 1, 2002, and as of that date is repealed, unless a later enacted statute, which is enacted before January 1, 2002, deletes or extends that date. *(Renumbered and amended by Statutes 1997 Amendment 787)*

B.3 California Code of Regulations, Title 14

B.3.1 Ocean Fishing

§27.00. Definition
The Ocean and San Francisco Bay District consists of the open seas adjacent to the coast and islands or in the waters of those open or enclosed bays contiguous to the ocean, and including San Francisco and San Pablo bays plus all their tidal bays, tidal portions of their rivers and streams, sloughs and estuaries between Golden Gate Bridge and Carquinez Bridge, and the waters of Elkhorn Slough, west of Elkhorn Road between Castroville and Watsonville.

§27.15. Multi-Day Fishing Trips.
The following provisions apply to anglers and to boat owners and operators when a Declaration for a Multi-Day Fishing Trip has been filed with the Department of Fish and Game.
(a) Provisions related to the angler: Up to three daily bag and possession limits of saltwater fin fish, lobster and rock scallops and up to two daily bag and possession limits of abalone are allowed for a person fishing during a multi-day trip in ocean waters from a boat whose owner or operator has filed a Declaration for Multi-Day Fishing Trip, pursuant to the provisions of subsection (b) below.
(1) The provisions of this section do not authorize any person to take more than one daily bag limit of fish during one calendar day.
(2) The provisions of this section do not apply to the taking and possession of salmon, steelhead, striped bass and sturgeon.
(b) Provisions related to the boat owner or operator who has filed for a Declaration for a Multi-Day Fishing Trip:
(1) The owner or operator of a boat shall mail or deliver to the nearest office of the department a Declaration for Multi-Day Fishing Trip application form provided by the department and a $3.50 filing fee. The applicant shall provide the following information:
(A) Place, date and time of departure of the boat.
(B) Place, date and estimated time of return of the boat.
(C) Name and/or number of the boat, including the number of any Fish and Game registration number plates assigned to the vessel.
(D) Copy of passenger manifest if fishing within 10 miles of the mainland shore of California.
(E) Date and hour Declaration mailed or delivered to the Fish and Game Department office.
(2) The Declaration for Multi-Day Fishing Trip form must be submitted to the nearest office of the department in order for any person aboard such boat to possess more than one bag limit of saltwater fin fish, abalone, lobster and rock scallops. If mailed, the form

must be received at least 48 hours prior to the date of the boat's departure. If the 48-hours advance notice is not met, the original copy of the form signed by an authorized department representative, must be aboard the vessel during the trip. Forms will be accepted for authorization only during business hours of 8:00 a.m. to 5:00 p.m.
(3) A Declaration for Multi-Day Fishing Trip may not be filed for a trip unless the trip is continuous and extends for a period of 12 hours or more on the first and last days of the trip and no berthing or docking is permitted within five miles of the mainland shore.
(4) The owner or operator of a boat filing a Declaration for Multi-Day Fishing Trip shall prepare such form in duplicate, and shall require the duplicate to be posted in full view of the passengers aboard the boat.
(5) All passengers must disembark at place of return stated on Declaration.

B.3.2 Invertebrates

§29.05. General

(a) Except as provided in this article there are no closed seasons, closed hours or minimum size limits for any invertebrate. The bag limit on all invertebrates for which the take is authorized and for which there is not a bag limit otherwise established in this article is 35. In San Francisco and San Pablo bays and saltwater tributaries east of the Golden Gate Bridge invertebrates may not be taken at night except from the shore.
(b) Tidal invertebrates may not be taken in any tidepool or other areas between the high tide mark (defined as Mean Higher High Tide) and 1,000 feet seaward and lateral to the low tide mark (defined as Mean Lower Low Water) except as follows:
(1) In state parks, state beaches, state recreation areas, state underwater parks, state reserves, national parks, national monuments or national seashores: Only abalones, chiones, clams, cockles, rock scallops, native oysters, crabs, lobsters, ghost shrimp and sea urchins may be taken. Worms may be taken except that no worms may be taken in any mussel bed, unless worms are taken incidental to the harvesting of mussels. Mussels may be taken in all areas except in state park system reserves or natural preserves.
(2) In all other areas, except where prohibited within marine life refuges or other special closures: Abalone, limpets, moon snails, turban snails, chiones, clams, cockles, mussels, rock scallops, native oysters, octopuses, squid, crabs, lobsters, shrimp, sand dollars, sea urchins and worms may be taken.
(3) Special Closure. No invertebrates shall be taken on the mainland shore within the boundaries of Ano Nuevo State Reserve between the high tide mark and 100 feet beyond the low tide mark between November 30 and April 30. Public access to Año Nuevo State Reserve is subject to change and anglers are advised to contact the Reserve office (650) 879-2025 prior to fishing. No invertebrates may be taken between the high tide mark and 1000 feet beyond the low tide mark along the lee side of Santa Catalina Island between Lion Head Point and Arrow Point.
(c) Measuring Devices. Every person while taking invertebrates which have a size limit shall carry a device which is capable of accurately measuring the size of the species taken.
(d) In all ocean waters skin and SCUBA divers may take invertebrates as provided in this article except that in all ocean waters north of Yankee Point (Monterey Co.),

self-contained underwater breathing apparatus (SCUBA) may be used only to take sea urchins, rock scallops and crabs of the genus *Cancer*. For the purpose of this section, breathing tubes are not underwater artificial breathing devices.

§29.10. General.

(a) Except as otherwise provided in this article, saltwater mollusks, including octopus, may be taken only on hook and line or with the hands.
(b) The size of a mollusk is measured in greatest shell diameter.

§29.15. Abalone.

(a) Geographical Area: Abalone may only be taken north of a line drawn due west magnetic from the center of the mouth of San Francisco Bay. No abalone may be taken, landed, or possessed if landed south of this line.
(b) Open Season and Hours: Abalone may be taken only during the months of April, May, June, August, September, October and November from one-half hour before sunrise to one-half hour after sunset.
(c) Bag Limit and Yearly Trip Limit: Three red abalone, *Haliotis rufescens*, may be taken per day. No more than three abalone may be possessed at any time. No other species of abalone may be taken or possessed. Each person taking abalone shall stop detaching abalone when the limit of three is reached. No person shall take more than 24 abalone during a calendar year.
(d) Minimum Abalone Size: All red abalone must be seven inches or greater measured along the longest shell diameter. All legal size abalone detached must be retained. No undersize abalone may be brought ashore or aboard any boat, placed in any type of receiver, kept on the person, or retained in any person's possession or under his control. Undersize abalone must be replaced immediately to the same surface of the rock from which detached. Abalones brought ashore shall be in such a condition that the size can be determined.
(e) Special Gear Provisions: The use of SCUBA gear or surface-supplied air to take abalone is prohibited. Abalone may not be taken or possessed aboard any boat, vessel, or floating device in the water containing SCUBA or surface-supplied air. Abalone may be taken only by hand or by devices commonly known as abalone irons. Abalone irons must be less than 36 inches long, straight or with a curve having a radius of not less than 18 inches, and must not be less than 3/4 inch wide nor less than 1/16 inch thick. All edges must be rounded and free of sharp edges. Knives, screwdrivers and sharp instruments are prohibited.
(f) Measuring Device: Every person while taking abalone shall carry a fixed caliper measuring gauge capable of accurately measuring seven inches. The measuring device shall have fixed opposing arms of sufficient length to measure the abalone by placing the gauge over the shell.
(g) Abalone Possession and Transportation: Abalones must not be removed from their shell, except when being prepared for immediate consumption.
(h) Abalone Permit Report Card. All persons required to possess a sport fishing license must have a non-transferable Abalone Permit Report Card (FG 2915 (New 12/03) issued by the department while taking abalone. The Abalone Permit Report Card shall be kept with the fishing license while taking or attempting to take abalone. Persons

diving from a boat shall keep the license and Abalone Permit Report Card in the boat. The Abalone Permit Report Card shall be completed as required immediately upon returning and boarding the boat with abalone. Persons diving from the shore shall keep the license and Abalone Permit Report Card within 500 yards of the shore. Persons shall, immediately upon bringing ashore an abalone, make a hole and completely remove the punched section from the report card in one of the designated locations for each abalone taken, and record with indelible ink, the date, time, and location code in the spaces provided adjacent to the hole. For the purposes of theis sectin a boat is defined as any watercraft used or capable of being used as a means of transportation on water (reference Section 9840(a), Vehicle Code and Section 6552(q), Title 14, California Code of Regulations). An Abalone Permit Report Card shall be valid during the open season for taking abalone in the calendar year for which it was issued. No person may be issued or possess more than one Abalone Permit Report Card or any Abalone Permit Report Card other than their own. The Abalone Permit Report Card must be returned to the Department of Fish and Game at 19160 South Harbor Drive, Fort Bragg, California, 95437-5798.
(i) Upon purchase of the Abalone Permit Report Card, the card number shall be entered by the license agent in ink on the back of the angler's sport fishing license. The sport fishing license number shall be entered by the license agent on the Abalone Permit Report Card on the appropriate line.

B.3.3 Commercial Fish

§100. Abalone.

Abalone may not be taken for commercial purposes.

Appendix C. Location of the Requirements and Items Suggested for Inclusion in the ARMP by Fish and Game Code §5522(a) and (b).

FGC Section	Content Requirements	Location in ARMP
5522(a)(1)	Explanation of scientific knowledge	Chapter 2
5522(a)(2)	Interim and long-term recovery goals	Chapter 6
	Interim and long-term conservation and management goals and activities	Chapter 7
5522(a)(3)	Alternatives for allocating harvest between sport and commercial divers if allocation is warranted	Chapter 7
5522(a)(4)	Estimate of the time and costs to meet the recovery goals, including funding sources and an implementation timeline	Chapters 6 and 8
5522(a)(5)	Estimate of time necessary to meet the interim recovery goals	Chapters 6 and 8
	Triggers for review and amendment of strategy	Chapters 6 and 8
5522(a)(6)	Description of objective measurable criteria to determine whether the goals and objectives of the recovery strategy are being met and procedures for the recognition of successful recovery	Chapter 6
5522(a)(6)(A)	Specified abundance and size frequency distribution criteria for former abalone beds (in non-otter territory)	Chapters 6 and 7
5522(a)(6)(B)	Size frequency distributions exhibiting multiple size classes	Chapter 6
5522(a)(6)(C)	Reproductive importance to the ecosystem of areas proposed for reopening and impact on recovery of abalone populations in adjacent areas	Chapters 6 and 7
5522(b)(1)	A network of no-take reserves	Chapters 6 and 7
5522(b)(2)	A total allowable catch	Chapter 7
5522(b)(3)	A permanent reduction in harvest	Chapter 7

Appendix D. Maps of Historical Commercial and Recreational Abalone Fishing by Fishing Blocks

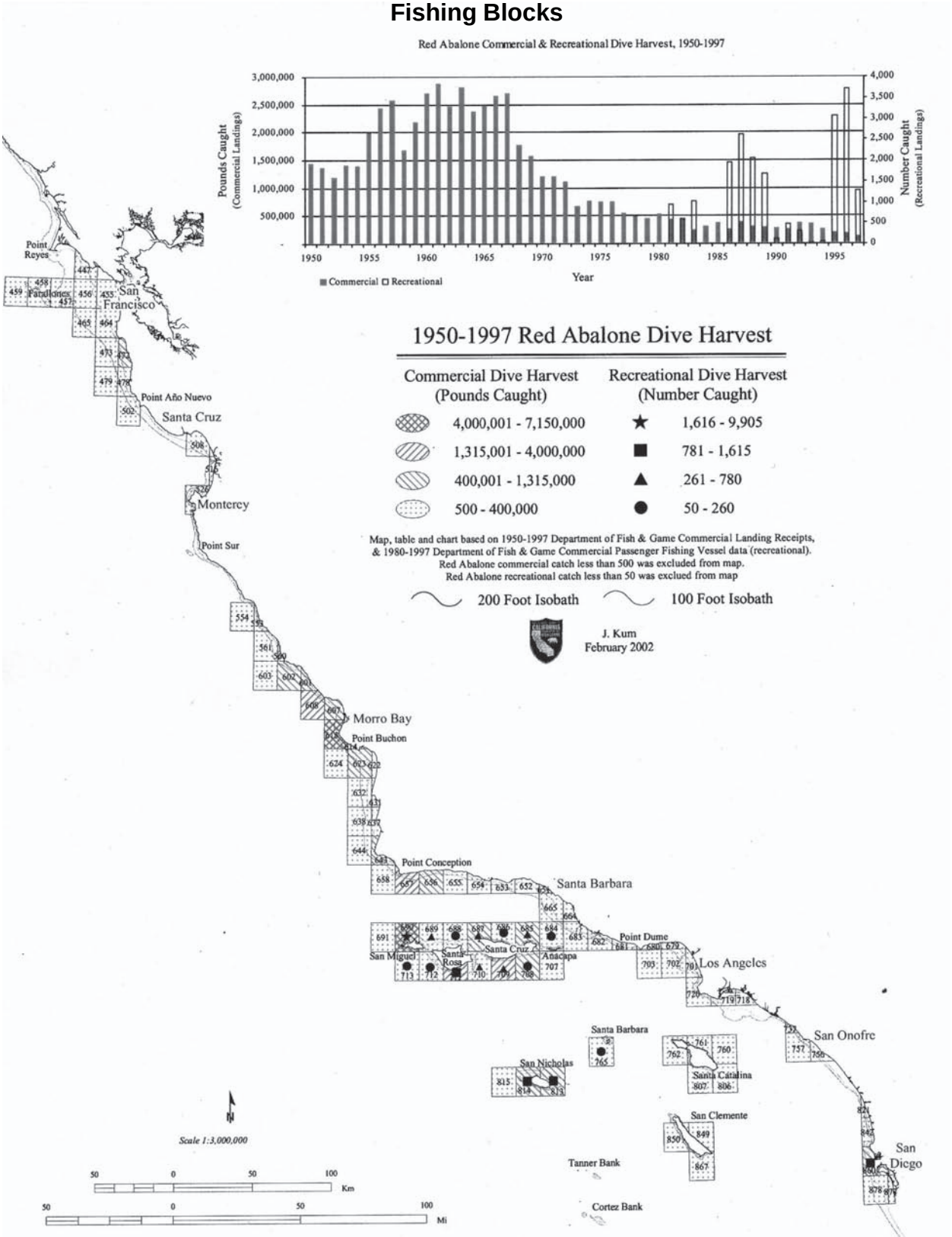

Figure D-1. Red abalone commercial catch from 1950 to 1997, and recreational catch for 1980 to 1997. The table (legend) codes range of commercial landings in pounds, and the range of sport take in numbers within the CDFG fishery block system (map). The graph displays the commercial take (pounds) and sport take (numbers) by year.

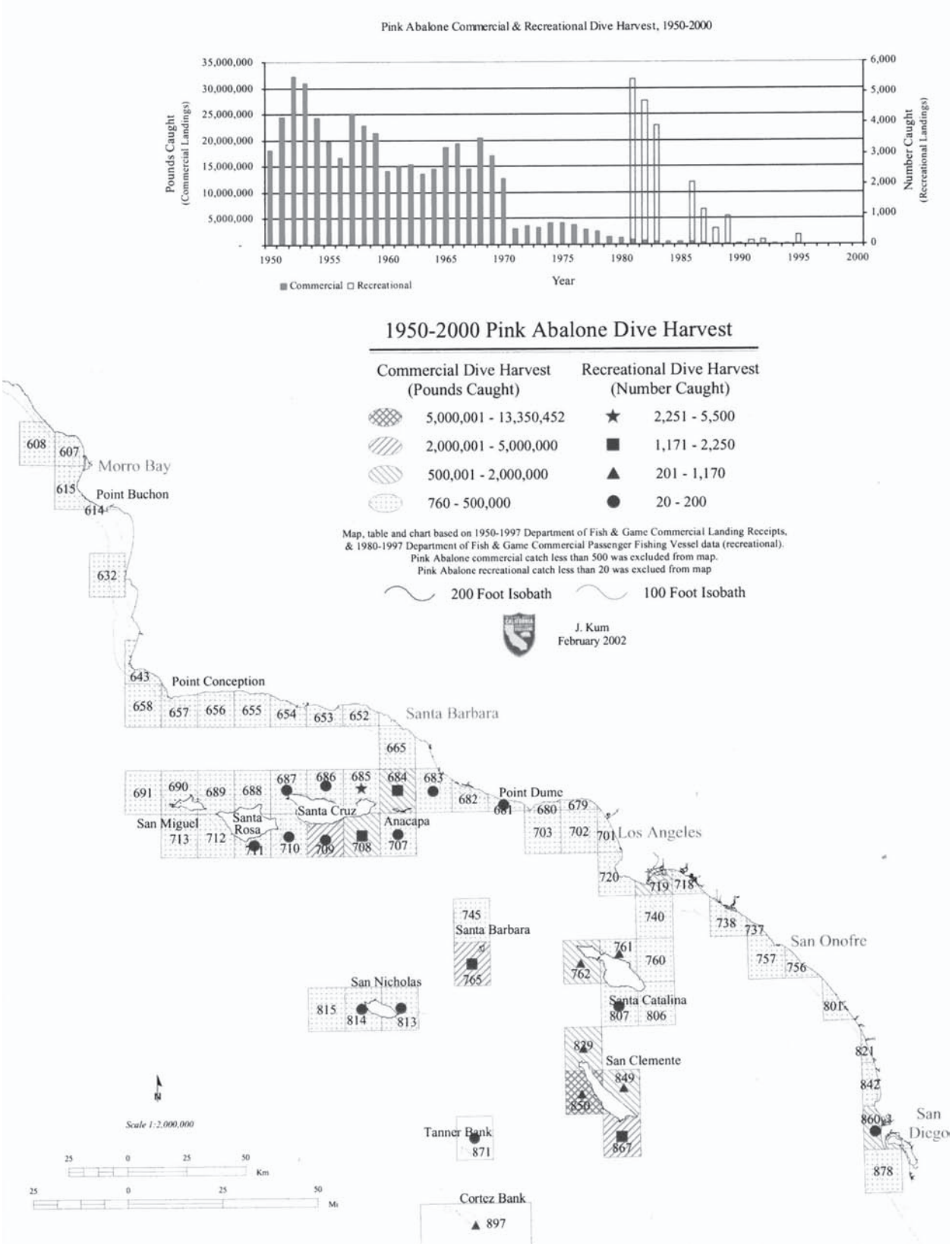

Figure D-2. Pink abalone commercial catch from 1950 to 1997, and recreational catch for 1980 to 1997. The table (legend) codes range of commercial landings in pounds, and the range of sport take in numbers within the CDFG fishery block system (map). The graph displays the commercial take (pounds) and sport take (numbers) by year.

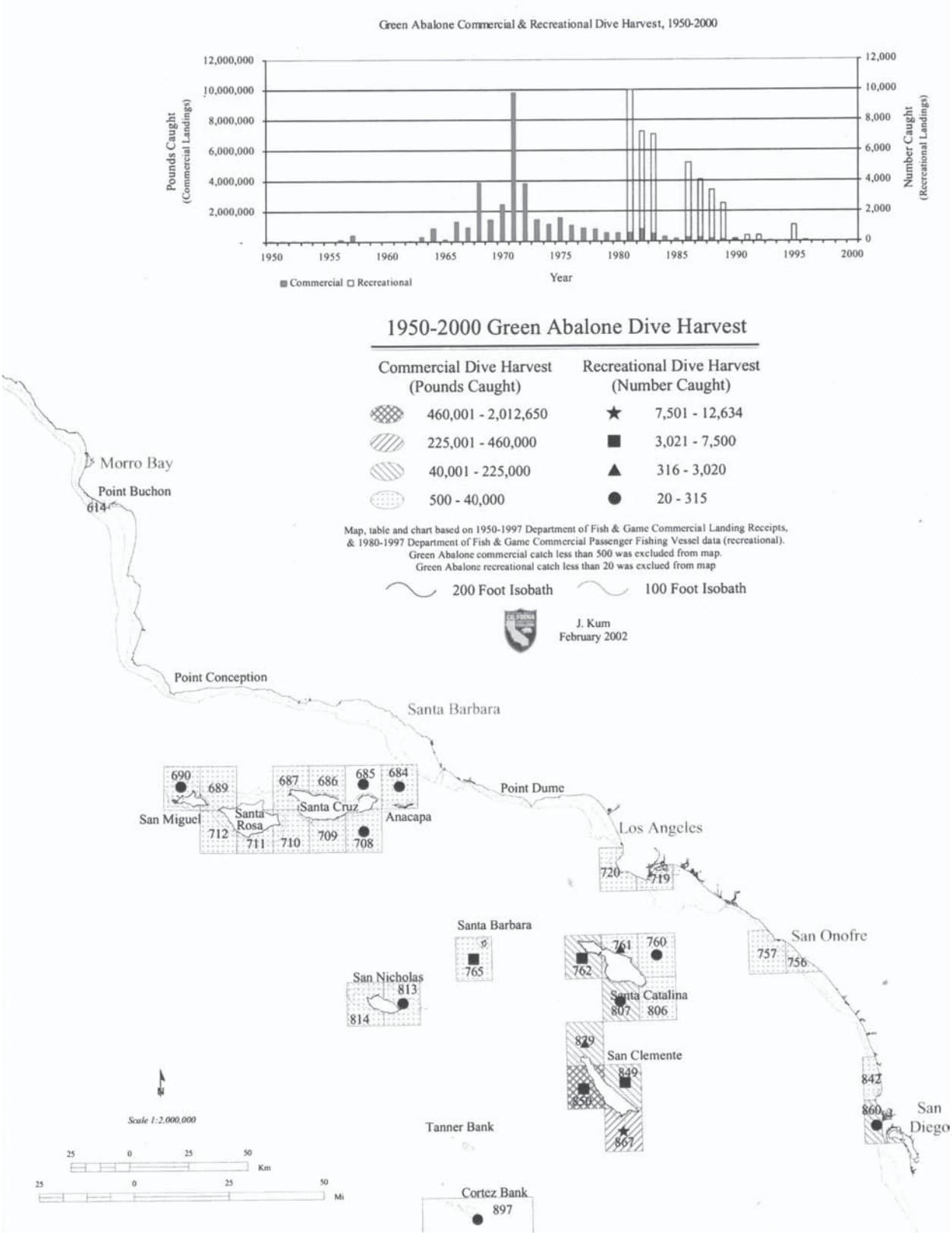

Figure D-3. Green abalone commercial catch from 1950 to 1997, and recreational catch for 1980 to 1997. The table (legend) codes range of commercial landings in pounds, and the range of sport take in numbers within the CDFG fishery block system (map). The graph displays the commercial take (pounds) and sport take (numbers) by year.

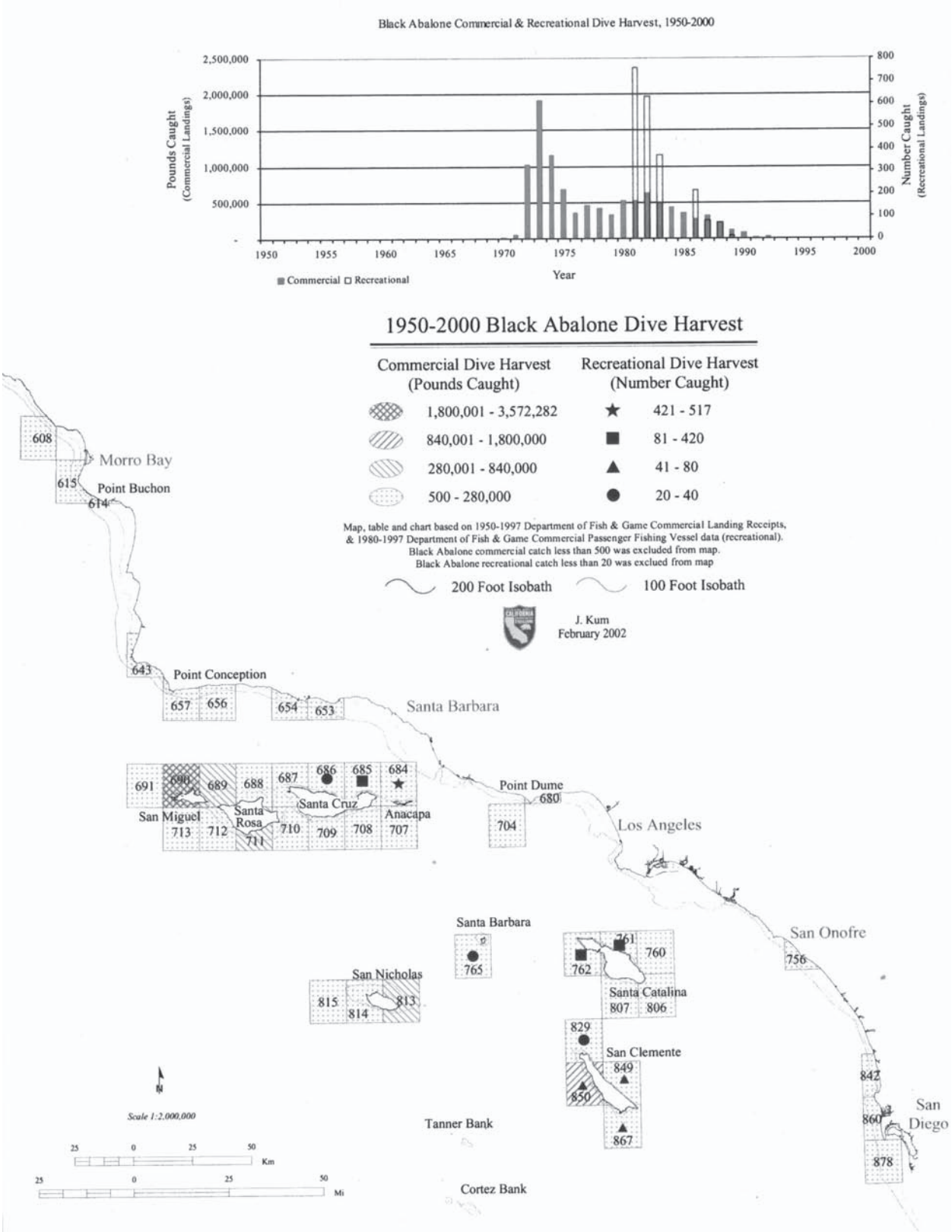

Figure D-4. Black abalone commercial catch from 1950 to 1997, and recreational catch for 1980 to 1997. The table (legend) codes range of commercial landings in pounds, and the range of sport take in numbers within the CDFG fishery block system (map). The graph displays the commercial take (pounds) and sport take (numbers) by year.

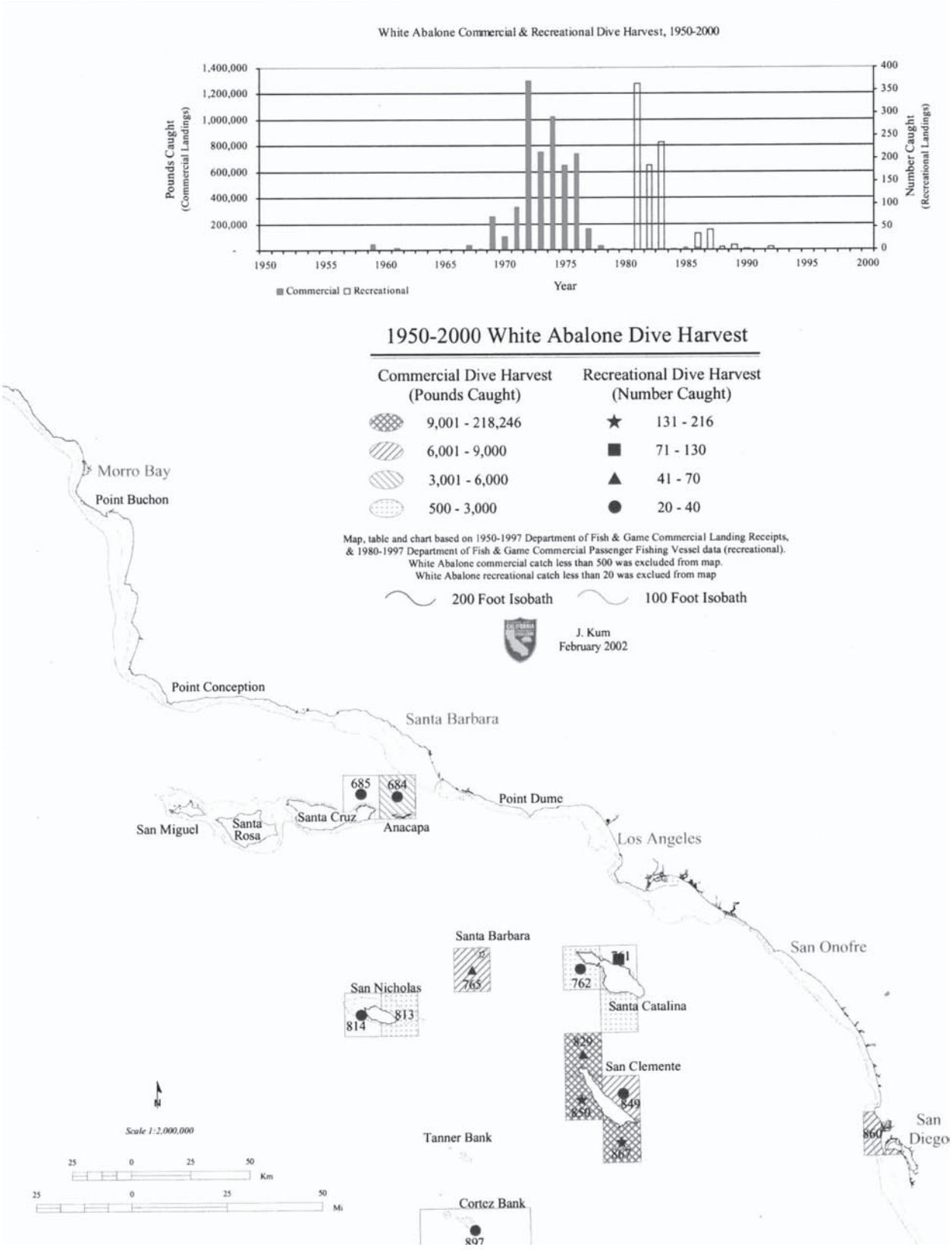

Figure D-5. White abalone commercial catch from 1950 to 1997, and recreational catch for 1980 to 1997. The table (legend) codes range of commercial landings in pounds, and the range of sport take in numbers within the CDFG fishery block system (map). The graph displays the commercial take (pounds) and sport take (numbers) by year.

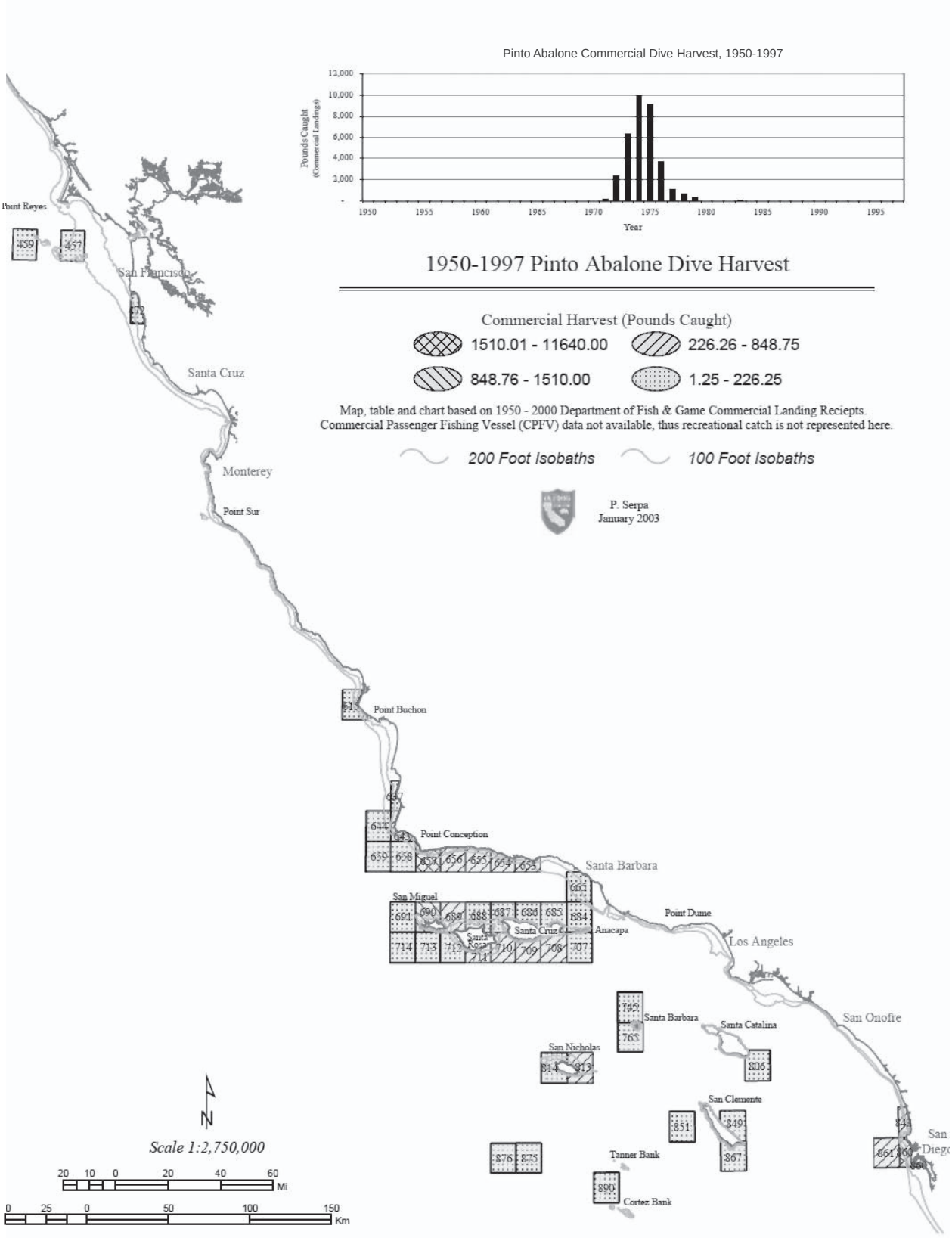

Figure D-6. Pinto abalone commercial catch from 1950 to 1997. The table (legend) codes range of commercial landings in pounds within the CDFG fishery block system (map). The graph displays the commercial take (pounds) by year.

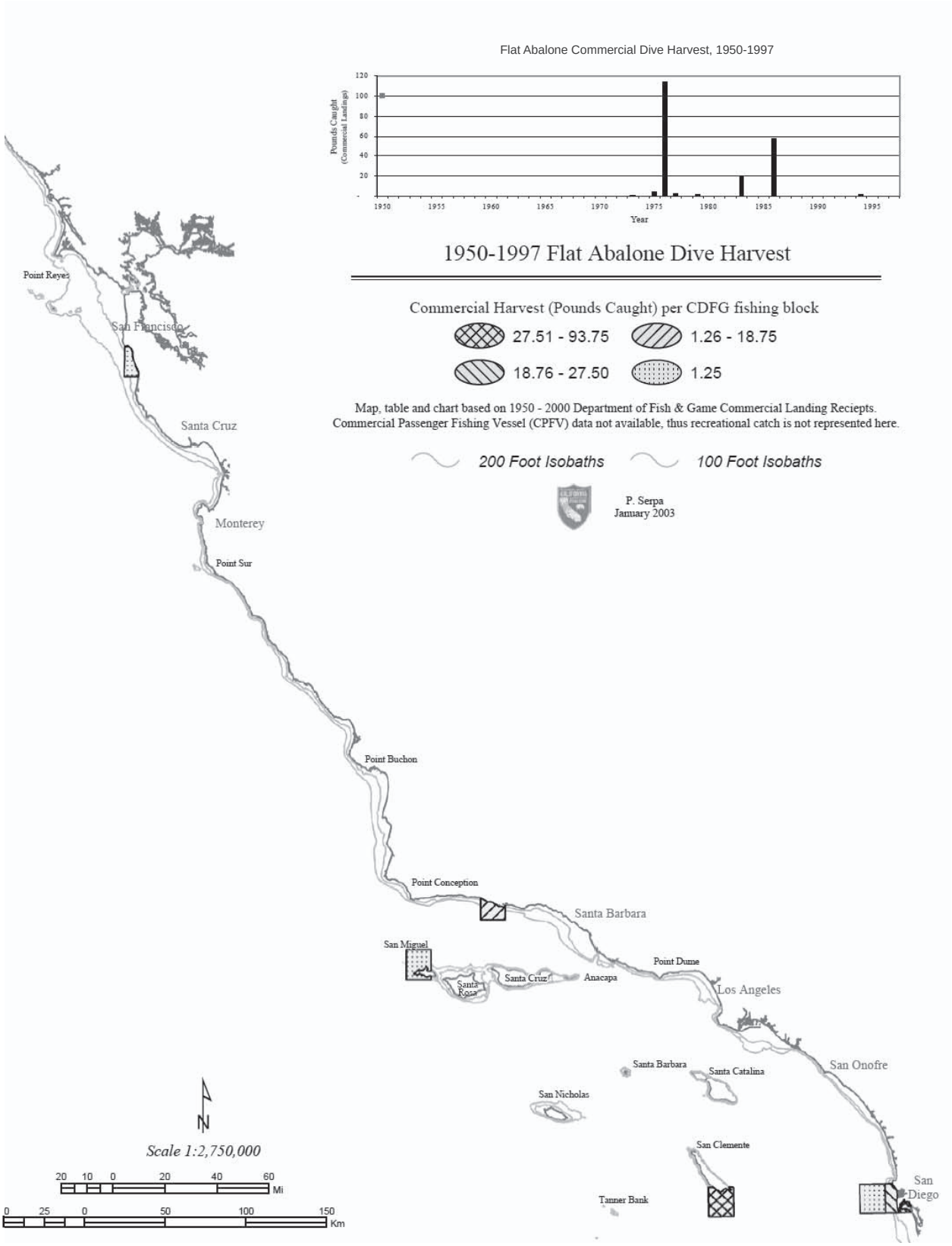

Figure D-7. Flat abalone commercial catch from 1950 to 1997. The table (legend) codes range of commercial landings in pounds within the CDFG fishery block system (map). The graph displays the commercial take (pounds).

Appendix E. Survey Methods

E.1 Timed Search Surveys

Timed-diver searches in appropriate habitat are used to find, measure, and count abalone, collect information about abalone aggregations, document the presence of withering syndrome (WS), and collect abalone shell data. The key information collected includes:

- Relative abundance of abalone, expressed in terms of abalone encountered per unit search time (number per hr.)
- The size frequency distribution of abalone in a given location
- A count of the number and size of abalone aggregations.

A timed-search survey is conducted by a two or three person dive team. Multiple dive teams may conduct surveys within a given location at different depth ranges.

A survey starts with a dive team recording the GPS point of reference on the water surface just prior to the start of the dive. Then the dive team descends to the bottom and begins swimming in a specific compass direction, usually along a depth contour. All abalone encountered during the swim are measured to the nearest millimeter and counted. Abalone that cannot be measured due to inaccessibility or other reasons are only counted. Abalone counts and measurements are recorded by species. Abalone aggregations (two or more abalone within a meter of each other) are counted and the number of individuals in the group are noted. Any abalone exhibiting signs of disease, such as WS, is noted. At the end of the survey the total time spent searching for abalone is noted prior to ascending to the surface.

One problem with this method is the lack of comparability between surveys due to variability among divers' ability to find abalone; some divers are much better and will find more abalone per unit time than other divers, given the same density of abalone. Also, the higher the abalone density, the more time spent removing, measuring, and examining abalone and recording information, which is not accounted for in the recorded search time. These problems can also make the calibration of timed surveys with unit area surveys difficult.

E.2 Transect Surveys

Since density-based transect surveys will not be employed until after criterion 1 levels occur, it is expected that new methods will modify current density-based surveys in the future. In the interim, the current transect methodology used in management of the northern California red abalone fishery is described for use in these recovery surveys.

There are two types of transects that are used. The first type, called emergent transects, are long (30 x 2 m) and target animals greater than 50 mm. The second type, invasive transects, are smaller (5 x 2 m) and are used to assess the density of cryptic juvenile invertebrates.

Dive teams are deployed at target locations and depths using GPS and sonar devices (either hand-held or boat-mounted). Transect tapes are stretched out by divers on rocky substrate (more than 50% rock substrate) and the ends of the tapes are

secured. Divers swim transect lines roughly north-south, following the targeted depth contour. Each diver collects information from one side of the transect (1 x 30m) either to the right or the left side. Transects are marked every 5 meters.

Emergent transects are used to collect abundance and size frequency data for animals visible on the surface of rocks, in rock crevices, and on the underside of rocks. The substrate (including rocks and sea urchins) is not moved during emergent surveys. Divers conducting invasive transect surveys collect abundance and size frequency data by moving rocks and sea urchins, searching with flashlights and within foliose algae, looking specifically for juveniles (young-of-the-year), in addition to recording emergent animals. Invasive transects are deployed from one end of an emergent transect.

E.3 Detailed Habitat Survey

The objective of the detailed habitat survey is to quantify habitat characteristics in areas where abalone occur. The goal is to identify optimal habitat for the abalone species. A description of the optimal habitat will be beneficial in selecting areas for recovery actions and in refining abundance estimates.

The detailed habitat survey is conducted in different ways depending on the type of survey equipment involved. In the case of white abalone, habitat surveys involve the use of video recordings from either ROV or manned submersible searches in deeper white abalone habitat. For green and pink abalone, which occur at shallower depths, a SCUBA diver tracking and information recording system such as the Dive Tracker could be used to quantify habitat.

For ROV or submersible surveys, the video record for each dive will be post-processed for habitat typing. Technicians will quantify habitat by watching the video and recording data by a standard time interval. Algal cover including a selected list of species, the number of abalone by species, depth, habitat type, and substrate relief will also be recorded. The habitat data with the time interval and the recorded GPS track data for the ROV or submersible can be used in constructing community maps in a Geographic Information System.

The SCUBA diving surveys which use a diver tracking system will work in a similar manner to the ROV/submersible surveys except that the data can be collected and recorded in real time rather than post-processed from a video recording. The diver tracking system records the diver's movement, which can be used in mapping. The diver can also enter habitat data into a key pad which stores the data for downloading to a computer at the end of the dive.

E.4 Intertidal Surveys

Intertidal surveys are designed for measuring and counting black abalone populations. Surveys are conducted during negative tide periods. Timed searches in appropriate habitat are used to find, measure, and count abalone, collect information about abalone aggregations, document the presence of WS, and collect abalone shell data. The key information collected includes:

- Relative abundance of abalone, expressed in terms of abalone encountered per
- Unit search time (number per hr.)
- A size frequency distribution of abalone in a given location

- A count of the number and size of abalone group aggregations.
- To conduct a survey, personnel search all available rocky crevice habitat in a given area for 30 minutes. Within this time interval all abalone encountered are measured to the nearest millimeter and counted. Abalone that cannot be measured for various reasons are just counted. Abalone aggregations (two or more abalone that are within a meter of each other) are counted and the number of individuals in the group are noted. Any abalone exhibiting signs of sickness, such as WS, is noted.

E.5 Remotely-operated Vehicle (ROV) Surveys

ROVs are useful tools for assessing populations of abalones in nearshore waters deeper than 5 m. ROVs have few operational depth and bottom-time limits, making them a useful alternative to SCUBA and manned submarine surveys. ROVs allow the investigation of hazardous habitat that would otherwise remain unsurveyed.

Surveys using ROVs provide much information about the ecology, distribution, and available habitat of California's invertebrates, including abalones. In addition to collecting data on abalones, information on community structure is also collected. This peripheral information provides insight into the community associations that greatly influence abalone. ROV-collected videos generate detailed descriptions of available habitat, which are necessary for monitoring species-specific habitat loss over time. Since all ROV dives are tracked by a Global Positioning System based tracking system, these communities can be easily located on a map, providing further monitoring information.

ROVs typically include:

- A GPS-based tracking system to facilitate track placement on a map
- A high quality video recording of the track to verify and identify individual abalone, associated plants, and substrate type
- A means to record depth along the track
- A minimum of two parallel mounted lasers, which provide a means of measuring animal size and generating estimated transect width
- A form of artificial lighting to illuminate the transect

Following an ROV dive, technicians view the video to record data on the species of abalones present, their sizes and numbers, other species present, and the habitat in which they occur. The data and comments are entered into a database record which is linked to a time code and GPS position from the dive. From this record, the specific locations of each abalone, along with its community associates and habitat, can be mapped.

Appendix F. Peer Review Process

F.1 Peer Review

The Sea Grant Cooperative Extension program administered the independent peer review of the draft ARMP. Sea Grant was responsible for acquiring the services of appropriately qualified experts and for providing a written report to the Department. Department staff have reviewed the peer review findings and revised the ARMP accordingly. If the Department disagreed with any aspect of the peer review findings, it explained the basis for disagreement (see below). The Department has submitted the peer review report to the Commission.

F.1.1 Overview of Peer Review Comments

The following review of the Abalone Recovery and Management Plan (ARMP) was submitted in response to Section 7062 (a) of the Fish and Game Code, which requires "external peer review of the scientific basis of marine living resources management documents." The review was written by a panel of four scientists with diverse backgrounds and expertise in fisheries matters: Louis W. Botsford, University of California at Davis; Alan Campbell, Fisheries and Oceans, Canada; Susan S. Hanna, Oregon State University; and Robert E. Sizemore, Washington Department of Fish and Wildlife.

The peer review panelists acknowledged that developing a recovery and management plan for abalone is a complex and challenging task, and commended the staff of the Department (CDFG) for the work it has done. Nevertheless, the ARMP contained deficiencies that are identified and discussed in the following sections.

F.1.2 Comments From the Peer Review Report, with Department Responses in Italics

F.1.2.1 Report Organization

Comment: The report as presently organized contains a great deal of redundancy and is lacking a logical progression in the presentation of information. Terms should be more specifically defined. The ARMP contains many assertions that should be supported by citations of the scientific literature. Technical editing is needed.

Response: *Redundant statements were removed from sections where they were deemed unnecessary and references were made to the sections where the statements were retained. The overall organization follows the format for fishery management plans developed by the Department's Marine Region. Definitions for terms indicated by Peer Review Panel (reviewers) and Department staff were added to the Glossary.*

Initially, the document was written with citations in the traditional scientific document format. After this draft was reviewed internally it was decided that in order to make the document more user-friendly to a wider public audience these citations should be removed. Citations have been re-incorporated into the document as suggested.

Comment: A fishery management plan is a framework document that guides decisions. As such, it should contain a systematic assessment of what is known and not known about the fishery, its history, management objectives, and options for actions. The general structure of a fishery management plan is to begin with an assessment of the current situation (legal environment, status of stocks, management, and socio-economics) followed by an evaluative history of the fishery, specification of objectives, identification of management alternatives to meet those objectives, evaluation of management alternatives for achieving those objectives, specification of a plan to monitor and evaluate progress toward meeting objectives, and identification of research and data needs.

Response: *The revised ARMP covers the topics suggested by the reviewers. The structure of the ARMP deviates from reviewers suggestions because it follows the format for fishery management plans developed by the Marine Region.*

Comment: The white abalone status report (Hobday, A.J. and M. J. Tegner. 2000. *Status review of white abalone (Haliotis sorenseni)* NOAA Technical Memorandum NAA-TM-NMFS-SWR-035. May 2000.) is a good example of the technical level of writing that should be in the plan.

Response: *The Department drafted the ARMP to appeal to a wider audience than that for a technical memorandum. This has resulted in a reduction of some of the more technical aspects, while still providing enough technical information for informed decision-making either directly in the plan or in appendices or via cited reference material.*

Comment: Chapter 4 (legal framework) lays out the institutional context for abalone management. This should be brought to the front of the document.

Response: *The structure of the ARMP deviates from reviewers suggestions because it follows the format for fishery management plans developed by the Marine Region.*

Comment: A positive aspect of the plan highlighted by the review team is its inclusion of criteria to guide changes in TACs and to evaluate different stages of resource recovery. The criteria could be made more specific in terms of their operational definitions, but the fact that quantitative criteria to evaluate decisions are included is praiseworthy. It indicates intent to take a systematic, adaptive approach to recovery and management. However, the decision programs specified will work only if they are rigorously enforced (i.e., standards are not lowered when abundance declines).

Response*: Establishing criteria for TAC changes are a key to the ARMP. While the Fish and Game Commission has the final authority for regulating the fishery, formalizing the criteria through the ARMP helps ensure that those standard levels will be maintained in the future.*

F.1.2.2 Costs and Funding

Comment: The management of the abalone fishery was previously conducted with insufficient fishery-independent data or technical expertise, which contributed, in part, to the present need for closures, quota reductions, and restoration.

***Response**: Although insufficient data and expertise were factors in the closure of California abalone fisheries, another significant factor was the sentiment that biologists needed to demonstrate harm to fished populations before further restricting the fishery.*

A more precautionary outlook is prevalent in fisheries management today that will facilitate protecting abalone populations.

Comment: The average annual allocations for recovery assessments total $66,000 and management assessments total $68,000. This represents only 9% of the costs identified to implement the management plan and is inadequate to meet the stated need for improved stock assessment. The reviewers recommend that funding for stock assessment should be increased.

***Response**: The allocations mentioned come from Table 9-3 and do not include Department staff salaries which consist of an additional estimated $413.5 thousand for recovery and management.*

Comment: The funding from sport fishers reporting cards creates a dependent relationship between continuation of the fishery and implementation of this plan, which compromises the precautionary approach and the objective to re-build stocks.

***Response**: Because abalone is a high priority species, the majority of funding expended is from sources other than abalone permit report card funds (Table 9-3). If abalone permit report card funds are reduced or eliminated due to closures, it is likely that alternative funding will be identified to cover management, research, and enforcement needs. If funding sources become less available, the Department will adopt a more cautious management approach for abalone.*

Comment: The reviewers recommend that funding for community involvement and public education should be increased.

***Response**: The Department agrees that community involvement and public education are important components to management plans and many public education efforts such as contact by wardens and answering questions during creel sampling, boat shows, and ocean-themed festivals are not accounted for in the ARMP cost tables.*

Comment: Lacking funding from other sources, increases in cost recovery from user groups could be explored for funding of research, fishery catch monitoring and other critical rebuilding elements.

***Response**: The only current user group is the northern California recreational abalone fishermen. Increasing fees would require legislation and the unpredictability of the legislative process makes it an unreliable method of increasing available funding. Increases in fees could also cause an overall decline in revenues if a large number of people decline to participate in the fishery due to higher fees.*

F.1.2.3 Expected Elements

Comment: The ARMP is not in the form of a typical fishery management plan or recovery plan. It needs to be a technical, scientifically supported framework that policy makers can use to make management decisions.

***Response**: Chapter 5 is a summary of information presented in greater detail in Chapters 6 and 7, which was added to address some of these concerns. The structure of the ARMP deviates from reviewers' suggestions because it follows the format for fishery management plans developed by the Marine Region.*

Comment: The summary of existing scientific knowledge of California abalone should be complete (i.e., include all relevant scientific information) and well-documented (i.e., supported by references).

***Response**: Text and references were added to make the summary of knowledge more complete.*

Comment: Both technical terms (e.g., "keystone species") and critical commonly used terms (e.g., "sustainable") should be defined.

***Response**: Technical terms and critical commonly used terms were added to the Glossary.*

Comment: In addition to definitions, the report needs an operational basis for computing the value of defined terms to enable judging whether a definition or goal is met (i.e. The northern California fishery is referred to as "sustainable"; does that simply mean that it has not collapsed yet?)

***Response**: The ARMP supplies densities for critical population levels such as minimum viable population and sustainable fishing level in Chapter 5. The sustainable fishery level was determined from Department surveys conducted in 1999 and 2000 at 3 sites (see Section 7.1.2.1). The density acts as a target to be achieved by a recovering fishery.*

Comment: Both recovery and fishery management require a clear assessment of alternative ways of meeting well-defined, measurable objectives.

***Response**: Section 6.8: Alternative Approaches to Recovery *and* Section 7.3: Management Alternatives, *were added to address these issues.*

Comment: Fisheries management should follow a precautionary approach, including a Control Law (a statement of actions to be taken for all possible states of the fishery) based on both Target Reference Points and Limit Reference Points. Table 7-2 is a step in the right direction. See:

> Shelton, P.A. and J.R. Rice. 2002. Limits to overfishing: reference points in the context of the Canadian perspective on the precautionary approach. Canadian Science Advisory Secretariat Research Document 2002/084. It can be read here: http://www.ncr.dfo.ca/csas/

***Response**: The ARMP follows the precautionary approach and has incorporated it to the extent possible for California abalone resources. We have attempted to integrate the concept of target and limit reference points into our approach as outlined in Chapter 5 (see Figure 5-1). The MVP is essentially our best estimate proxy for a biomass limit reference point for these fisheries.*

Comment: Recovery planning should be based on a measure of risk such as Probability of Extinction, and should include Delisting Criteria (i.e., measurable means of determining that a population is secure).

***Response**: Presently, the white abalone is the only 'listed' species of abalone, an action of the federal government. The Department assists on the federal white abalone recovery team. Criteria for evaluating resource recovery are explained in* Chapter 6: Recovery.

Comment: Both fisheries management and recovery require a plan for monitoring, evaluation and adaptive management.

***Response**: The ARMP adequately outlines just such a plan.*

Comment: The ARMP should also include an analytical summary of the driving economic and ecological forces in the fishery, identifying essential, specific knowledge, critical uncertainties and needed research.

***Response**: The ARMP attempts to meet this concern with a revised* Section 3.2: Socio-economic Characteristics of the Fishery. *Needed research was described in* Section 7.2.3: Future Research. *Delving into greater depth would have required more resources and may have deviated from the focus of the ARMP.*

F.1.2.4 History of Abalone Fishery Management

Comment: The report contains historical information scattered throughout different sections. What is missing is an integrated assessment of the evolution of the present abalone management problem.

Response*: The Department concurs, and has added* Section 3.1.1.1 *to* Chapter 3: History and Socio-economics of the Fishery *to more thoroughly address the problem from a serial depletion perspective.*

Comment: An ecological-economic-management history of abalone stocks, their management, the fishery and fishing communities, would integrate these pieces of information in a way that would demonstrate how the different pieces of this complicated picture have fit together. To set the stage for recovery and sustainable management, the report should provide a clear understanding of how the different components of the fishery have interacted to produce the present situation.

Response: Chapter 2: Description of the Stocks *was expanded, in part, to address this concern.*

Comment: A summary of the history of management actions could be produced from information contained in Appendix A and included here.

Response*: We have chosen to leave that level of detail in the Appendix.*

Comment: The integrated history should go beyond a description of what happened to evaluate why things happened. For example, the history should not only include past management decisions, but why those decisions were made, why stocks were overfished, why management has been ineffective, and why the commercial and recreational fisheries developed as they did.

Response*: The Department agrees, and has added a sub-section to* Section 3.1.1.1 *in* Chapter 3: History and Socio-economics of the Fishery *describing serial depletion, causes of the decline, and factors in management failure. See Karpov et al. (2000) and Dugan and Davis (1993)(in the* Literature Cited *section) for a more detailed explanation.*

Comment: The point of the fishery history section is to evaluate the biological, ecological, economic and management history of the fishery in a way that allows lessons to be learned from what has been done in the past and sets the stage for assessing management alternatives for recovery.

Response: Chapter 3. History and Socio-economics of the Fishery *was extensively revised to address this concern.*

F.1.2.5 Quantitative Analysis

Comment: The ARMP does not contain the quantitative analysis necessary for stock assessment and population viability analysis. This aspect seems to be inadequately funded. Additional expertise in this discipline is needed.

Response: *We agree that more and better quantitative analysis needs to be developed, and that given additional resources, these areas could be developed under both long-term management, and recovery.* Section 7.2.3*,* Future Research*, states the need for improving knowledge of key population parameters such as growth, mortality and recruitment rates, and defining the stock-recruitment relationship for each abalone species, essential information for abalone population modeling.*

Comment: No size distribution or growth data are presented. These data exist and can be used to estimate population parameters necessary to assess the effects of size limits, fishing effort, etc. on catch, sustainability and population persistence.

Response: *Figure 2-1 was added showing density-weighted abalone size distributions from Van Damme State Park subtidal surveys for 6 years from 1986-99. Previous investigators demonstrated that the present size limits are optimal, using Yield Per Recruit analysis (see Table 2-3).*

Comment: A more complete discussion of the effectiveness, efficiency, and statistical adequacy of timed and transect surveys is needed, including discussion of habitat destruction in invasive surveys, and time lags of information on recruitment.

Response*: A more complete discussion of timed surveys and a comparison with transects are not needed since data from this type of survey is not used for management decisions other than to determine whether abalone densities are high enough for transect surveys.*

Comment: The level of poaching and its effects on populations needs to be estimated (e.g., included in mortality rates).

Response: *Poaching is difficult to estimate but has the same effect as natural and legal fishing mortalities in lowering abalone density. Since our decision table (Table 7-2) is based on abalone density, poaching is accounted for in this way. Problems would arise if poaching approached the magnitude of the legal catch but there is no indication that is the case.*

Comment: There is inadequate scientific basis for the TAC estimation, and other population goals given. A program for refining the estimate should be identified. The uncertainty in the TAC should be quantified and the consequences should be assessed.

***Response**: The TAC was set based on a combination of current and historical fishery conditions and an added precautionary element. The level was set following regulation change by the Fish and Game Commission that reduced take by an estimated 41%. The information was the best available at the time and any additional data will be incorporated when possible. The ARMP provides for further reductions (or increases) in the TAC, based on abundance changes at index sites as a component of adaptive management. The long term management plan calls for a zonal based refinement of TAC.*

Comment: An operational quantitative expression for relative population jeopardy or risk is needed for each species. It should include population abundance, size structure and spatial structure.

***Response**: While an operational expression of this type would be useful it is beyond the scope of the ARMP at this time*.

Comment: Criterion 1 is not related to population dynamics, and depends as much on sample size as on existing population size structure.

***Response**: More detail was added explaining the importance of a broad size range early in recovery for severely depleted populations.* Section 6.2.1 *was revised and an additional sub-section (6.2.1.1) was added. The Fish and Game Code requires recovery at multiple locations so the broad size distribution requirements must be met at multiple index sites.*

Comment: Constituent involvement in surveys is a good idea, but plans for training and data verification should be included.

***Response**: Plans for constituent involvement in surveys are still in initial stages and are not available for the ARMP.*

Comment: Consider closer monitoring of removals (catch).

***Response**: The abalone permit report card system in combination with our telephone survey is unique among marine recreational fisheries in its ability to provide reliable catch estimates.* Chapter 8, Abalone Enforcement Activities *was added to address this and related issues.*

F.1.2.6 Human Dimensions

Comment: The human component of the abalone fishery needs much greater emphasis in the document. The present *Chapter 3: History and Socio-economics of the Fishery* is inadequate. The ARMP neglects to present a thorough review of the literature, omits important economic aspects of abalone, and contains technical errors in the presentation of economics.

***Response**: The ARMP now includes historic information on market values and trends over time. Additional information on commercial harvest ex-vessel revenues, adjusted to a base year price index, is also presented. References to resource value and economic value have been clarified or defined where necessary, to distinguish between revenues (e.g. ex-vessel revenues) and value (e.g. estimates of value based on travel cost method analyses).*

Comment: An economist or other social scientist, with expertise in fishing systems, should write Chapter 3.

***Response**: We had a staff person with an economics background review and make additions to this chapter.*

Comment: The unique economic and ecological characteristics of abalone make the human component a large part of the recovery and management problem. The chapter should contain information on human demographics (e.g. population changes in California coastal communities over time), abalone markets (domestic and international), ports of landing, and user groups.

***Response**: The increase in fishing effort for abalone in northern California is detailed in* Section 3.1.3.2: Historical Catch and Effort - Recreational. *This trend is more pertinent to the fishery than demographic changes in the coastal communities over time. Since there is no longer a commercial fishery, abalone markets and ports of landing are not relevant.*

Comment: An evaluation of the interaction of management and markets over time and their influence on compliance should be included.

***Response**: Since there is no longer a commercial fishery, management and market interactions are not relevant.*

F.1.2.7 Management

Comment: Chapter 7 describes present management measures and provides some management alternatives for the future. What is missing from the discussion is analysis of the effectiveness of alternative management tools for abalone populations.

This section should contain a literature review of other abalone management programs with an emphasis on the effectiveness of various management instruments in abalone populations elsewhere.

Most abalone management programs center around commercial fisheries and do not apply to a recreational-only fishery. The ARMP needs a clearer assessment of how various management alternatives meet the goals. The section should outline a wider array of management alternatives and assess their relative merits for the California abalone recovery and management regions. Management alternatives to assess would

include closing the northern fishery, access limitation, size limits, spatial management (e.g. TURFs), temporal management (e.g. open/closed areas that change over time), community based property rights (e.g. co-management by area) or individual property rights (e.g. tradable quota share). These management alternatives should be assessed for their potential to contribute to recovery, enforcement, social and economic net benefits.

***Response**: Section 7.3: Management Alternatives was added to address these concerns. Some of the suggested alternatives such as property rights are more relevant to a commercial fishery than our recreational-only fishery and were not included.*

Comment: The management section should also identify critical uncertainties (gaps in data and knowledge) and discuss alternative means to reduce them. These uncertainties should be accommodated not only in management decisions (through precautionary adjustments) but also in a monitoring and evaluation plan designed to generate information. There needs to be a clear plan for monitoring and evaluating the fishery and the abalone populations as part of adaptive management.

***Response**: The interim and long-term management plans outlined in Chapter 7 adequately address this issue.*

Comment: Collapse of the southern California fisheries lead naturally to the question of whether the northern California red abalone fishery is on the same path to collapse. The ARMP does not demonstrate that the northern California fishery is sustainable, but it does outline a management plan in Table 7-2.

***Response**: A more precautionary management alternative was added to* Section 7.3 *to address this concern.*

Comment: The Department should demonstrate that the northern California red abalone fishery is sustainable. Additional data, such as size distributions should be presented and analyzed. Further analysis of the apparent lack of recent recruitment and the evidence for local serial depletion should be presented. Analysis of the expected effects of recent reductions in take limits should be presented.

***Response**: Section 2.2.1.1 was added to address these concerns, while the recommended TAC is expected to coincide with the recent reductions in take limits.*

Comment: If the fishery is not closed now, and it is not sustainable, the management plan embodied in Table 7-2 may close it in the near future. However, it can be depended on to do so only if rigorously enforced, and the population will be at an even lower level and take longer to recover. If the fishery is not closed now, that enforcement should be ensured. The Department should compare the costs of closing the fishery now with the cost of closing the fishery later, when it has declined even further.

***Response**: Our observations in the field indicate the fishery is not close to a condition in which closures and the consequences of the timing of closures need to be considered.*

F.1.2.8 Inter-jurisdictional Issues

Comment: The relationship between state management of invertebrate resources (including recreational abalone and commercial urchin fisheries), federal management of ESA-listed species, and management of marine invertebrate resources in other nations should be discussed in greater detail.

The white abalone is listed as an endangered species under ESA and black abalone may be a candidate species. The ranges of six abalone species found in California (including white abalone) extend into Mexico. It is not clear what cooperative structures exist with Mexico to address ESA protections and the relationship between Mexico abalone fisheries and illegal harvest of abalone in California.

***Response**: International issues are beyond the scope of the required ARMP elements.*

Comment: Inter-state and international enforcement issues should be discussed.

***Response**: See previous response.*

Comment: The impact of sea otter re-introduction under the MMPA and ESA on abalone stocks needs additional development and discussion.

***Response**: Section 6.5.2: Sea Otters, was added to address this issue.*

Comment: International scientific exchange is not evident in the plan and should be encouraged to improve management.

***Response**: Department biologists frequently interact with abalone biologists from other jurisdictions at international conferences, etc.*

Comment: Use of university resources should also be employed to improve management and supplement limited management resources.

***Response**: The ARMP was developed with input from experts in academia both formally during advisory workshops and informally, and cooperative research will continue in the future.*

F.1.2.9 Enforcement and Poaching

Comment: The ARMP acknowledges that illegal harvest (poaching) has a major impact on abalone stocks, both in closed areas and areas open for (recreational) harvest. Consistent and successful enforcement effort is crucial to abalone recovery. Measurable criteria for enforcement success need to be developed, and included in the plan, with a schedule for evaluation.

Response*: Enforcement success is difficult to quantify, since it is directly related to the level of enforcement effort, however trends in parameters such as the rate of violations per interdiction can be determined and may prove useful for estimating success.*

Comment: It is important to understand who is involved in poaching (sport or commercial divers) and what markets (personal, local or international) consume poached product, in order to find ways to curtail poaching.

Response*: Our enforcement branch has a good understanding of these problems.*

Comment: Use of forensics and other scientific procedures should be implemented to enhance enforcement and prosecution of poachers. For example, genetic analysis could be used to definitively identify species that are not open for harvest.

Response*: Procedures such as these have been used by our enforcement staff.*

Comment: Enforcement alone will not resolve the problem, however, and further development of a multi-disciplinary approach to compliance is needed.

Response*:* Chapter 8: Abalone Enforcement Activities *was added to detail enforcement efforts.*

Comment: If fishery managers are not presently including estimates of illegal harvest as part of the total fishery-related mortalities, then this should be done by subtracting it from the TAC (Total Allowable Catch).

Response: *A reliable estimate of the amount of poaching is not available, though crude estimates have been made from warden intercept data. However, the impact of poaching, like all forms of mortality, would be evident in declining population densities during dive surveys, which would then become part of the decision-making process outlined in the plan.*

Comment: Opening other fisheries, such as the commercial urchin fishery, should take into account areas where remnant populations of abalone exist, either to exclude those areas and reduce the potential for poaching, or closely monitor the fishery and assess the abalone populations pre- and post-fishing.

***Response**: Because these issues are better addressed through the Marine Protected Area (MPA) process, they are not included in the ARMP.*

Comment: To raise public awareness, and encourage compliance, outreach strategies should be more fully developed. As examples the public could be engaged through a "coast watch" to monitor local fishing activities, education curricula could be developed, and internet games and activities could be utilized. Mechanisms should also be identified which encourage communication and linkage between enforcement, managers, and the public. Educating the public to the impacts of poaching could exert "peer" pressure to reduce poaching and encourage reporting of poaching activities.

Response: Section 8.5: Community Outreach *was added to address this issue.*

F.1.2.10 Ecological Interactions

Comment: Understanding the ecology of abalone is essential to the purpose of the plan.

***Response**: The Department concurs and has added sections to address this issue.*

Comment: The relationship between abalone and sea urchins is described in the plan, due to similarities in the ecological niche and coordinated management of fisheries. Review and research into this important relationship needs to be more fully developed. For example, the beneficial role of sea urchins to the protection of juvenile abalone may be more important on smooth substrate versus highly rugose substrates.

Response: Section 2.1.10: Competition, *and* Section 2.1.11:Community Associates of Abalone, *discuss this relationship*.

Comment: The complex interaction between sea otter re-introduction and removal of competitive/beneficial sea urchins through the commercial sea urchin fishery highlights the pressing need for additional research into suitable/preferred habitat, grazing preferences, and other predator/prey relationships such as sea stars.

Response: Section 7.2.3: Future Research *acknowledges these research needs*.

Comment: Information about critical/preferred habitat should be mapped and used in management decisions for identifying MPAs, enhancement sites, and fishery openings/closures.

***Response**: Benthic habitat mapping is underway and has been completed for some index areas in northern California, but completion of extensive mapping of nearshore rocky habitat is a long way off into the future.*

F.1.2.11 Genetics and Disease

Comment: The panel recommends that the ARMP review hazards of introducing sabellid polychaetes, withering syndrome and other diseases and novel genes into new areas with abalone translocations.

Response*:* Sections 6.4.3.2 *and* 6.5.1 *were added to address this comment regarding Withering Syndrome and other diseases.* Section 6.4.3.1 *was added to identify the needs for genetic research prior to beginning enhancement activities.*

Comment: Discuss the existing CDFG shellfish health program as it relates to abalone.

Response*: The Department shellfish health issues are discussed in newly added* Sections 6.4.3.2 *and* 6.5.1.

Comment: Discuss the effectiveness of this program (e.g., for freedom of diseases) in screening and certification of transplanted broodstock and or progeny to and from hatcheries and into the wild.

Response*: The initial comment was directed to sabellid infestation. The Department has a very active shellfish health program that addresses the concerns of the comment, however, we did not feel the issue needed more detail than was provided in* Section 2.1.9.2: Diseases and Parasites. *In addition, a sentence was added to this section explaining that the only known infestation in the wild is believed to be eradicated.*

F.1.2.12 Broodstock Management

Comment: The panel recommends that the ARMP develop protocol to assess and minimize impact of wild broodstock removal on the extant wild population (i.e., numbers and sizes), for culture programs.

Response*: Specific protocols for broodstock collection are not written in the ARMP. However, wording was added to* Section 6.6.1.2 -Task 4*, to recognize the need for such protocols in the future if culture/out-planting techniques progress to a larger scale for enhancing recovery.*

Comment: Develop less damaging methods for broodstock collection (e.g., use of sea stars) to reduce mortality during handling and transport.

Response*: Protocols for minimizing broodstock collection mortality have been developed and are used currently for white abalone. However they were not included as part of the ARMP.*

Comment: Consider genetic issues for broodstock maintenance, control of inbreeding (maximize genetic diversity, reduce potential for genetic bottlenecks), and impacts of out planting offspring.

Response: Section 6.4.3.1: Genetics Research *outlines these concerns*.

Comment: Attempt to develop and use withering syndrome disease-resistant strains in different abalone species.

Response: *Refer to* Section 6.6.1.3: Evaluation of Resistance to WS - Task 10

Comment: Develop hatchery methods for optimum survival and production of high quality gametes.

Response: *While this suggestion would be a valuable component for a fully developed hatchery program, hatchery work will remain on a small scale for the foreseeable future.*

F.1.2.13 Recovery Experiments

Comment: The ARMP should develop a program for disease control and genetics management prior to translocation.

Response: Section 6.6.1.2: Feasibility Studies for Aggregation/Translocation - Task 6, *was revised to recognize the need for such programs for disease control and genetics management prior to the start of translocation activities*.

Comment: Review literature with pros and cons of each rebuilding method already tried in California and elsewhere.

Response*: There is a body of literature relating to rebuilding techniques, particularly attempts at rebuilding and enhancing local stocks, and some on larval (competent) outplanting. Unfortunately, most of it has been unsuccessful for various reasons. A current problem is the prohibition of out planting cultured abalones from most facilities since they have not yet been certified as disease-free. And for the most part, only red abalone are available at this time for a major seeding effort, especially in southern California. White and green abalone are of limited availability and these species are not widely cultured now.*

Comment: Provide rationale for specific methods to be tested with estimated cost benefits.

Response*: Specific methods are discussed in Chapter 6. Recovery and management costs are generally outlined in* Section 9.3.1.1

Comment: Describe possible experimental design (treatment replicates & controls), trying different spatial scales may be important.

Response*: This might be a little premature for two reasons:*

1. We don't have source stocks for most species from which to collect individuals for translocation and out-planting.
2. Since assessments have not been completed there is no reliable information as to source locations for individuals, or where the best locations would be for establishing study sites for each species. Only red abalone populations might be sufficient to serve as a source in southern California. With the establishment of MPAs, we will have a better idea of where to start work.

F.1.2.14 Marine Protected Area (MPA) Issues

Comment: The ARMP should discuss how development of restoration methods and use of pilot studies in no-take MPAs (i.e., Channel Islands), where no interference from poaching can be assured, is a supported and a recommended approach.

Response: Section 6.4.2.4: Establishing Marine Protected Areas *was modified to address these comments.*

Comment: Define the goals and objectives of MPAs for abalone in terms of suitable habitat, area size and location frequency requirements, and how this approach is appropriate as a rebuilding tool (e.g., broodstock protection and potential larval transport to other areas).

Response: *Although some of the points raised in this comment were not addressed, the ARMP adequately covers MPA planning in the revised* Section 6.4.2.4: Establishing Marine Protected Areas. *The MPA planning process will take an ecosystem approach and single species issues will be considered in relation to a comprehensive plan.*

Comment: Discuss the pros and cons of establishing MPAs throughout California coast, in terms of ecological and biological benefits to abalone populations, and how poaching in these no take areas can be avoided.

Response*: The authority and responsibility of designating MPAs for all species does not fall to the ARMP (See Ch. 4). The ARMP addresses criteria for MPAs which would be beneficial for abalone.*

Comment: Discuss implications of oceanic currents to larval dispersal & transport to local and distant areas (sources and sinks) in relation to MPAs.

Response*: Little information exists about the dispersal of larval and juvenile abalone. Genetic studies suggest that black abalone residing primarily in the intertidal may*

disperse less widely than red abalone. The question of the impacts of MPAs outside their borders has not been answered for a large number of fished species.

Comment: Acknowledge that size structure information from long-term protected areas is essential for stock assessment.

***Response**: The value of size structure information from long-term protected areas will need to be assessed for California abalone since growth rates are slow and the effects of habitat quality upon growth are unknown.*

Comment: Provide scientific evidence and references for the assertion that the breath-hold snorkeling fishery provides a "de facto" MPA and therefore formal MPAs are not needed in these areas.

***Response**: The breath-hold fishery* de facto *depth refuge is discussed and referenced in* Section 7.1.1.2: Gear Restrictions. *There is no provision in the ARMP to limit the creation of northern California MPAs because of the existence of the abalone* de facto *depth refuge.*

Comment: Manage the abalone fishery and MPAs consistently with each other.

***Response:** The Department is very cognizant of the need to coordinate the management of abalone and MPAs.*

Comment: Implement a monitoring plan to accompany implementation of MPAs.

***Response**: A monitoring plan for abalone within MPAs would need to be integrated into general monitoring efforts for the MPAs. Planning for abalone monitoring in MPAs will be incorporated with MPA monitoring plans.*

Appendix G. Constituent Involvement and Public Input

G.1 Constituent Involvement

Broad participation in the development of the ARMP improves the overall quality of the plan, the effectiveness of its management and recovery portions, and the Department's ability to implement the plan. Public involvement in the development of the plan ensures that decision makers consider a variety of perspectives which might otherwise not be available to them, addressing topics such as biological characteristics of the resource, the fishery, non-consumptive considerations, ecological considerations, and economic and social issues related to the resource. In addition, involving the public in the development of the plan includes them in the responsibility of sustainable management of the resource. The public will also be involved in the adoption of the plan, in addition to its implementation and amendment.

The draft ARMP has been developed with the input of various constituents, including the Recreational Abalone Advisory Committee, commercial abalone fishermen, the ARMP Advisory Panel, and members of the general public. As the Department developed concepts to be considered for the draft ARMP, it received constituent input on those concepts in addition to other ideas. The Department began the process of gathering public input for the development of the ARMP in July 2000, when it held a workshop for commercial abalone constituents. In fall 2001, the Department established an Advisory Panel for the ARMP. The panel is composed of members and alternates who represent recreational anglers and divers, environmental organizations, aquaculturists, and academia. The panelists were selected to reflect a diversity of interests and expertise in abalone and issues related to abalone. The first advisory panel workshop was held on 16 November 2001 at the Los Alamitos CDFG office. The focus of this workshop was the recovery of abalone resources in California. The ARMP advisory panel and Recreational Abalone Advisory Panel then participated in a workshop to provide input on the management of California's abalone on 15 March 2002, in Oakland. At the November and March workshops, members of the general public also provided input.

An early draft of the ARMP was made available for informal public review on the Department's web site (www.dfg.ca.gov/mrd) and Department offices. In addition, two town hall meetings were held in September 2002 to further provide the public with the opportunity to become more informed, ask questions, and make recommendations for the ARMP. Written comments were due to the Department by 5:00 p.m. October 4, 2002. Informal public comments were reviewed and summarized, and appropriate changes were made to the draft ARMP. Appendix G contains summaries of the public input events which occurred during the evolution of the draft ARMP, and a summary of the public comments.

The time line for the development of the draft ARMP, which included the dates of workshops, town hall meetings, and the informal public review period, was posted on the Department's web site. To inform the public of the availability of the draft ARMP for informal public review, a news release was distributed to over 500 media contacts, including reporters, major media outlets, legislators, and natural resource organizations. In addition, post cards and emails announcing the availability of the draft ARMP were sent to constituents interested in abalone issues.

G.2 Early Public Input

G.2.1 Abalone Recovery And Management Plan Commercial Constituent Workshop

G.2.1.1 Workshop Summary

The following is a summary of the first Abalone Recovery and Management Plan (ARMP) workshop, held in Santa Barbara on 26 July 2000. The workshop was intended to be an initial step in creating the ARMP which is required under Fish and Game Code §5522, and is due to the Fish and Game Commission on or before January 1, 2003. One intended outcome of this workshop was to allow commercial constituents interested in the ARMP to voice views on recovery and the future of California abalone populations. Another goal was to begin a positive dialogue with all constituents concerned with abalone recovery. Future workshops will include interested constituent groups, in order to get more complete input on the ARMP.

This summary covers the major topics discussed at the workshop, lists some of the key points brought forward, and details the next steps agreed to by the workshop participants. Names listed in parenthesis are individuals who led discussions, or made specific presentations on each topic.

Introductions

Ms. Kristine Barsky, CDFG senior invertebrate specialist, welcomed the participants and introduced the Department biologists present at the workshop. Participants then introduced themselves (see participant list). She asked that everyone do several things to have a productive meeting:

- Focus on common goals
- Identify points of disagreement, and look for solutions to them
- Acknowledge the legislative mandates governing the ARMP process

Workshop Objectives, Ground Rules, and Agenda

Ms. Debra Nudelman, a senior mediator at RESOLVE, Inc., was hired by the Department to assist in effective constituent involvement. She discussed her role as a guide through the process of the meeting, and a neutral leader who could help keep the group on track. Ms. Nudelman listed some ground rules for participation, so that everyone had a fair opportunity to discuss concerns without sidetracking the process or being disruptive. She also stated the main objectives of the workshop to:

- Share information about California abalone populations
- Develop preliminary perspectives on goals for the future
- Begin a constructive dialogue between the Department and constituents and decide who else might need to be involved in the ARMP process

Overview of California Abalone Population

Mr. Peter Haaker, CDFG associate marine biologist, gave a summary of abalone stock decline in southern California over the past 50 years. He made it clear

that even though many of his graphs used commercial abalone landings as an indicator of decline, there is a shared responsibility for the decline and many other contributing factors in addition to commercial take. These include sport take, inadequate management (managing as a group, not by species and area), poaching, pollution, habitat loss, disease, predation (mostly sea otter), and natural environmental changes (like the frequency of El Niño events in the last two decades). He spoke about how multiple abalone species supported what looked like a sustainable fishery, when in fact species composition and location of catch were shifting as individual areas and species were depleted. Workshop participants brought up several points of discussion and concerns that need to be addressed. An overriding concern, brought up here and in later discussions, was that of sea otter repopulation in southern California. It was agreed that while this was not a goal of the workshop it should be addressed when writing the ARMP. Sea otters are mentioned in FGC §5522 (a) (6) (A) where it states that measurable criteria to determine whether the goals of recovery are being met shall include "specified abundance and size frequency distribution criteria for former abalone beds within suitable habitat not dominated by sea otters" among others. Areas dominated by sea otters would not have to achieve the specified abundance and size frequency. Other participant comments included:

- Many early efforts to manage the fishery failed, these must be considered in future management
- The Commission should be directly informed of the other causes of decline, so the blame is shared among all contributing causes
- The Department should partner with other agencies to prevent causes of population decline, such as pollution and habitat loss

While Mr. Haaker stated that we can only control take, the Department should also be looking seriously at the possibility of enhancement (both larval outplanting, and translocation).

<u>Overview and Comparisons between Northern California and Southern California Stock Status, and the Northern California Sport Fishery</u>

Dr. Laura Rogers-Bennett, CDFG associate marine biologist, described current abalone assessment efforts on the north coast. These studies now include both transect counts and timed swim counts. The timed swim counts were initiated to give a comparison to counts occurring in southern California. A 1999 northern California study duplicated a study done in 1986. While the total population looks very good, it is apparent that little recruitment has occurred in the past 5 years, possibly due to poor oceanic conditions. The sport fishery, however, has sustained a high level of take. Approximately 35,000 abalone stamps are sold to sport divers who take an estimated 1 to 3 million pounds of abalone each year. The average size of individual abalone taken is increasing, but again it appears that few small abalone have come into the fishery in the past 5 years. The lack of a significant recruitment event causes some concern about the health of the abalone stock for the near future. Management recommendations to reduce sport take may be needed to insure a continued healthy stock.

Mr. Ian Taniguchi, CDFG marine biologist, described the current status of abalone populations in southern California. He noted that abundances at San Miguel island in the 1970s were similar to current north coast levels. Present stock, however, is well below that level. All other locations have current densities lower than those necessary to sustain any significant harvest. For both speakers the participants' comments focused on two major concerns: How is the research being conducted and how often will future surveys be done? It was acknowledged that the last survey at San Miguel Island was completed in 1999.

Regular sampling is an ongoing problem that will hopefully be resolved by funding increases, a new research vessel available this year, and a higher priority for abalone research. The research methods are being modernized so that timed swim data will be more directly comparable to past and future transect data. This may even allow the conversion of abalone per hour of dive (abundance estimates) to abalone per square meter (density estimates). Another concern expressed was that southern and northern California are such different habitats that comparisons may not be realistic. The concept of managing by individual areas, not as a single region, was brought forward as a possibility.

Current Regulations and the Mandates of FGC §5522

Ms. Barsky described current legal requirements for the ARMP and how they relate to the Marine Life Management Act. She apologized for the fact that commitments were previously made about when the ARMP would be completed. These commitments were made without consideration of the time involved in preparing a viable plan. This workshop was one way of trying to fulfill the intent of that commitment. The plan is due to the Commission by 1 January 2003. She also clarified the roles of current mandated abalone constituent groups working with the Department. The "Recreational Abalone Advisory Committee" (RAAC) reviews proposals and recommends projects and budgets for the expenditure of the abalone stamp fees to the Department's Director. RAAC will also make recommendations on the ARMP to the Director.

The "Director's Abalone Advisory Committee" (DAAC) makes recommendations on how to spend the commercial landing tax fund. This fund has about $255,000 remaining (approximately $420,000 was collected). When collected the fund was earmarked for enhancement. If this fund is not spent or without further legislation it will sunset and revert to the general preservation fund on 1 January 2003. Both committees have commercial diver membership.

A serious concern arose regarding the overlap in the ARMP and the Fisheries Management Plan written in 1997. The question of why the 1997 Fisheries Management Plan wasn't being used was asked. A clarification was made that the 1997 Plan became obsolete with the closure of the fishery. A draft version of the 1997 Plan exists, and will be used for parts of the ARMP. The ARMP is mandated by law, and must contain very specific sections that are not in a normal Fisheries Management Plan. It will be completed by 1 January 2003.

The Department's Initial Views on Recovery

Mr. Haaker presented a four-tiered "conceptual framework" of recovery including

recovery of the resource, fishery consideration, fishery development, and ecological consideration. He noted that any fishery must be conducted in a sustainable fashion. He also outlined criteria for a determining if a population is recovered including area, stock abundance, size distribution, and ecological condition. He noted that area, stock abundance, and size distributions must reach historical levels. Ecological condition (environmental change, ecosystem strength) must also be taken into account.

Participant comments focused on the fact that recovery must be defined specifically with numbers. While the framework listed abundances and size distributions, the question was raised as to how the specific levels would be calculated. The usefulness of landings data to "back-calculate" abundance when it is recognized by all sides that these data are not complete was questioned. It was again noted that the frequency and locations of monitoring must be set, in order to determine if specific levels of recovery are being met. Another major concern was that the idea of enhancement was still not being given more consideration. It was noted that while the speaker's primary mode for recovery was through natural recovery, the tax fund's sole purpose was supposed to be enhancement. Certain types of enhancement were discussed, and it was agreed that more research is needed to prove which are the most effective.

Finally the concept of whether recovery and a future fishery could occur together was questioned. This was a major concern, as many of the participants felt it was the only real question. Some noted that if recovery had to occur in all areas before any fishery could begin, then no fishery would occur in their lifetimes. The idea was raised that if one area or species is healthy, perhaps a small fishery could occur. The FGC was cited to note that a fishery could not adversely affect adjacent areas. Genetic studies might show whether a specific island provided young to other areas. It was agreed that this type of information is of high priority to all concerned.

Current and Future Research Goals

Mr. Konstantin Karpov, CDFG senior marine biologist, discussed the Department's goals for research, and how they will be funded. These goals included habitat mapping, population monitoring, settlement and recruitment studies, enhancement, disease and parasite studies, and fishery assessment. Funding is being provided by the sport abalone stamp fund, outside grants, and Fish and Game Preservation Account funds. He asked for ideas on expenditures.

A suggestion was made to use commercial diver's knowledge of where habitat is as a means of effectively using their expertise and saving money and resources on that part of the study. Enhancement was again discussed. A concern of the Department was where the funding would come from for major enhancement efforts, and whether current science supports one or another specific type of enhancement.

Discussion Items, Identified Issues, and Concerns

At this point the meeting became more focused on bringing forward topics that could be discussed in the workshop setting, and developing ways to address them. Each participant was given the opportunity to voice a single, overriding, concern that they wanted the group to address. The 47 individual items voiced fell into six general categories:

1. Sea otter management, population expansion, its effects on abalone, and the Department's role
2. How to achieve real input from constituents that the Department heeds and the need for more constituent involvement in both management and research
3. Research and monitoring issues: what types of research are necessary, when and how monitoring will occur, and how will specifics of recovery be defined
4. The need for more enhancement activities on the short and long term timeline
5. The need for appropriate and sufficient enforcement to support recovery
6. What will the actual products of this meeting be?

Many of these categories were discussed briefly and some specific suggestions of how to address the identified concerns were made. Listed below are some of the participant's suggestions:

- Experience from New Zealand and Australia should be utilized
- There should be an efficient system to monitor and change catch limits (adaptive management)
- Catch limits should be based on quantitative data; densities for sustainability
- There should be several surveys of San Miguel Island each year to determine a baseline for sustainability
- Collecting data from the south coast should be an interim goal
- There should be a survey to bring local knowledge into the decision making process and acquire some of the baseline data
- We should not have the same density goals in all areas
- Enhancement is an important way to help recover this fishery

Participants' Views on Recovery

The discussion of concerns led to a need for clarification of what could realistically be accomplished at the single day workshop. Questions were asked of the group to elicit responses that would provide an initial view of recovery:

- What is recovery?
- What is the definition and criteria for measurement?
- What is "sustainability"?
- What are the commercial constituents' realistic goals for the future?
- What does a healthy fishery look like?

The definition of "sustainable" was discussed briefly and answered more fully by a quotation from FGC §99.5: "Sustainable," "sustainable use," and "sustainability" with regard to a marine fishery, mean both of the following:

- Continuous replacement of resources, taking into account fluctuations in abundance and environmental variability.
- Securing the fullest possible range of present and long-term economic, social, and ecological benefits, maintaining biological diversity, and, in the case of fishery

management based on maximum sustainable yield, taking in a fishery that does not exceed optimum yield.

It was also noted that definitions of many of the terms used are defined in the Fish and Game Code. A definite short-term goal of defining recovery, from the Department's perspective, was asked for. The participants showed a real desire to help with enhancement and research activities. A discussion of how this might happen resulted, and the Department gave some information on hindrances to their ability to work with outside contractors. Two major problems were in the areas of liability insurance for boat operators, and coverage for divers working for the Department. The biologists showed a desire to help overcome these obstacles. Participants also felt that it would be important to identify areas that are healthy as well as areas in need of recovery.

Since the definition of recovery is critical to the ARMP, the participants discussed methods for creating specific definitions that would be acceptable to the commercial constituents. One suggestion was that recovery should at least be a set number of abalone per square meter. The suggestions included:

- Recovery should at least be a set number of abalone per square meter. Possible approaches to determine this density include :
    - Densities on the north coast
    - Densities seen in healthy fisheries elsewhere (New Zealand, Australia)
    - The divers' knowledge of historical populations
    - Densities within areas dominated by sea otter
- Populations should be monitored by conducting at least 2 surveys per year in each of several pre-determined sites. These sites should be chosen taking into account the divers' input.
- Because each area may be different, recovery should be based on a separate goal in each area, and the existence of normal environmental cycles should be included.

Next Steps

As a final product of the workshop, specific short-term steps were agreed upon. These steps were based on ideas and concerns raised throughout the day. A goal of having at least one Department employee and one commercial constituent as co-chairs of work-teams for each item was stated. The work-teams will report back at the next workshop to update all concerned parties on accomplishments and future needs. Each of these steps is listed below, along with the names of those who stated an intent to help with the work-teams:

- Develop an anecdotal fishery data form and distribute it to sport and commercial divers. This form will be used to identify sites that have or had abalone populations and to choose index sites for monitoring that are acceptable to both the divers and the biologists (Jim Marshall, Jim Finch, Carl Nienaber, John Ugoretz – this form is intended to be distributed by the end of September, 2000).

- Develop a way to determine projects needed to fulfill interim recovery goals to successfully complete the ARMP (John Colgate, Dave Parker, Ian Taniguchi).
- Determine the steps necessary to begin larval out-planting. This will include research needs, permitting issues, possible Sea Grant matching funds, and other topics (Kristine Barsky, Laura Rogers-Bennett, Sam Shrout, Phillip Sanders, Pete Haaker).
- Attempt to solve insurance issues regarding allowing the commercial divers to work with the Department in research and enhancement (Kristine Barsky).
- Determine genetic studies which need to be conducted, and locate possible funding sources (Kon Karpov, John Colgate).
- Explore the idea of forming an Abalone Council, to help with issues surrounding the ARMP and determine how this group will fit in with RAAC and DAAC (Michael Harrington, Kon Karpov, John Ugoretz, Debra Nudelman).

Shortly after the workshop it was determined that two planned scoping sessions would address at least some of the identified concerns. These two sessions could take the form of broad constituent input workshops, rather than an actual council.

Workshop Summary and Adjournment

Ms. Nudelman briefly summarized the highlights of the workshop. Ms. Barsky thanked the participants for their hard work and efforts. The workshop was adjourned at 5:00 pm.

Participants

Betts, Jerome	Commercial Diver
Brooker, Craig	Commercial Diver
Brown, Locky	Sport Diver
Colborn, Katherine	Marine Life Management Project
Colgate, John	Commercial Diver
Douglas, Jeff	Commercial Diver
Duncan, Bob	Commercial Diver
Finch, James	Commercial Diver
Frederick, Gabriella	Senator O'Connell's Office
Graziano, Norman	Commercial Diver
Gritsch, Jeff	Commercial Diver
Harrington, Michael	Commercial Diver
Liquornik, Harry	Commercial Diver
Marcus, Leonard	Commercial Diver
Marshall, Jim	Commercial Diver
McBride, Susan	Sea Grant Marine Advisor
Nienaber, Carl	Commercial Diver
O'Brin, Trudi	Commercial Diver
Packard, Michael	Commercial Diver
Pattie, Ian	Commercial Diver
Pettersen, Carlton	Commercial Diver
Rebuck, Steve	Industry Consultant

Richards, John	University of California
Sanders, Phil	Commercial Diver
Shrout, Sam	Commercial Diver
Thompson, Don	Commercial Diver
Voss, Chris	Commercial Diver
Williams, Richard	Save Our Shellfish
Wilson, Darrel	Commercial Diver
Zertuche, Ruben	Commercial Diver

G.2.2 Abalone Recovery and Management Plan Advisory Panel

The Abalone Recovery and Management Plan Advisory Panel was established to aid Department biologists with the development of the ARMP. The advisory panel was made up from constituents and experts representing as broad an interest base as possible including environmental organizations, scientists, aquaculturists, commercial and recreational fishermen. Two advisory panel workshops were held to provide the department with advice, feedback, and recommendations regarding the issues and actions that need to be included in the ARMP. Prior to both workshops, ARMP panelists and alternates received a workshop overview and specific focus questions. All the advisory panel workshops were open to the public, and a comment period was provided at each meeting.

G.2.2.1 Advisory Panel Workshop, Los Alamitos

The following is a summary of the ARMP Advisory Panel workshop, held at 4665 Lampson Ave., Suite C, Los Alamitos, California on 16 November 2001. The ARMP Advisory Panel is composed of members and alternates representing commercial and sport abalone fishermen, environmental organizations, aquaculturists, and scientists. The Department established this panel to obtain input and advice from a broad interest and experience base. The purpose of this workshop was to receive input on southern California abalone recovery.

Prior to the workshop, ARMP panelists and alternates received a workshop overview which included a review of potential recovery measures to be considered, and specific focus questions for the panel to answer. The objectives for this workshop were to review and comment on interim and long-term recovery goals and criteria, and evaluate suggested means of recovery and suggest alternative or additional approaches not considered. The workshop was led by Mr. Paul De Morgan of *RESOLVE*, a neutral facilitation organization based in Portland Oregon.

<u>Welcome, Opening Comments, Introductions, Agenda Review</u>

Ms. Patty Wolf, CDFG marine region manager, and Mr. Peter Haaker, CDFG senior marine biologist, welcomed the panel and thanked them for their efforts to aid the Department in the development of the ARMP. The facilitator, Mr. Paul De Morgan, led the introductions of Department staff and panel members present. He then reviewed the proposed workshop objectives and agenda. Ms. Diana Watters, CDFG associate marine biologist, briefly reviewed logistical items for the workshop.

Overview of Advisory Panel Purpose

Mr. Haaker presented an overview of the panel's purpose. He explained that the panel's input, comments, ideas, and suggestions would be used to assist the Department in the development of the ARMP. This workshop provided the Department with the opportunity to hear from the panelists regarding the Department's preliminary approach to the recovery portion of the ARMP.

Mr. Haaker presented a brief history of the abalone fisheries in California. He noted that five of the seven endemic species were important in the fishery, with all species occurring in the south, and two occurring in the north part of California. He reviewed the current moratorium for commercial and recreational abalone fishing south of San Francisco, and the recreational fishery which operates north of San Francisco.

Mr. Haaker explained that the Department felt that recovery of southern abalone, while related, is different in scope and nature from management of the northern recreational fishery. As such, the Department is addressing these two subjects separately in the ARMP. He reiterated that the focus of this workshop would be issues associated with recovery of southern California abalone stocks. Management of the northern California recreational fishery would be the focus of the next workshop planned for Spring 2002. He explained that members of the public attending the meeting would have an opportunity to comment on workshop topics during a working lunch. He introduced Department abalone team members who would be presenting information to the panel.

It was explained that most of the work to be completed for the day would take place during the panel discussion after the Department presentations. The panel was asked to:

- Address the conceptual framework for recovery
- Evaluate the Department's approach to development of the ARMP
- Address the focus questions about interim and long-term recovery goals, criteria, and activities
- Suggest alternative approaches which have not been addressed.

He added a final note of appreciation for the panel members' time and concern.

Presentation: Review of Fish and Game Code and Biology of Abalone

Mr. Konstantin Karpov, CDFG senior marine biologist, reviewed the legal framework guiding abalone management and the ARMP. Federal laws which have implications for abalone management and which supercede state law include the Endangered Species Act and the Marine Mammal Protection Act. These two federal laws affect sea otter and white abalone management. Mr. Karpov next explained the California law, under Fish and Game Code §5521, §5521.5, §5520, and §5522, which pertain to abalone and the ARMP. Section 5521 addresses the moratorium on the recreational and commercial take of abalone south of San Francisco; §5521.5 addresses the closure of the commercial fishery for abalone north of San Francisco; §5520 explains the Legislature's intent with regard to abalone management; and §5522 addresses the ARMP's content and due date (on or before 1 January 2003), as well as provisions for

reopening abalone fisheries (the Department may apply to reopen the abalone fishery on or before 1 January 2008).

Presentation: Biology of Abalone

Ms. Jennifer O'Leary, CDFG marine biologist, reviewed the biological aspects of abalone that present challenges to recovery. Abalone are long-lived (30 years or longer), slow-growing (10 to 14 years for red abalone to reach the minimum sport legal size), and have highly variable recruitment (successful reproductive years). Ms. O'Leary explained the Allee effect, a minimum density below which abalone cannot reproduce successfully. The Allee effect contributes to the vulnerability of abalone stocks to collapse at low densities. The limited distance that abalone larvae are able to disperse limits their ability to re-colonize depleted areas. Ms. O'Leary pointed out that abalone fisheries cannot coexist with sea otter populations. Sea otters consume 25% of their body weight per day, and abalone is one of the primary food items. Withering syndrome was a contributor to the decline of abalone populations in southern California, and must be considered in recovering populations.

Presentation: Interim and Long-term Recovery Goals and Criteria

Mr. Pete Kalvass, CDFG associate marine biologist, presented a conceptual framework for recovery, based on a model created by Restrepo et al. (1998). The model provides a potential means for measuring recovery, interim and long-term recovery goals, recovery evaluation criteria, and timelines for recovery, all of which are required for the ARMP. The presented model was developed to measure the rebuilding of finfish fisheries as part of the National Standard Guidelines in the federal Magnuson-Stevenson Fisheries Act. The model uses biomass at maximum sustainable yield as a measure of recovery. The boundaries between over-fished, recovering, and sustainable status are based on proportions of the biomass level at maximum sustained yield.

The proposed long-term goal of the ARMP is to rebuild depleted stocks in southern California to a maximum sustainable level with robust size distribution in former abalone beds. The proposed interim recovery goals include:

- Prevent extinction
- Re-establish sustainable abundances with robust size distributions at former abalone beds
- Attain biomass levels with sufficient surplus stock to warrant consideration of re-establishing a fishery

Mr. Kalvass explained how red abalone densities on the north coast, where red abalone are relatively abundant, could be used to set a biomass at maximum sustainable yield for the recovery model. This could serve as a proxy for the abundance criteria for recovery of southern California abalone stocks.

Presentation: Recovery Activities

Mr. Ian Taniguchi, CDFG associate marine biologist, discussed the pros and cons of various recovery techniques, as well as their implementation. Recovering

depleted stocks can be achieved using a range of activities to prevent extinction, assist in the recovery process, and increase recovery goals. Recovery techniques being considered include: translocation of adult stock from one area to another, aggregation of adult abalone within an area, larval out-planting, captive breeding programs, and establishing marine protected areas. The recovery program will require an assessment strategy to evaluate the effectiveness of each stage of recovery on a species by species basis. Assessments will be integrated into statewide research protocols that are currently being developed by the Department with collaboration from other state and federal agency researchers. The necessity for recovery actions will be reevaluated as abalone populations recover to self-sustainability.

Public Comment During Lunch

During the lunch break, members of the audience were given the opportunity to provide input. Mr. John Richards with the University of California's Sea Grant Extension Program made a general announcement explaining his involvement with Sea Grant and potential sources of information and funding available through Sea Grant.

Advisory Panel Discussion of Interim and Long-term Recovery Goals and Criteria

Comments made by the panel members are summarized here. The comments are in response to focus questions presented to the panel by the Department's Abalone Team, which is responsible for developing the Abalone Recovery and Management Plan.

Q: Are the interim and long-term goals valid?

- Several panel members expressed concern about the long-term goal of reopening an abalone fishery in southern California because the stocks are currently so depleted. It was recommended that this goal not be part of the plan. Rather, the immediate goal should be to recover these stocks and design a specific step-by-step plan for doing so. Such a plan should include research methods to assess the success or failure and cost-effectiveness of the methodologies employed.
- The panel was concerned about reopening a limited fishery once the population reached the minimum B_{msy}, suggested by the Restrepo et al. (1998) model. This concern was linked to the applicability of the Restrepo model to invertebrate populations.
- It is likely that sea otters will expand their range, and this should be considered for recovery of southern abalone stocks. The U.S. Fish and Wildlife Service (USFWS) has not implemented the capture and relocation provisions of the 1987 Sea Otter Translocation Plan since early 1993, thus allowing natural expansion of the otter population into southern California**.** The USFWS is currently evaluating whether failure criteria in the Translocation Plan have been met. If deemed a failure, there are no legal mechanisms for limiting sea otter range expansion. Therefore, if the long-term goal is to recover southern California abalone stocks to the point that a fishery can be reopened, that goal may be unattainable because of sea otter recolonization in southern California. The U.S. Fish and Wildlife Service should work together as partners on this situation.

- It was suggested that recovering a population to prevent extinction is a different goal than recovering a fishery. These two goals have different approaches which should be specified. The interim and long-term goals for the two kinds of recovery must be clearly defined and measurable.
- The recovery plan needs to be able to address the habitat quality at different locations for different species.
- The plan should be able to address the problem of incidental take if a fishery is reopened for fewer than all the species of abalone.
- Some panel members thought the interim goal of preventing extinction is redundant.

Q: Are there additional interim and long-term goals that should be considered?

- Re-ordering the interim and long-term goals was suggested. Some members felt management steps should come earlier in the process of recovery. There was some interest in the reopening of a fishery at the minimum biomass levels, but it was pointed out that this would extend the period for achieving maximum biomass levels.
- Add more interim goals to deal with various aspects of recovery; some of the long-term goals should be interim goals.
- Organize goals into stages of recovery (I, II, III, etc.) with specific triggers to signal transition into next stage.

Q: Are the long-term goals appropriate for all five species?

- There should be realistic specific goals for each species. One panel member suggested linking red abalone recovery goals to specific areas such as San Miguel Island.
- Do not consider reopening fisheries for black and green abalones. These species are found in very shallow, restricted habitats and are too available to divers. Even limited take could have serious negative effects on populations.

Q: Do you agree with the criteria as described?

- The panel felt that the recovery criteria presented did not adequately address Section 5522.6c, which pertains to the importance of areas proposed for reopening and the potential impact to the recovery of adjacent areas. Some panel members pointed out that some areas where abalone were found are no longer suitable for populations because of habitat loss and ecological changes.
- Triggers: Several panel members disliked the use of B_{msy} (or maximum sustained yield (MSY)) because they felt more data are needed to form the basis of a model. Some felt that 30% of B_{msy} is not a conservative threshold for a slow growing animal. These comments relate to the idea that the Restrepo model was inappropriate for application to invertebrates.

Q: Do you have any additional suggested criteria for recovery?

- If B_{smy} is used as a recovery criteria, there should be a clear measure for setting it (the perception was that the Department does not have a clear measure). The use of optimum yield (OY) in place of MSY was suggested.
- Develop specific research protocols for stock assessment.
- Incorporate university research and cooperative research efforts with abalone fishers.
- Establish a method to assess the effectiveness of these criteria as they are implemented.
- Age and growth data should be collected as they may be useful for making predictions about the future settlement and recruitment.
- Look to work done in Australia to use as a model for research and management (for example, Alistair Hobday's work).
- Begin gathering data immediately at San Miguel Island so that this data will be available for future assessments.
- Hold off on setting a maximum threshold for establishment of a fishery. In the interim, all work should be directed towards rebuilding stocks.
- Choose marine protected area (MPA) sites for abalone as soon as possible. Choose sites that can be protected by enforcement.
- Incorporate these MPA sites into the current MLPA and MERWG processes as soon as possible.
- The recovery plan presented lacks the flexibility to manage for differences in habitat quality among different populations, or for incidental take if a fishery is reopened in southern California for some species.

<u>Advisory Panel Discussion of Recovery Activities</u>

Review and comment on recovery activities:

- Several panel members stressed the critical need for assessment and filling data gaps. More research is needed in areas such as genetics for stock identification, density determination, effectiveness of abalone recruitment modules (ARMs), etc.
- The members were concerned about using fishery-dependant data in developing assumptions to be used in management plans.
- Larval out-planting and aggregation methods are uncertain in their ability to enhance natural stocks. Thus, more traditional monitoring of abalone populations is crucial. Aggregation experiments and ARMS have been unsuccessful so far. The actual cause of mortality is unknown. Experiments are needed to determine the validity of these recovery activities.
- Focus on designing experiments appropriate to recovery activities.

Q: Can you evaluate suggested means of recovery and suggest alternative or additional approaches not considered?

- Establish a data monitoring program and research methodology to determine the level of recovery for populations.

- Conduct experiments to test the effectiveness of recovery treatments. One could use a BACI (before/after control impact) approach with a sufficient number of replicates (example: six per site).
- Establish MPAs (for control sites) on Santa Cruz, Santa Catalina, and Santa Barbara Islands. Protect sites with effective enforcement. Recovery techniques must be linked to MPAs to protect stocks.
- Panel members suggested a compilation of existing data and literature be assembled. Funding could be sought from private and public grant agencies. Sea Grant Rapid Response funding was suggested.
- A recruitment model would be helpful to evaluate which sites to enhance, but there is an absence of the data to generate such a model.
- Baseline population genetic data are needed but difficult to obtain. Could look at recruitment and test for genetic homogeneity.
- A panelist advocated using aggregation rather than translocation because the areas chosen should have similar habitat and population structure. There was also concern about the spread of disease and parasites during these operations.
- Consider habitat grooming to aid larval out-planting. Such techniques as using coralline covered rocks in out-planting operations should be investigated as a technique for enhancement.
- Consider not applying enhancement techniques in certain areas; and there should be criteria about when to cease enhancement techniques, i.e., when population recovery is evident.
- Consider ocean current patterns when doing translocation studies to identify potential source and sink populations.

Additional focus questions posed to the panel based on the morning discussion:

Q: Does the model (Restrepo et al. 1998) make sense? Are there alternative models?

- Several panel members thought the Restrepo model was inappropriate for invertebrates and that it is not sufficiently conservative.
- In place of a Restrepo model, develop a model that includes individual growth rates, fecundity, size data, an estimate of mortality, and genetic connectivity between populations/stocks.
- A Skillam model was suggested as an alternative to Restrepo.
- A population model, rather than a fishery model was suggested.

Q: Are northern California stock densities appropriate for southern California recovery criteria?

- Density at San Miguel Island was suggested by one panel member to be a more realistic proxy for southern California recovery criteria.

Panel requested clarification and /or definition of the following terms/ideas:

- Robust size distribution

- Self-reproducing population
- How surplus stock will be measured
- Definition of former abalone bed

Next Steps

Mr. Paul De Morgan led a discussion of the next steps for the panel and the Department to take or consider taking:

- Explore funding opportunities (e.g., Sea Grant, NFWF) for development of an Abalone Data Library - Pete Haaker, Lead; Kate Wing, advice.
- Consider getting support of full panel behind the funding requests - would require drafting a proposal and sending out to the panel members for endorsement.
- Establish a science subcommittee - Pete Kalvass, Lead; Ron Burton, Tom Ebert, Steve Schroeter.
- Obtain and examine “raw” existing data.
- Further develop ideas for alternative models.
- Draft and distribute for comment a summary of the proceedings to all panel members.
- Schedule the March meeting.
- Consider adding a half-day of meeting in March to discuss recovery related issues.
- Consider convening conference calls to discuss issues (e.g., new models) prior to the next meeting.
- CDFG will consider potential MPAs and share their views on the most valuable marine areas for abalone recovery with the panel members.

Participants

Ben Beede	panel member
Tom McCormick	panel member
Kate Wing	panel member
Jim Curland	panel member
John Colgate	panel member
Jim Marshall	panel member
Michael Henderson	panel member
Stephen Benavides	panel member
Gregory S. Sanders	panel member
John Butler	panel alternate
Ron Burton	panel member
Stephen Schroeter	panel member
Thomas Ebert	panel member
Carolyn Friedman	panel member (participated by phone)
Pete Haaker	CDFG
Kon Karpov	CDFG
Peter Kalvass	CDFG
Jennifer O’Leary	CDFG
Ian Taniguchi	CDFG
Mary Bergen	CDFG

Kelly O'Reilly	CDFG
Diana Watters	CDFG
Jonathan Ramsay	CDFG
Patricia Wolf	CDFG
Fred Wendell	CDFG
Paul DeMorgan	Resolve, Inc.
John Richards	Sea Grant

G.2.2.2 Advisory Panel and Recreational Abalone Advisory Committee Workshop, Oakland

Members of the ARMP Advisory Panel and the Recreational Abalone Advisory Committee (RAAC) met at the Elihu Harris State Office Building,1515 Clay Street, Oakland, California on 15 March 2002, to provide input to CDFG on northern California abalone management. The objectives of the workshop were to:

- Evaluate and comment on the proposed management approach; and
- Evaluate and comment on alternative management strategies and refinements and make additional suggestions.

The ARMP Advisory Panel is composed of individuals representing commercial and sport abalone fishermen, environmental organizations, aquaculturists, scientists, and others. The panel was established by CDFG to obtain input and advice from a broad range of interests on efforts to develop the ARMP. The RAAC is an on-going Committee advising the CDFG on issues associated with the recreational abalone fishery. Copies of presentation slides and other materials distributed at the meeting may be obtained by contacting Diana Watters, at (650) 631-2535, or dwatters@dfg.ca.gov.

Welcome and Opening Remarks

Mr. Peter Haaker, CDFG senior marine biologist, welcomed everyone to the workshop. He noted that the Department was holding the workshop to solicit comments and suggestions from various perspectives, including those of biologists, non-governmental organizations, and recreational divers. He explained that the workshop included both the ARMP Advisory Panel and the RAAC in order to broaden the range of expertise and comments.

Introductions and Agenda Review

Mr. Paul De Morgan, RESOLVE, introduced himself and explained that as facilitator of the workshop he would ensure that CDFG had an opportunity to present the proposed management approach and the rationale behind it, and ensure that everyone had an opportunity to comment on the proposed approach and rationale.

After members of the ARMP Advisory Panel, RAAC, CDFG staff, and audience introduced themselves. Mr. De Morgan reviewed the agenda and other materials presented to the workshop participants. He outlined the ground rules for the workshop and asked the ARMP Advisory Panel and RAAC members to focus their comments on the management aspects of the proposed plan.

Presentation: Update on Progress Since First ARMP Workshop and Overview of Workshop Purpose

Before providing the update, Mr. Haaker offered the apologies of Ms. Patty Wolf, CDFG marine region manager, and Mr. Fred Wendell, acting CDFG northern marine region manager, who were unable to attend the workshop but have been very involved in developing the ARMP.

Mr. Haaker reported that CDFG has been seeking funding for the abalone data library, but no funding has been secured yet. He said that in response to comments on the importance of marine protected areas (MPAs) he and Ms. Laura Rogers-Bennett, CDFG associate marine biologist, had evaluated all of the proposed MPA sites for their potential benefit to abalone. He noted that a consideration was that sites for concentration of abalone must be able to be protected or located in remote locations. He said that many of the proposed sites are in the vicinity of major population centers and probably would not be useful in abalone work. He also reported that Department staff had provided southern California abalone tagging and cruise data to the scientific subcommittee.

To help illustrate the connectivity of recovery and management, Mr. Haaker presented a general model for the ARMP.

Mr. Konstantin Karpov, CDFG senior marine biologist, explained that the Department is developing a management plan that is precautionary in a data-poor environment and uses an empirically derived total allowable catch (TAC). He said that the starting point for the proposed plan is the recent Fish and Game Commission action. He commented that the Department considers the plan a living document, allowing for refinements as more data become available and the science progresses. Mr. Karpov said that the proposed plan includes criteria that will "trigger" management actions based on the conditions of the abalone stocks and environment. He explained that in plan development, the Department is considering local area closures to protect the resource from localized depletions. He said the Department also is considering closing and opening fisheries as area-wide recovery dictates, thus linking proposed management to the recovery portion of the ARMP. In closing, Mr. Karpov commented that the Department's staff was open to comments and critical thinking on the proposed management approach.

Presentation: Status of Stocks and Management Considerations

Mr. Jerry Kashiwada, CDFG marine biologist, presented an overview of the status of abalone stocks and management considerations. He presented historical data on the serial depletion and overall decline of red abalone in central and southern California. He listed the fishery-dependent and fishery-independent assessment sites for northern California, commenting that the limited number of sites contributes to the data-poor scenario. He outlined the data on the northern red abalone fishery that indicate current trends of concentrated fishery effort and increased take, few young abalone, declines of deep-water stocks, and serial depletion in high-use areas. Mr. Kashiwada said that earlier this year, the Fish and Game Commission considered these trends and lowered the daily bag and possession limit from four abalone to three and the annual limit from 100 to 24. He commented that the new limits result in a projected annual take of 430,000 abalone.

In response to questions, CDFG staff made the following comments:

- Estimates of poaching (such as the number of people stopped who do not have an abalone report card or who have more than the bag limit) are developed primarily from information collected at enforcement checkpoints. "Black market" poaching is much more difficult to estimate.
- About 1-2% of fishermen caught their annual limit of 100 abalone under the old regulations. The average annual catch was 18 abalone. In 2001 there were approximately 40,000 fishermen.
- CDFG estimates bar-cut mortality at 2-3%, which is lower than in the past due to current gear regulations and education efforts.

A member commented that despite all the effort going toward abalone, the scenario is still data-poor. Dr. Rogers-Bennett noted that the Department is just beginning to receive data from increased research efforts supported by funds from the abalone stamp.

Proposed Management Approach

Mr. Peter Kalvass, CDFG associate marine biologist, and Ms. Jennifer O'Leary, CDFG marine biologist, presented an overview of the proposed management approach. Mr. Kalvass explained that the proposed plan is based on an empirically determined total allowable catch (TAC) of 430,000 abalone. He said that under the proposed plan total catch would be measured annually, post-season, and the Department would conduct a review every other year to determine if the TAC is being met with existing regulations, to determine if alterations of the TAC are warranted based on the established criteria, and to evaluate the sustainability of local areas.

Mr. Kalvass outlined the proposed criteria for recruitment, density, occurrence of adverse effects, and serial depletion and explained how each was developed. He noted, however, that since completing the document submitted to the panel ("Overview of Abalone Recovery and Management Plan Workshop on Management") the Department had reconsidered the adverse effects criterion. He said the staff decided to propose the disease criterion but not the other adverse effects criterion, believing that not enough is known about El Niño, poaching, and sea otters to make strict criteria on them. He noted that the disease criterion distinguishes between a minor event (5-20% of stocks affected) and a major event (more than 20% of stocks affected).

Ms. O'Leary explained how the criteria work within the decision tables. She reviewed the fishery-wide TAC decision table, outlining the combinations of criteria (recruitment, density, and adverse events) that would dictate increasing the TAC, maintaining the TAC, decreasing the TAC, closing the fishery, or reopening the fishery. She noted that the maximum TAC would be set at 25 % above the base TAC of 430,000 abalone per year. She offered an example of a situation in which the criteria would require reducing the TAC.

Ms. O'Leary also reviewed the localized area closure decision table. She outlined the combinations of criteria (density, serial depletion, and adverse events) that would trigger a survey to determine if density in the area is approaching minimal viable population, closure of an area, or reopening of a closed area. She noted that if an area

were closed, the overall TAC would be reduced proportionately to prevent increased take in the remaining open areas. Ms. O'Leary also explained that a localized area that met the criteria for reopening would not be reopened if the entire fishery were closed (i.e., these criteria would not apply to localized areas in the southern fishery until the entire fishery met the criteria to reopen a fishery).

Ms. O'Leary listed the tools currently available to the Department to manage the fishery: gear restrictions, size limits, area closures, seasonal closures, daily limits, and annual limits. She commented that these tools may be refined or others may be added in the future and noted that daily and annual limits are the primary tools currently being used to adjust the TAC.

In response to questions, CDFG staff made the following comments:

- It takes from 5 to 10 years for an abalone to grow from emergent size to harvestable size; however, growth rates vary greatly in response to food source and some abalone may take several more years to grow from emergent to harvestable size.
- The fishery-dependent surveys are designed around access sites, with high use sites serving as index sites. There are no strict criteria for defining the boundaries of the sites, though the fishery-dependent surveys generally extend as far as the fishermen go. CDFG would prefer to have a different, random frame if it were possible. Monitoring a consistent area is likely more important than where the boundaries of sites lie.
- The biennial review of the TAC will coincide with the 2-year cycle of the Fish and Game Commission's regular sport fishery review. Total catch will be monitored annually, and it would be possible to make adjustments within the 2-year period if the situation warranted it.
- Estimates of the extent of withering syndrome at San Miguel Island in 1993 are based on data from CFG cruises, which indicated that up to 5% of abalone examined at some individual sites were affected by the disease.

A panel member noted that for the serial depletion criteria, a "significant" increase in distance from access point or "significant" decline in catch per unit effort (CPUE) means a *statistically* significant increase or decline, which may be large or small in magnitude and may or may not be biologically significant.

Refinements of the Proposed Plan and Alternative Management Strategies

Ms. Rogers-Bennett presented some of the CDFG staff's ideas of refinements and alternatives to improve the plan as new information becomes available. She noted that these refinements and alternatives will not be included in the first ARMP. Ms. Rogers-Bennett focused on five areas:

- *New criteria* - Aggregation criteria or criteria on the effects of El Niño, poaching, and sea otters may be incorporated in management decision making.
- *Marine protected areas* - MPAs may be established in shallow habitat to provide insurance against stock collapse.
- *Alternative management strategies* - Rather than a TAC-based strategy, the plan could use an area-based management strategy, which would adjust the amount of

habitat reserved from fishing according to criteria.

- *Alternative approaches for setting TACs* - The proposed plan uses previous fishing levels to set the TAC. Alternatively, if data were available to support the methods, the TAC could be set based on a surplus production model or in response to the environment.
- *Additional quantitative methods* - Refining estimates of population parameters (growth, mortality, and reproduction) or modeling proposed management strategies could help to evaluate management options.

In response to questions, Mr. Karpov clarified that the TAC in the proposed plan does not assume any closed areas; if any areas are closed, as MPAs or for other reasons, the TAC would be lowered proportionately.

A member commented that the effects of MPAs may be counterintuitive. She gave the example that if an MPA included urchins, an increase in their population could reduce the amount of kelp in the area, which in turn could hurt the abalone population. Another member commented that CDFG staff should ensure that MPAs are beneficial for abalone. Ms. Rogers-Bennett noted that biologists do not understand all the intricacies of species interactions. CDFG explained that Mr. Haaker serves as a link between the ARMP and the MLPA processes, providing information on the potential effects of proposed MPAs on abalone. A member pointed out that unless an MPA is closed to all fishing it is difficult to prevent poaching.

Discussion of Overall Plan

Focus Questions:

- What is your general reaction to the proposed management approach?
- Will it result in a sustainable fishery?

Several members commented that generally the proposed approach is good, given the data limitations.

A member expressed concern about basing decisions on data averaged across all sites and asked whether this was the best approach given the difficulty of predicting recruitment. Another member responded that treating the fishery as one unit may be the best approach since so little is known about the interconnections among sites from a population standpoint.

Several members commented on the need for CDFG to prepare a research plan that states priorities and timeframes for filling various data gaps. One member noted that clear priorities and rationale would be helpful in seeking funding from outside sources and or competing for limited state research funding. Comments on specific areas of research included:

- CDFG needs to determine the extent of abalone habitat (and the extent of accessible abalone habitat) in order to estimate the size of the fishery reliably.
- CDFG needs to outline what additional information it will gather and use to assess and prevent serial depletion. Site-specific data are important as different sites will

need to be managed differently. Site-specific reporting on the abalone report cards is a good start.

- The data need to cover the entire area. In particular, research should determine both where the juveniles are and what is happening in the grazer areas where the larger abalone reside.
- Data on connectivity of sites are important but extremely difficult to obtain given current technology. The use of non-genetic tracers as a way to identify larval sources was suggested.
- Data on settlement of postlarvae would be very useful as they provide an indication of the future population. Settlement collectors would be preferable to Abalone Recruitment Modules (ARMs) if an effective collector could be developed for abalone.
- CDFG should work to determine what impacts (e.g., fishing, El Niño, sea otters) have the greatest effect on abalone.

A member commented that when the Department's approach is to err toward conservation in a data-poor scenario, the Department may implement closures that fishermen believe are not justified. He said that adequate research and funding may alleviate some of this negative reaction.

Additional comments included the following:

- The plan should include a law enforcement component.
- The plan should include quantitative criteria to allow the public to evaluate whether CDFG is achieving its goals.
- The areas most heavily fished are those that are most accessible, not necessarily those that are most productive.

Public Comment

Mr. E.A. Flynn requested that the RAAC consider opening San Mateo County to recreational abalone fishing. He commented that opening San Mateo County would reduce fishing pressure on other counties and would also show how 5 years of closure had helped the abalone recover. He reported that he had observed an eighteen-fold increase in abalone in one area.

Mr. Paul Weakland expressed concern about the lack of abalone data and the resulting choice by CDFG to err on the side of conservation. He commented that all disease events should be considered major rather than using the proposed two-tier classification. He suggested that CDFG increase the minimum size requirement for harvestable abalone in order to increase abalone populations. He commented that 52 of the 104 existing MPAs are closed to abalone fishing and questioned why more MPAs are being identified when it is unknown whether the existing ones have benefitted abalone. He also requested that CDFG report the margin of error on its surveys.

Mr. Harold M. Hoogasian stated that raising the minimum size requirement is the easiest way to increase the abalone population. He commented that the Department's estimates of poaching are a gross underestimate and that commercial poachers are causing a lot of damage. He said that the abalone stamps are too inexpensive and suggested that fishermen would be willing to pay more if they knew the money were

going toward research. He also suggested that fishermen would be willing to give CDFG a tissue sample from the abalone they catch so that the Department could do a genetic population sample.

Discussion of the Proposed Criteria

Focus Questions:

- Will the criteria assist the Department in determining fishery adjustments?
- What is the best proxy for good recruitment: emergent or invasive densities, or a combination of both?
- Is it reasonable to use average densities from emergent surveys at three index sites as the sustainable population density target in northern California?
- What measurable criteria could be used for El Niño events and poaching?
- Should sea otter expansion trigger localized or total closure?
- Are the definitions of minor and major disease events logical?
- Are there additional criteria that the department should consider?

A member suggested that the CDFG staff draw on the formal body of literature on decision making matrices to help develop the plan. She commented that the literature could offer methods of incorporating uncertainty into decision making and methods to take advantage of expert opinions as well as quantitative information.

Members discussed the advantages and limitations of survey methods. Several expressed concern about the impact of invasive surveys on the reef habitat, and some noted that invasive surveys are time consuming and labor intensive. One member commented that due to the long time it takes for abalone to grow from emergent size to harvestable size, CDFG can use emergent survey data to evaluate the fishery and effect management changes, making the invasive surveys unnecessary. Another member noted that emergent surveys do not adequately capture the 'hidden' part of the population which could lead to over- or under-estimations of stock trajectories. Some members recommended that the CDFG should continue to utilize the invasive surveys as they provide valuable information about the young-of-the-year. One member suggested that CDFG should think "outside the box" in developing new means of gathering data on the young-of-the-year. Specific suggestions offered by members included creating artificial habitat, using Lucite tubes to view the abalone, and using data from settlement collectors to focus the invasive surveys.

A member commented that collecting young-of-the-year for analysis is important. He suggested that chemical analyses of the shells might indicate locations where they were spawned. He said that archiving tissue samples might also be useful, noting that the samples should be from both large and small abalone.

A member commented that three index sites are too few for management decisions. He suggested that data from the three sites could be used as a trigger for more extensive data gathering efforts. He also commented that Van Damme is an anomaly and should not be used as an index site. Another member agreed that three sites is too few for management decisions, observing that an unusual event at one of the sites would have a large influence on the overall data if there were only three sites

total. A member commented that the very best sites should not be chosen as index sites as they are not representative of the whole fishery. Another member suggested analyzing how well the long-term sites tracked with each other and with the area-wide surveys.

A member expressed a concern about the limited number of sampling areas outside of northern California. She commented that some people might argue based on the criteria that some areas closed under the moratorium should be opened. She and others commented that in particular, CDFG should clarify how the plan applies to San Mateo County and whether it could be reopened under the criteria.

A member observed that the proposed criteria consider population size but not population trends. She suggested that developing an index of abundance over time would be useful. Another member suggested sampling more sites to build a genetics library that would help with developing a population structure and help with enforcement efforts. A third member suggested doing a delta plot and time series analysis to help determine how typical various sites are and whether different sites fluctuate similarly. He commented that if staff and funding constraints limit research efforts, CDFG should opt for developing time series data over expanding the number of sites sampled. He also suggested sampling annually to develop the time series, though another member commented that sampling every other year may be adequate.

A member requested that CFG provide a better explanation of how recruitment will be measured and how it will factor into decision making.

Members discussed adverse events and whether the Department should develop criteria based on them. One member suggested that the Department should distinguish between reversible adverse events, such as El Niño, and non-reversible events, such as the establishment of sea otters.

- *Disease* - A member suggested that areas affected by disease should be open to fishing as lowering the population density may decrease or slow the spread of the disease. Another member, however, expressed concern that fishing might harvest out disease-resistant animals. A member asked whether Crescent City would be closed under the proposed disease criteria. CDFG staff noted that the criterion requires the abalone to show symptoms of the disease, so Crescent City would not be closed. Mr. Haaker added that Dr. Carolyn Friedman (a shellfish pathologist) has advised CDFG that the proposed disease criteria are too simplistic and the criteria may need to be expanded.
- *Poaching* - Some members expressed concern about using criteria based on poaching estimates, given the difficulty of developing accurate and reliable estimates. One member commented that the effects of poaching are already incorporated implicitly in other criteria.
- *El Niño* - A member observed that the proposed plan focused on the potential negative effects of El Niño. He commented that El Niño may also have positive effects, noting that the period of strong recruitment at Van Damme was during El Niño. He said that using El Niño criteria as a trigger for closer research on its effects may be appropriate.
- *Sea otters* - One member commented that there is nothing management can do about otters; they will deplete an area of abalone on their own. Another member

commented that it is difficult to determine what constitutes establishment of an otter population. Noting that the presence of otters would be detected by a change in abalone densities, he commented that otter establishment should not be a criterion, but rather criteria should focus on what is happening in the fishery. Some members suggested that areas in central California where otters are established and the abalone are surviving should be used to determine the minimum viable population level for abalone. One member commented that it remains unclear whether sea otters will establish in the north, though another member commented that it is likely they will establish over the next decades. A member pointed out that the huge population of abalone was the result of the near extermination of sea otters, which is unlikely to happen again. One member suggested that rather than closing areas as otters move in, the TAC could be lowered incrementally. Another member responded that otters should trigger the opening of areas rather than closing, to allow fishermen access to the abalone before they are depleted by the otters.

Discussion of the Proposed Management Approach and Alternative Management Strategies and Refinements

Focus Questions on Fishery Adjustment:

- Are the options presented in the decision tables logical?
- Do the specified sets of criteria warrant the actions listed?
- Do the listed actions provide adequate management alternatives?

Focus Questions on Alternative Management Strategies and Refinements:

- Would the new criteria improve abalone management efforts?
- Would the alternative approaches improve TAC estimates?
- Are there any additional alternative strategies that should be considered?
- Are there any additional quantitative methods to evaluate management options?

Some members noted that according to the proposed plan, the TAC would be reduced if the average population density fell below 5,000 abalone per hectare (ab/ha), the fishery would be closed if the density fell below 3,000 ab/ha, but the fishery would not be reopened until density rose above 6,600 ab/ha. They questioned why the proposed plan would allow fishing at reduced levels while the abalone population density was falling from 5,000 to 3,000 ab/ha but not while density was rising from 3,000 to 6,600 ab/ha. Some suggested that the plan should allow incremental reopening. One member suggested that an auction or lottery system be used to open closed sites on a limited basis, with the revenue going toward research. Another member commented, however, that closed areas should not be opened incrementally when population density is increasing because the fishery will need time to build up a surplus population without fishing pressure. Other members agreed, and one noted that requiring high densities before opening an area would be especially important in the absence of recruitment criteria.

A member recommended that the decision tables allow for discretionary adjustments. He commented that when implementing the plan, CDFG will learn which criteria and methods are most effective and should allow the possibility of dropping criteria in favor of others that work better. Another member supported the idea of having a range around the criteria (a buffer) such that if stocks reach the boundaries of this range, additional studies would be triggered before changes to the fishery regulations. He commented that without such a range, closures and TAC changes could be triggered every year.

One member asked whether the plan would include a range of alternative management goals and activities as required by the Fish and Game Code. Mr. Haaker responded that CDFG did not intend to include alternative density level criteria but would include different actions to respond to the criteria. Mr. Kalvass commented that the Department would welcome suggestions of alternatives.

A member observed that the Van Damme study site experienced a period of major recruitment and then a decade of no recruitment. He commented that under such a scenario, a model of linear increases in stocks in closed areas may not result in appropriate trigger points. He recommended that CDFG consider the time frame for evaluating stocks and consider using models to explore the effects of the proposed management actions under different recruitment scenarios. Another member commented that settlement may be on a 10-year cycle, with one good settlement event followed by a decade of poor settlement, and such a pulse of settlement might trigger a management change under the proposed plan. He suggested that CDFG could explore the effect of the pulse using a relatively simple model. Mr. Karpov commented that an incremental increase in the TAC in response to the pulse would not likely pose a major risk to stocks. The member responded, however, that the pulse may not actually produce a surplus, but rather an occasional major settlement event may be normal and necessary for a population of long-lived animals such as abalone. He suggested that if this were true, it would argue for a conservative response to major settlement events.

Other comments and suggestions included:

- Consider developing criteria based on concentration levels.
- MPAs are more difficult to enforce than changes in bag and annual limits or season length in part because enforcement could require continuous observation.
- Education efforts to explain the plan and what is being done with money from the abalone stamp will help reduce negative reactions to management activities.
- Consider what will happen in the absence of necessary data; the proposed plan seems to indicate that the fishery would be closed if the data were not available.
- Consider developing a population model to determine which sizes of abalone are most important for population survival and growth.
- Increasing the minimum size requirement may not increase larval production as younger abalone may be better reproducers. CDFG should examine what effect changing the minimum size requirement would have on reproduction.

Several members offered suggestions of cost effective ways to increase data collection:

- Contract commercial divers
- Use data collection partnerships
- Take advantage of volunteer programs
- Reach out to university students who are dive-certified

Public Comment

Mr. Jesus Ruiz, of the YMCA SCUBA Program, commented that CDFG should look for ways to leverage research funding. He suggested that this could be done by further training researchers from other institutions (e.g., universities, junior colleges) to meet CDFG standards or by training volunteer researchers. He cautioned CDFG about raising a conflict in the Legislature or creating a social stratum by increasing license fees or establishing a lottery to open areas to a limited number of people. He also commented that the abalone fishery affects more than fishermen and has an economic impact on communities.

Mr. E.A. Flynn commented that the Fish and Game Commission has good control of the abalone resource through existing management tools. He commented that raising the minimum size requirement from 7 inches to 7.5 inches would increase reproduction. He also noted that the size of the area being considered affects the abalone density level.

Mr. Harold M. Hoogasian offered his support of Mr. Flynn's suggestion that raising the minimum size requirement would aid reproduction. He also commented in support of establishing a lottery or some other system to allow limited opening of some areas with the revenue going toward conservation. He suggested that a similar system might also be used for limited reintroduction of commercial fishing, which would relieve some of the pressure on the resource from black market poaching.

Summary of Comments

Mr. Karpov and Mr. Haaker listed some of the comments they had heard from members and the public during the day's discussions:

- Generally the framework is sound.
- Reconsider the logic behind some of the proposed steps, and explain the rationale clearly in the plan.
- Opinions vary as to whether emergent or young-of-the-year (invasive) surveys are best.
- Three index sites are not a large enough sample for management decisions but could be used to trigger additional data collection. Sampling sites should be more numerous and more broadly distributed.
- Time series data are important.
- Examining the vectors of population change may provide useful information.
- Given the long time between major recruitment events, build conservativeness into the framework.
- Consider adding a buffer around the criteria to allow discretion with respect to what action is triggered.
- Consider expanding recruitment criteria.
- Sea otters probably should not be a criterion.

- It is not appropriate to have an El Niño criterion at this point. CDFG should further research the effects of El Niño on abalone.
- Prioritize the research needs to assess the stocks.
- Develop new or improved research methods.
- Consider ways to cost-effectively increase data collection efforts.
- The proposed criteria do not adequately address the complexity of disease events.
- Consider management tools other than bag and annual limits and seasonal closures.
- Consider how the plan applies to the central coast.
- Provide a means for the public to evaluate how CDFG's work is affecting the resource.

Mr. Karpov commented that the input from the panels and the public was very helpful in stimulating and focusing the thinking of the CDFG staff. He said the staff will incorporate the comments offered today as they continue developing the ARMP. Mr. Haaker added that he hoped everyone at the workshop would continue to provide input to CDFG in the future.

Participants

Ben Beede	panel member
Tom McCormick	panel member
Kate Wing	panel member
Jim Curland	panel member
Jim Marshall	panel member
Gregory S. Sanders	panel member
Ron Burton	panel member
Stephen Schroeter	panel member
Thomas Ebert	panel member
Leah Gerber	alternate for Carolyn Friedman
Stephen Campi	RAAC
Richard Pogre	RAAC
Steve Riske	RAAC
John Colgate	RAAC and panel member
Stephen Benavides	RAAC and panel member
Rocky Daniels	RAAC and panel alternate for Mike Henderson
Pete Haaker	CDFG
Kon Karpov	CDFG
Peter Kalvass	CDFG
Jennifer O'Leary	CDFG
Mary Bergen	CDFG
Jerry Kashiwada	CDFG
Jim Moore	CDFG
Thea Robbins	CDFG
Laura Rogers-Bennett	CDFG
Diana Watters	CDFG
Jonathan Ramsay	CDFG

Fred Wendell	CDFG
Eric Larson	CDFG
Frank Spear	CDFG
Paul DeMorgan	Resolve, Inc.
Sarah Litke	Resolve, Inc.

G.3 Informal Public Comments

G.3.1 Town Hall Meetings

Two town hall meetings were held in Fort Bragg and Santa Barbara to receive informal public comments on the draft Abalone Recovery and Management Plan (ARMP). The objectives of the town hall meetings were to explain key features of the draft ARMP and to obtain public comments and suggestions on the draft ARMP. Presentations were given on abalone biology, status of stocks, recovery and both interim and long-term management proposals. Presentations were followed by a public comment and discussion period.

G.3.1.1 Fort Bragg Town Hall Meeting Summary

CDFG held a town hall meeting at Fort Bragg City Hall in Fort Bragg, California on September 7, 2002, to receive informal public comments on the draft ARMP. The objectives of the town hall meeting were to:

- Explain key features of the draft ARMP.
- Obtain public comments and suggestions on the draft ARMP.

Welcome and Opening Remarks

Mr. Konstantin Karpov, CDFG senior marine biologist, welcomed everyone and thanked them for attending the meeting. He noted that CDFG was holding the meeting to receive informal public input on the development of the draft ARMP. He explained that this meeting follows a series of workshops held by the CDFG, in July 2000, November 2001, and March 2002, to receive input from a broad spectrum of abalone interests and expertise. He also explained that opportunity for formal public comment on the ARMP would follow the CDFG's submission of the plan to the Fish and Game Commission in early December. Mr. Karpov then reviewed the agenda for the meeting. He explained the terms "precautionary" and "sustainable". He introduced CDFG's presenters that would be explaining key features of the draft ARMP.

Presentation: Abalone Biology and Status of the Stocks

Mr. Jerry Kashiwada, CDFG marine biologist, presented an overview of abalone biology and the status of the stocks, explaining aspects of reproduction, age and growth, disease, predation, and environmental conditions that affect abalone stocks. He explained the importance of close abalone aggregations for successful reproduction. Studies indicate that fertilization drops to 50% if abalone are more than 2 meters apart. CDFG estimates that a minimum viable population level of 2,000 abalone per hectare (2.5 acres) is needed for populations to sustain themselves. He explained

that abalone larvae don't travel far and for that reason, once adult populations are depleted, it is difficult for abalone to recover. At about 4 in., abalone appear in emergent surveys. Although CDFG biologists see many legal-sized abalone in surveys, they have not seen good recruitment of these newly emerged abalone. Since it takes at least seven years (in the south) for abalone to grow to legal size, the legal-sized abalone that are seen now must supply the fishery for several years. Mr. Kashiwada explained the impact of disease on abalone particularly withering syndrome in black abalone, which has devastated that population in southern California. Although the bacteria that causes the disease has been found in northern California abalone, the disease has not been detected. It is thought that the colder water in northern California has prevented the disease from occurring there. Sea otters are a significant predator of abalone and will preclude a significant fishery within their range. Mr. Kashiwada went on to explain the affects that environmental factors such as El Niño and pollution can have on abalone stocks. El Niño events affect the food supply, which affects abalone growth; in addition, warmer water may exacerbate the effects of withering syndrome. Pollution can impact kelp beds, affecting a food source and abalone habitat.

In describing the status of abalone stocks in southern California, commercial landings data from before the 1997 moratorium illustrated the decline of abalone species to very low levels; the decline was caused by disease, sea otter range extension and predation, and fishing. White abalone are federally listed as an endangered species, black abalone is a candidate for federal listing, and green and pink abalones are potential future candidates. Southern California red abalone has been reduced to one remnant population at San Miguel Island.

In the northern California red abalone fishery, concentrated fishery effort and increased take, poor recruitment (few young abalone), a decline in deep water stocks, and depletion in high use areas is evident. Consideration of these factors resulted in the Fish and Game Commission's decision to reduce the daily and annual limits for sport abalone.

A short period for clarifying questions followed.

Presentation: Recovery Plan

Mr. Peter Haaker, CDFG senior marine biologist, presented highlights of the recovery portion of the ARMP. He explained that the recovery portion of the draft ARMP focuses on southern California abalone stocks (south of San Francisco). The draft ARMP's interim goals are to: prevent extinction, rebuild populations to self-sustainability, and rebuild populations to fishable levels. The long-term goal of the draft plan is to rebuild populations to levels that a fishery could be considered. Mr. Haaker presented a conceptual model from the draft plan, which illustrates various levels of stock abundance. 6,600 abalone per hectare (2.5 acres) is considered a sustainable fishery level. From 6,600 abalone per hectare to 3,000 abalone per hectare is a precautionary zone, below which is the 2,000 abalone per hectare minimum viable population. Below the 2,000 abalone per hectare level is an at risk zone.

Mr. Haaker went on to present the draft plan's approach to monitoring recovery, using criteria from key index sites. Criterion 1 would be broad size ranges at all index sites; Criterion 2 would be self-sustaining populations, at densities of 2,000 abalone per hectare at all key locations; and Criterion 3 would be an average of 6,600 abalone per

hectare at the index locations in at least 75% of the recovery areas, the sustainable fishery level. These criteria would need to apply to each species. The number of index site locations could be re-evaluated in the event of habitat loss, environmental change, or other such factors, including sea otter reoccupation.

Mr. Haaker went on to describe the draft plan's proposed recovery activities and their potential drawbacks, including: aggregation of emergent stock, translocation of emergent stock, and culture. Mr. Haaker explained that the timeline for recovery is likely to take decades.

A short period for questions followed.

Presentation: Management – Interim and Long-term Approaches

Ms. Jennifer O'Leary, CDFG marine biologist, described the highlights of the management portion of the ARMP. She explained that the proposed plan consists of an interim plan that is precautionary and short-term (2003 through 2009), and is based on limited data and imprecise management controls. The proposed long-term plan could be less precautionary because it would be based on better and more data. She again reviewed the proposed conceptual model for interim management. 6,600 abalone per hectare would be considered a sustainable fishery level, and a level at which a closed fishery would be considered for re-opening. 3,000 abalone per hectare would be the level at which fishery closure would be proposed by the Department. Again, 2,000 abalone per hectare is the minimum viable population level.

Ms. O'Leary described the draft plan's interim management components, which include an annual total allowable catch (TAC), criteria for measuring stock conditions, and two decision tables using criteria to guide changes. She described the proposed criteria in the plan for stock conditions: recruitment (high abundance of sub-legal, emergent abalone); densities of 6,600 abalone per hectare at all depths and 3,300 abalone per hectare for deep depths, and 2,000 abalone per hectare minimum viable population; and catch-per-unit effort and serial (local) depletion (decrease in CPUE, significant increase in the distance traveled from an access point). Recruitment and density criteria would be used to adjust the TAC up or down, while CPUE, serial depletion, and density criteria would be used to consider area closures and re-openings. Ms. O'Leary explained some of the limitations of the proposed interim management plan, including the limited amount of data available for decision making, and that the TAC applies to the entire fishery range.

The key elements of the proposed long-term management plan were described, including zonal management, use of abalone tags, and increased fishery independent data collection. The proposed target for the long-term management plan's implementation is 2010. The proposed plan calls for a planning process for re-opening fisheries when 75% of the recovery index sites meet the 6,600 abalone per hectare criteria.

A short question period followed.

Public Comment

Mr. Ed Schulze suggested that the abalone report cards should include an explanation that the abalone need to be kept in the shell. He suggested that in order to get better compliance on returns of abalone punch cards, that the punch card system

be modified to be like the deer and bear tag systems. He proposed that the system be modified so that in order to receive an abalone card, one should fill out an application, and if the card is not returned, then that person would not be eligible for a card the next season. He provided written materials on the CDFG's hunting programs for reference. Mr. Schulze proposed that a raffle system for certain areas be considered by CDFG. He expressed a willingness to serve on a committee to help advise CDFG in these matters. He also suggested that CDFG consider an education program that includes an abalone safety course, to better educate the public on how to not fatally injure sub-legal abalone.

Mr. Mike Wilkins explained that he had an extensive background of 16 years as an urchin diver on the north coast. He stated that he thought a daily limit was alright, as well as a seasonal limit. He stated that he sees a lot of abalone, in the tens of thousands, and is sure that he could provide CDFG with areas that would exceed 6,600 abalone per hectare. He also stated that he sees size ranges that are desirable. Mr. Wilkins commented that he has never been approached to participate in surveys or to provide CDFG with information, and that he would be willing to help with surveys. He stated that he has observed areas that are not being fished where coastal access is limited, but even in areas where access is not as limited he sees a lot of abalone. Mr. Wilkins commented that he was skeptical of the TAC based on the survey sites that CDFG uses. He also stated that tag drawings could be problematic, that people could be moved around inefficiently in such a system. Mr. Wilkins expressed a strong interest in getting involved.

Mr. Paul Weakland commented that he was disappointed with CDFG because his questions have not been answered. He submitted a report that he wrote entitled "Calamity California", dated November 1997. He expressed concern about withering syndrome. He stated that if his questions were answered, the CDFG would not need to hold public meetings. He commented that the CDFG had not done a good job responding to comments. He stated that the CDFG needed to state the level of error in their data.

Mr. Gene Kramer commented that he liked the density criteria proposed in the draft ARMP. He also commented that he thought the TAC was appropriate. He suggested that a zonal management approach would need to be fine scaled enough to allow individual beaches a rest. He suggested that underwater scooters would allow the CDFG to cover more area in their surveys, which would help in areas with low abalone densities.

Mr. Ed Flynn commented that all indications are that there are a lot of abalone out there in the north. He stated that the CDFG's survey efforts should be focused on divers, not shore pickers, and that diving should be defined as greater than 10 feet.

Ms. Mary Lorenz commented that she agreed with Mike Wilkins, that the divers that she knows see a lot of abalone. She suggested that the CDFG take advantage of local people who know the coastline. She stated that the ARMP does not contain an education component, which needs to be emphasized. Ms. Lorenz suggested that an abalone education program be similar to a hunter safety program and that such a course be a requirement for obtaining an abalone card. She suggested that any closures be implemented on a rotating area basis, not total closures. She also suggested that CDFG include night dives as part of their diving surveys. Ms. Lorenz

also commented that CDFG should make available the scientific papers that it cites, not just the citations, because it is difficult for the public to locate scientific papers. She also requested that the CDFG hold another town hall meeting in Fort Bragg to allow more people to attend.

Mr. Fonseca commented that he thought that CDFG's enforcement was doing a good job. He stated that it was difficult to find follow-up reports on research that had been done. He also commented that there is a tremendous resource of local divers that CDFG is not utilizing. He suggested that any peer review of the ARMP include the international community, and that the recovery in New Zealand has been phenomenal. He expressed alarm over the outplanting of abalone on the north coast and the potential for disease. Mr. Fonseca commented that the CDFG is not using good science. He suggested a scientific study of outplants to check for disease, with only those without disease being used for outplants. He stated that the quarantine policy of the CDFG has not been adequate. He commented that imported animals must be quarantined.

Mr. Bob Janetz commented that there is plenty of abalone. He stated that he is in favor of closing areas that need it, but doesn't want continued take reductions. He stated that the three sites used for data collection are not representative. He suggested translocation of abalone. Mr. Janetz stated that he appreciated the meeting.

Mayor Jere Melo submitted written comments. He stated that the first that he was aware of the meeting was from the local newspaper on August 29, and that because of that, there wasn't enough time for all council members to provide comments by the morning of the town hall meeting. He thanked CDFG for holding a town hall meeting in Fort Bragg. He expressed how important abalone is to the residents of the Mendocino coast, as a food source, and as an important component of the local economy. He stated that local residents see poaching as a serious threat to abalone stocks, and that the sport abalone fishery helps in deterring poaching through the presence of sport divers. He encouraged CDFG to seek improved public access to the coast. He commented that the ARMP should allow for collection of data on a statistically sound basis. He expressed concern with no take abalone preserves, stating that poaching in these areas could be a problem. He invited CDFG staff to provide updates on abalone management at City Council meetings.

Summary and Adjournment

Following a break, the CDFG staff presented a summary of the verbal comments that they heard at the meeting. Mr. Karpov thanked the audience for attending and providing the CDFG with their comments. The meeting was adjourned.

G.3.1.2 Santa Barbara Town Hall Meeting Summary

The CDFG held a town hall meeting at Buchanan Hall, University of California in Santa Barbara on September 14, 2002, to receive informal public comments on the draft ARMP. The objectives of the town hall meeting were to:

- Explain key features of the draft ARMP.
- Obtain public comments and suggestions on the draft ARMP.

Welcome and Opening Remarks

Mr. Fred Wendell, CDFG nearshore ecosystem coordinator, thanked those in attendance for their interest and for taking valuable time to help the CDFG with the process of developing the draft ARMP. He explained that the CDFG would give presentations on the key components of the draft ARMP, and then comments would be received. Comments will be considered in the process of revising the draft. He went on to explain that for the current informal comment process, each comment will not be responded to directly, but will be summarized and included in the draft ARMP. Mr. Wendell encouraged the audience to focus comments on how to improve the draft ARMP.

CDFG staff present were introduced. Members of the audience introduced themselves. Mr. Wendell directed the audience's attention to a handout of the Fish and Game Code sections that guide the content of the ARMP. He reviewed the public input process to date, and then explained that once the draft ARMP is submitted to the Fish and Game Commission, a formal public comment period will begin. He explained that formal public comments will be responded to.

Presentation: Abalone Biology and Status of Stocks

Mr. Jerry Kashiwada, CDFG marine biologist, presented the biology and status of the stocks components of the draft ARMP. He began by explaining factors which affect the status of stocks, focusing on age and growth, reproduction, disease, predation, and environmental conditions. Mr. Kashiwada explained that one important component of reproduction that affects abalone includes the minimum viable population (MVP) level, which is the minimum abundance at which populations can sustain themselves. Studies have shown that when abalone are spaced more than two yards apart, only 50% of abalone eggs are fertilized. Abalone larvae do not disperse far, thus population recovery is slow. Research has indicated that the MVP is 2,000 abalone/hectare (2.5 acres). An important factor of abalone reproduction is that it is sporadic. In1989 and 1990 there was a successful recruitment of young abalone, but none since then.

Mr. Kashiwada discussed abalone age and growth, which might be affected by environmental conditions. It takes about seven years for abalone in southern California to reach legal size and about 13 years in northern California, a result of different environmental conditions and food availability.

Mr. Kashiwada reviewed disease concerns for abalone particularly withering syndrome in southern California. He stated that although the bacteria that causes the disease has been found in a few individuals in northern California, no abalone in the region have been found showing signs of the disease. Research indicates that colder water temperatures on the north coast prevent the occurrence of the disease there.

It was explained that while humans and sea otters are major predators of abalones, sea otters will preclude a fishery within its range.

Mr. Kashiwada next addressed the status of abalone stocks. He explained that generally the stocks in southern California are in poor condition. White abalone is listed as an endangered species, black abalone is a candidate for listing under the Endangered Species Act, and pink and green abalones are potential future candidates for listing. Red abalone populations are mostly limited to San Miguel

Island. He noted the concerns about the northern California red abalone resource and fishery including concentration of fishery effort, irregular recruitment of young abalone, deep water stock decline, and serial (local) depletion (fishermen having to travel farther from access points to get abalone) in high use areas. He added that although there are many legal-sized abalone present today, the lack of recruitment of young abalone means that the large abalone present now will need to last for at least the next 10 years.

Clarifying questions and answers followed.

Presentation: Recovery

Mr. Peter Haaker, CDFG senior marine biologist, presented key features of the recovery portion of the draft ARMP. He explained that the recovery part of the ARMP applies to white, black, red, green, and pink abalone in southern California and red abalone at San Mateo Point and the Farallon Islands. Mr. Haaker stated that the draft plan proposes a seven-year timeline to implement interim recovery goals: prevent extinction, rebuild populations to self-sustaining levels, and rebuild populations to fishery levels. The long-term goal of the plan is to reach levels where a fishery would be considered.

Mr. Haaker described a conceptual model from the ARMP that illustrates recovery of stocks from current levels. Southern California red abalone is currently at sustainable levels at one island, but pink, green, white, and black abalones are below minimum viable population levels. Proposed target minimum viable population levels are 2,000 abalone per hectare (2.6 acres), and fishery consideration would occur at 6,600 abalone per hectare. These levels are adaptable and could be changed when recovery occurs.

Mr. Haaker described three criteria to use in assessing the status of stocks. Criterion 1 would be a broad size range at many sites, which indicates growth and good reproduction. Data for this criterion would be collected from swim surveys. Once Criterion 1 was met, then density surveys could be used to evaluate Criterion 2, which would be 2,000 abalone per hectare, the minimum viable population level. Criterion 3 would be density of 6,600 abalone per hectare, the level at which a fishery could be considered. The criteria would apply to each individual species, at all index sites for Criteria 1 and 2, and at 75% of the sites for Criterion 3.

Mr. Haaker explained that the draft plan is adaptive, that index locations could me modified due to habitat loss, sea otter expansion, or environmental change. He noted that if recovery areas declined by 50% for a particular abalone species, then there would not be a fishery for that species, because of reduced biological capacity.

Mr. Haaker described activities that the plan uses for recovery. Aggregation, or moving abalone closer together, could help with reproduction, but has potential problems with handling and poaching and the source of individuals. Translocation, or moving abalone to other areas to re-establish them is another activity described in the plan, with similar potential problems to aggregation. Culture, or breeding abalone in captivity is another possible activity described in the plan; its drawbacks include cost, and past outplanting activity has been problematic. Mr. Haaker explained that future activities would depend on what happens in the interim period. He cautioned that the recovery period is likely to be a long one.

Clarifying questions and answers followed.

Presentation: Management – Interim and Long-term Approaches

Ms. Jennifer O'Leary, CDFG marine biologist, described key features of the management portion of the ARMP. She explained that the proposed plan consists of interim and long-term parts. The interim part is precautionary and short-term (2003 through 2009), and is based on current limited data and management. The proposed long-term plan could be less precautionary because it will be based on more data and allow more precise management of the fishery. She reviewed the proposed conceptual model for interim management. 6,600 abalone per hectare would be considered a sustainable fishery level, and a level at which a closed fishery would be considered for re-opening. 3,000 abalone per hectare would be the level at which fishery closure would be proposed by the Department. Again, 2,000 abalone per hectare is the minimum viable population level.

Ms. O'Leary described the draft plan's interim management components, which include an annual total allowable catch (TAC), criteria for measuring stock conditions, and two decision tables using criteria to guide changes. She described three proposed criteria in the plan for stock conditions:

- Recruitment (high abundance of sub-legal, emergent abalone)
- Density (6,600 abalone per hectare at all depths and 3,300 abalone per hectare for deep depths, and 2,000 abalone per hectare minimum viable population)
- Catch-per-unit-of-effort (CPUE) and serial (local) depletion (decrease in CPUE, significant increase in the distance traveled from an access point).

Recruitment and density criteria would be used to adjust the TAC up or down, while CPUE, serial depletion, and density criteria would be used to consider area closures and re-openings. Ms. O'Leary explained some of the limitations of the proposed interim management plan, including the limited amount of data available for decision making, and that the TAC applies to the entire fishery range.

The key elements of the proposed long-term management plan were described and include: zonal management, abalone tags, and increased fishery independent data collection. The proposed target for the long-term management plan's implementation is 2009. The proposed plan calls for a planning process for re-opening fisheries when 75% of the recovery index sites meet the 6,600 abalone per hectare criteria.

A short question period followed.

Public Comments

Mr. Steve Rebuck commented that the patch dynamics of abalone should be considered, because even though habitat may look good for abalone, they may be absent. He stated that suitable habitat doesn't necessarily mean that abalone will be there. He suggested that CDFG use commercial divers to help locate abalone. Mr. Rebuck questioned what had happened to the 45,000 to 50,000 abalone being taken at the time of the fishery closure, and stated that they were continuing to grow and reproduce. He stated that he thought that there was some stability in the fishery at

the time of closure. He stated that survey work was needed at the Farallon Islands and mainland. He suggested that otter areas should be considered for fisheries and that the plan needed to be strengthened with regard to otters. Mr. Rebuck stated that a commercial fishery should be considered at the Farallon Islands. He also stated that there are a lot of abalone at Van Damme. He stated that some of the plan's goals were unrealistic, that we can't return to prehistoric levels. Mr. Rebuck suggested quotas and slot fisheries would be effective management tools. He agreed with Don Thompson that the CDFG has not delivered what it promised. Mr. Rebuck submitted a plan for ITQs in southern California. He stated that 50% of red abalone landings were made by 10 divers, and that the transferability of permits is a good idea. Mr. Rebuck stated that he would like to see electronic devices used to track fishermen. He stated that in 1991 he submitted a plan for using tags at the request of Earl Ebert, and was pleased to see that tags were in the plan. With regards to stock assessment, Mr. Rebuck commented that the CDFG's 1997 cruise report stated that commercial sized abalone were 1.2% of the population, and that he thinks that there are 4,000,000 abalone available to harvest south of San Francisco.

Mr. Mark Becker disagreed with the CDFG's statement that it takes from 10 to 14 years for abalone to reach legal size. He stated that Johnson's Lee data are wrong, and needs to be re-addressed. He stated that the decline data were wrong and that the die-off at Palos Verdes needs to be re-addressed. He commented that data from block 690 need to be verified, and suggested that fish tickets be linked to fuel receipts to prove that block 690 produced the abalone that were shown from there. Mr. Becker expressed concern about the movement of abalone, the effects of copper piping on them, and rickettsia. He stated that the CDFG needs more stringent controls over spread of disease. He commented that the science that was presented was poor, and that the plan is skewed. He stated that the plan needs new science collected with the cooperation of fishermen, and that studies need to be developed now.

Mr. Paul Weakland commented that he did not receive the postcard announcing the town hall meeting until late, and that the meeting was scheduled on the same day as an urchin meeting. He also commented that many people don't have Adobe Acrobat which is needed to view the ARMP on the Internet. He commented that the 6,600 abalone per hectare number is too precautionary and not realistic. He stated that the minimum viable population level figure should be reduced to 1,200 abalone per hectare, and that all of the numbers should be reduced. He stated that divers are stewards of the resource, and that withering syndrome is poisoning the roots of the abalone resource. He stated that disease is being ignored. Mr. Weakland stated that the CDFG is lying about sabellid worms and withering syndrome. He commented that the seven-year time line needs to be retroactive to the closing of the fishery. Mr. Weakland commented that he is offended that the ARMP is dedicated to Mia Tegner, and that that dedication should be removed.

Mr. Jim Marshall commented that pre-emergent abalone should be looked at for recruitment.

Mr. Jim Finch questioned what was meant by "deep water" and commented that free diving is becoming popular in southern California, so the CDFG should

consider that 25 feet is not that deep. He stated that poaching in northern California is a big problem. Mr. Finch commented that he believes in outplanting and thinks it works. He stated that divers saw results of outplanted abalone that became harvestable, but were discouraged when those abalone were wiped out by recreational fishermen. He stated that adequate penalties were needed to discourage poaching. Mr. Finch stated that tags were a good idea, and that education was needed. He suggested that fishermen not be allowed to take abalone without adequate education on handling them. He stated that the sport abalone size should be increased. He also stated that he starts to see abalone at 7 inches to 7.25 inches, and that a 7-inch size limit is a crime.

Mr. Mike Shane questioned the 6,600 abalone per hectare density, asking if that number was achievable in southern California. He asked that the plan be adaptable if that number was not possible for southern California. Mr. Shane also questioned the use of transplantation because there have been no genetics studies. He suggested that the plan contain a plan to do genetics work before translocating to avoid problems. He questioned whether there were plans to generate money from outside of the CDFG. Mr. Shane commented that he didn't want to see the CDFG five years down the road saying that we didn't have the money, and to make sure that the plan contains all potential sources of funding.

Mr. David Kushner commented that although fishermen say that biologists don't know how to find abalone, he believes that they do. He commented that an apprentice program is needed to train future people to identify and find abalone, because fishermen and biologists are a dying group of people. Mr. Kushner commented that the plan needs to clarify that threaded and pinto abalone are the same. He stated that we don't know what is going on with threaded abalone, that they have re-appeared, and that should be addressed. He stated that northern California populations should be looked at separately from southern California populations. He commented that there is no evidence that withering syndrome has affected red and pink abalone, and that that statement should be removed. Mr. Kushner commented that protection education needs to be emphasized more. He stated that the plan needs to document attempts at translocation and aggregation to look at successes and failures, in particular failures, since these are often not published.

Mr. Don Thompson complimented the plan's use of contingency tables in making decisions. He expressed concern about lack of data from only three sites. He commented that a biomass estimate is needed for abalone, and questioned why the CDFG had not extrapolated the data index sites to biomass estimates. He stated that he wanted the CDFG to stop grouping data over a long period. Mr. Thompson stated that a status report is needed to document recovery of abalone since the fishery closure. He commented that subjective statements should be removed from the ARMP and asked for more quantitative, statistical information. He stated that all of the information from the former plan, including public comments be included. Mr. Thompson stated that the CDFG ceased progress, and rescinded on promises made on a management plan for a fishery. He stated that in 1997 John Duffy stated that it was time to consider a possible re-opening of fisheries in southern California. He recalled a Fish and Game Commission meeting at which it was stated that the CDFG

was on its way to getting biomass estimates for abalone, and the CDFG still doesn't have them. Mr. Thompson commented that he was angry about how the CDFG is handling the delivery of the management plan, because CDFG has not delivered what it said it would do.

Mr. Bob Duncan expressed concern about poaching and questioned how the CDFG planned to protect areas where 6,000 abalone per hectare exist. He emphasized that enforcement needed to be better addressed. He stated that the plan needed to include a study of how threaded abalone have returned, and the ability for abalone to bounce back on their own.

Following a break, CDFG staff presented a summary of the oral comments received that day to the audience. Mr. Wendell again thanked those present for attending the meeting and providing valuable input. The meeting was adjourned.

G.3.2 Recreational Abalone Advisory Committee (RAAC) Meeting

Oral comments on the ARMP were received from members of the RAAC at their meeting in Los Alamitos, September 21, 2002. The following is a summary of those comments.

G.3.2.1 ARMP Review and Recommendations by RAAC

Prior to the meeting, members of RAAC were asked to read the draft ARMP and give the department their questions and comments. A brief presentation was prepared for RAAC. The committee declined so they could have more time to discussing the plan.

Mr. Campi asked if the daily poaching numbers of 4,800 abalone a day in were correct. It was indicated that in 1997 that was the number the department came up with. Mr. Colgate was concerned about the lack of index sites listed in the plan. He also wondered what would happen to a site which became populated with sea otters and if so would we choose a new site. A similar concern arose about the effects that pollution and temperature can have on a site. Mr. Campi asked what PISCO was and it was explained that they are a surveying; marine monitoring organization ran through University Of California Santa Barbara and University of California Santa Cruz. They are similar to the Channel Island Research Institute and groups like this will be very helpful in obtaining the data we are lacking.

Mr. Colgate was confused on broad size distribution as discussed in the plan under Criterion 1. Mr. Haaker explained that we want to see the size distribution discussed in Criterion 1 in all index cites. It was questioned on how much time will be spent at the index sites. This will help point out that a density survey is warranted, but we need more resources to do this.

Mr. Pogre was concerned that the Farallon fishery was closed due to a small percentage of poachers and it was unfair to preclude a fishery due to a few poachers. He was also concerned about commercials lying on their landing receipts by marking down North Coast poached abalone as Farallon abalone. Lt. Morse discussed a case where they tracked a commercial fisherman who transported 600 marked north coast abalone and reported them as Farallon abalone. Mr. Pogre commented that most abalone fishermen have changed their attitude and

understand that any new abalone fishery will not be a free for all. The remaining commercial fishermen have more respect for the fishery.

If 25% of MPAs are implemented, what effect will this have on the fishery? MPA's are a vital component of recovery but percentages are unknown. Mr. Karpov pointed out that the north coast already has a 15% defacto refuge because abalone located in deeper water can not be reached by free divers. Recovery needs some areas of total protection. They need aggregation to spawn and no take zones are vital for this.

Mr. Campi was concerned that the San Mateo coast surveys need to be done. Shift opening of the San Mateo coast from short term to long term. This would help to relive pressure from the north coast. This assessment should be made a priority and should be conducted sooner than 2006.

Mr. Daniels commented that in the past he had anxiety over RAAC material but overall was very impressed with the draft ARMP. He pointed out that interim and long term goals have no alternatives which fall short of the legal requirements from the Fish and Game Code §5022(a). Their was also some concern about the characterization of sea-otter and abalone long lived coexistence, which allowed maintenance of stable low density abalone populations. Mr. Daniels pointed out that there were some areas of high density areas.

Mr. Benevides was interested in fines money from abalone violations were going into the abalone fund. Lt. Riske said we are right now. Mr. Benevides was also interested if the laws and penalties were enough to protect the resource. Lt. Riske added that the commercial guidelines had been lowered from 30 to 12 abalone in possession. He added that enforcement has had special meetings with Mendocino's and Sonoma's judges and district attorneys to emphasize the importance for stiff fines and harsher sentences. Mr. Benevides again stated the importance of more enforcement is needed and that if we can not come up with more enforcement then the penalties for violations need to be harsher. A discussion about paper fines verses resource fines confirmed that some people fill out the abalone punch cards wrong and they are trying to be legal. A paper violation should not receive the same fine as someone who committed a resource violation. It was suggested to increase the resource violation and separate the two.

Mr. Benevides, who is also a member of on one of the Marine Life Protection Act working groups, stated that the MLPA process needs to hear from the abalone team for suggestions on areas for protection. Furthermore, MPAs need to be implemented right now and the MLPA process is moving too slow. Daniels suggested that RAAC needs to submit a letter, similar to the letter Dr. Mia Tegner previously submitted to the Department, to point out the importance of MPAs right now. This letter could be submitted to the commission, director and MLPA lead biologists.

A question about the sunset date for the DAAC funds and where they would go if lost. Mr. Campi clarified that the sunset date had been extended and the money will not be lost.

Mr. Pogre was concerned about central California red abalone and that if a fishery did open in that part of the state the commercial fishery should not be left out.

He added that assessment is necessary in the near future and that a commercial fishery would help relive some pressure on the north coast.

Mr. Colgate was upset that the plan had not been given to RAAC or the ARMP Advisory Panel, so their comments could accompany the document to the peer reviewers. No alternatives in the plan give a continued separation between the commercial fisherman and the Department. He also thought that white abalone had plenty of funding from the federal government and that the state would better spend its limited time and resource on the red abalone which can achieve a minimal viable population, unlike the white abalone. Mr. Colgate was also concerned that if sea otters move into an area which historically was unpopulated, would we let the sea otters decimate the abalone population. If this happens then a fishery for both sport and commercial fisherman should be open until the population reaches the 2000 abalone per hectare. Why should the sea otters be able to destroy the population? Mr. Colgate was also interested in the Farallon Island assessment be moved from long-term to interim goal. An assessment of the islands is needed as soon as possible.

Mr. Pogre believes that the recreational fishery lines should be moved south to Pigeon Point. He also believes that Pigeon Point would be a great index site. He also added that the Farallon Islands would be a good index site for the south. Mr. Pogre added that fishermen have developed a new attitude. They realize that they have a lot of money to lose and that they will as a whole respect the resource more than they did in the past.

Mr. Daniels felt that there need to be more index sites on the north and that there should not be a fishery on the Farallon Islands.

Mr. Campi was concerned that the ARMP did not follow the Marine Life Management Act (MLMA) guidelines. He thought that in the future, MLMA should guide changes in the ARMP even though the ARMP is not currently under the MLMA process now.

Mr. Campi was curious about differences between starving abalone and an abalone with withering syndrome. He added that two shrunken abalone were recently found on the north coast. Mr. Haaker explained that a hungry abalone will metabolize the foot thus causing foot shrinkage. Mr. Haaker reminded them that even if an abalone has the withering syndrome bacterium, the low water temperature in north coast waters does not allow the bacterium to take over. He added that all abalone with a shrunken foot should be sent to the Bodega Bay Marine Lab for assessment.

RAAC members present:
Steve Campi
Rocky Daniels
Richard Pogre
John Colgate
Steve Benavides
Lt. Steve Riske

G.3.3 Written Comments

Written informal comments on the ARMP came in the form of letters, faxes, and e-mail. The deadline for submission of written comments was 5:00 p.m., October 4, 2002. Written comments received are available on request, but are not appended to the plan. Comments that were considered relevant to the plan are included in the "Summary of Informal Public Comments", Section G.2.4.

G.3.4 Summary of Informal Public Comments

All of the written comments, and oral comments received at the town hall meetings and the RAAC meeting, were reviewed and considered by Department staff. Comments that were considered relevant to the plan and focused on improving it were given further consideration. If a comment or correction improved the plan, it was incorporated into the plan; if it was not found to improve the plan, it was not incorporated into the plan. To process all of the comments for consideration, each person who provided comments was assigned a number and each page of their comments was assigned a consecutive number, including the oral comments received at the town hall and RAAC meetings. Several people provided additional supporting documents to their written or oral comments. The supporting documents were assigned a lower case letter along with the person's number (i.e. Person 1= written comments, and 1a= supporting documents). All of the written comments that were received are available on request, but are not appended here.

The following table summarizes the comments that were considered relevant to the ARMP and focused on improving it. Comments are not responded to individually, but rather summarized into categories in the 'Comment' column of the table. The 'Source' column lists the numbers of people who provided each comment and refers to the page number of that person's comment. General responses to comments, when appropriate, are listed in the 'Response' column. Following this table is a second table, which lists the names of those who commented, their assigned number, and whether their comment was written or oral.

Table G-1. Summary of informal pubic comments on the draft ARMP.

Comment	Source No. = commenter, (pg. no. of comment or appendix G - FB=Fort Bragg TH, SB=Santa Barbara TH, LA=Los Alamitos RAAC meeting)	Response
Education		
There is a need for better education about abalone resource	8 (info signs), 5 (App. G-FB), 24 (App. G-SB)	
Punch card should say keep abalone attached in shell	5 (App. G-FB)	
Education program should be tied to receiving punch card	19 (App. G-FB), 22 (App. G-SB)	
Papers cited should be provided	19 (App. G-FB)	
Legal Framework		
ARMP and CEQA compliance	1a (pg. 5), 14	Sec. 4.2.2 - added
ARMP and MLMA	12 (pg. 7)	Sec. 4.2.3 - added
ARMP and ESA	12 (pg. 8), 14	Sec. 4.3 - modified Sec. 6.5.2.5 - modified
Biology		
Allee effects	1 (pg. 5)	Refer to sec. 2.1.2.2 - (Allee effects) Refer to sec. 2.1.9 - mortality
White abalone status	1 (pg.9), 12 (pg. 7)	Refer to sec. 2.2.5 - modified
Red abalone status at San Miguel Island	1 (pg. 11), 12 (pg. 2)	Refer to sec. 2.2.1.2 - modified Exec sum. Pg. I - modified
Flat and pinto abalone should not be referred to as rare	1a (pg. 11), 15 (pg. 4), 25 (app. G-SB)	Sec. 2.2.6 - modified
Include cite of Tegner et al. 2001 regarding importance of El Nino events	12 (pg. 5)	Sec. 2.1.9.2 - modified Lit. cited - modified
Question the optimal temperature for southern Cal. Red abalone	12 (pg. 5)	Sec. 2.1.12.2 - modified
Revise fig 2-2 San Miguel Is. Ab abundance data for 1974	12 (pg. 5)	Fig. 2-2 - modified

Inadequate data to assess trends at the Farallon Is. and Fitzgerald Mar. Reserve	12 (pg. 6)	Sec. 2.2.1.2 - modified
H. assimilis taxonomy (sp vs. subsp.)	14 (pg. 5), 24 (App. G-SB)	Sec. 1.1 - modified Sec. 2.1 - modified
Define central California area	14 (pg. 7)	Refer to fig. 1-1
How can it take 14 yr for a red abalone to reach 7 in. when studies report that they grow on average 1in. per year	15 (pg. 3)	Refer to sec. 2.1.6 and Table 2-3 - added
Include description of stocks in otter areas	32	
Include estimate of age at maturity	32	Sec. 2.1.2.1 - modified and Table 2-1- added
Include statement about age and growth dynamics are shorten in presence of otters	32	
Recovery		
Clarification between emergent recovery levels and sustainable levels in otter areas	1 (pg. 6), 14 (pg. 3)	Fig. 5-1 - modified Glossary - modified (add at risk def.)
Density criteria	1 (pg. 7, pg. 12), 14 (pg. 8), 15 (pg. 1), 18 (App. G-FB), 23 (App. G-SB)	Refer to sec. 6.2.2 - modified Sec. 6.2.3 - modified Refer to sec. 7.1.2.1 Criterion 2
Engaging constituents in data collection for recovery	1a (pg. 4), 12 (pg. 11)	Refer to sec. 6.4.1
ARMP lacks alternatives to recovery	1a (pg. 7), 12 (pg. 4, 8), 15 (pg. 7), 32	Sec. 6.8 - added
Provide estimates of time to reach density goals	1a (pg. 7)	Refer to sec. 6.7
Present status of recovery since closure of the fishery	1a (pg. 8)	Refer to sec. 6.6.1.1 Task 1
Do not eliminate pinto and flat from future fisheries	1a (pg. 8), 11	Modified plan to include minor species
State resources should be directed at red abalone rather than white abalone	26 (App. G-LA)	
Continue to develop methods to increase assessment abilities	11	Refer to sec. 7.2.3

Aggregation/translocation experiments seem unlikely to succeed	11, 15 (pg. 42), 24 (App. G-SB)	Refer to 6.4.2.1
Include contingencies for black abalone if listed under ESA	11	
Incorrect FG code Section cited in justifying Criterion 1	12 (pg. 9)	Sec. 6.2.1 - modified
Identify reproductive connectivity between index sites and among recovery areas	12 (pg. 10), 15	Refer to sec. 6.4.1.3
Assessments for recovery is too infrequent, too long(5 yr.)	12 (pg. 10)	Sec. 6.4.1 - modified Refer to table 9-1
Task 9 should occur before Tasks 4-8	12 (pg. 11), 23 (App. G-SB)	Sec. 6.6.1 - modified Refer to table 9-1
Using the 6600 ab/ha density based on Australian data is not appropriate	14 (pg. 3)	Refer to sec. 7.1.2.1 pg. 7-4 Criterion 2
One-size-fits-all is not a realistic approach	14 (pg. 3), 15, 23 (App. G-SB)	Sec. 6.2.2 - modified
Do not relocate red abalone from SMI to other sites	14(pg. 11)	
Out-planting feasibility	15 (pg. 3)	Refer to Sec. 6.6.1.2 and Sec. 6.6.1.3
What are the recovery techniques?	15 (pg. 6)	Refer to Sec. 6.4.2
What are the key index sites?	15 (pg. 21)	Refer to Tables 6-3 through 6-8
Disease is not adequately addressed	15, 16 (App. G-FB), 21 (App. G-SB)	Sec. 2.1.9.1 pg. 2-6 - modified
Add Farallon Is. and San Mateo coast to recovery index sites	6 (App. G-LA)	Table 6.3 - modified
Management		
Allocation of resources between recreational and commercial fisheries	8	
Daniels and Floren (1998) citation on pg. 7-17 is misleading	1a (Comment 50), 14 (pg. 3)	Sec. 7.1.4.3 - modified
Alternative goals for management	27 (App. G-LA)	Sec. 7.3 - added

Provide a range of alternative target densities which correlate with exploitation rates	1a (pg. 11)	Refer to sec. 7.1.2.2 and table 7-2
Require abalone report card for individuals under 16 yr of age	5	Sec. 7.1.1.7 - modified
Assessment protocols	8 (3)	Refer to Appendix E
Add Gerstle Cove to Sec. 7.1.2.4	12 (pg. 11)	Sec. 7.1.2.4 - modified
How do amendments to plan occur?	15 (pg. 5)	Refer to Sec. 4.4
Adaptability of plan to environmental changes	15 (pg. 6)	Refer to Sec. 7.1
Add Punta Gorda to Sec. 7.1.2.4	15 (pg. 16)	Sec. 7.1.2.4 - modified
Increase minimum size to 7.75 in.	15 (pg. 54), 22 (App. G-SB)	
Socio-economic data needs are lacking	15 (pg. 76)	Sec. 3.2 - modified
Rotating zonal management	18 (App. G-FB), 19 (App. G-FB)	
Fishery		
Initiate a complete abalone moratorium until numbers increase	3	Sec. 7.3.6 - added
Initiate a tag program	5 (App. G-FB), 14 (App. G-SB), 22 (App. G-SB)	Refer to Sec. 7.1.3.2
Redesign report card system to prevent multiple purchases and insure compliance with returns i.e. application for report card	5	Sec. 7.1.1.7 - modified
Determine biomass estimates for all abalones to better manage fishery	1	
Open limited commercial take in areas not easily accessed in northern California	4, 15 (pg. 8)	Refer to Appendix B §5521.5
Reopen areas from Pigeon Pt. north and the Farallons to take of abalone (commercial and/or recreational)	1, 6, 7, 8, 9, 10, 12 (pg. 11), 14 (pg. 6), 15 (pg. 16), 10 (App. G-LA), 29, 31	Sec. 7.1.4.3 - modified

Include Pigeon Point to Pescadero Creek a fishing area for consideration.	6	
Explain concept of “depleted fishery”	1a (pg. 10)	Glossary - modified
Open private areas to public access	4, 13 (pg. 2)	Refer to Sec. 4.1.2
Economic values of commercial and recreational fisheries are not directly comparable	12 (pg. 2), 14 (pg. 7)	Exec. Sum. - modified Sec. 3.2 - modified
No. of permits in 1997 was 103	12 (pg. 7)	sec. 3.1 - checked no. permits at closure
Oppose any commercial fishery in northern Calif.	13 (pg. 2)	
Have a fishery at San Miguel Is.	14 (pg. 8)	
Consider raffle system	5 (App. G-FB)	
Consider ITQs in fishery	14 (App. G-SB)	
Consider using electronic tracking devices to track comm. fishermen	14 (pp. G-SB)	
No commercial fishery at Farallon Is.	27 (App. G-LA)	
Allocation between recreational and commercial fisheries	8	
Research		
Surveys - more needed in broader and more areas or better data	8 (specific index sites), 15 (pg. 58), 17 (App. G-FB), 20 (App. G-FB), 21 (App. G-SB), 10 (App. G-LA), 27 (App. G-LA)	
Monitor environmental factors (kelp beds abundance, El Niños, etc.)	8	
Need abundance/biomass estimates for better management	1 (pg. 11-12)	Refer to Sec. 7.2.3

Collaborative research efforts should include diver constituents	12 (pg. 12), 17 (App. G-FB), 19 (App. G-FB), 16 (App. G-FB), 14 (App. G-SB), 21 (App. G-SB)	Refer to Sec. 6.4.1
Need a stock assessment	14 (pg. 2)	Refer to Sec. 6.4.1
Include nighttime surveys	19 (App. G-FB)	
Include international community in peer review of plan	16 (App. G-FB)	
Enforcement		
Increase protection	11, 13, 15 (pg. 4), 22 (App. G-SB), 25 (App. G-SB), 27 (App. G-LA)	
Marine Protected Areas		
Identify and establish potential MPAs for abalone recovery (coordinate w/MLPA process)	11, 15 (pg. 53), 27 (App. G-LA), 30	Refer to Sec. 6.4.2.4 and 7.1.1.3
New MPAs and enforcement issues	13 (pg. 2)	
Suggest rotating MPAs	14 (pg. 10)	
MPAs will not help abalone recovery	15 (pg. 15)	
Sea Otter		
Take action to gain state control of sea otters	2, 8, 14 (pg. 4)	Refer to Sec. 4.3
Determine the density level of abalone in the sea otters' range for comparison with areas outside otter range	1, 8	
Consider re-opening areas where sea otter re-colonization is imminent	1a (pg.8), 6, 9, 26 (App. G-LA)	Sec. 7.3.3 - added
Consider a fishery within otter areas	14 (pg. 4)	Sec. 7.3.4 - added
Plan for recovery is useless if otters recolonize recovery areas	2, 8, 14 (pg. 4),15 (pg. 26)	Refer to Sec. 4.3 Sec. 6.8.1 - added

Miscellaneous		
Change the word “would” to “could” in last sentence of Sec. 8.3.3 (now 9.3.3)	12 (pg. 12)	Sec. 9.3.3 - modified
Misleading language	1a (pg. 10)	Refer to glossary
Docent program (volunteer)	2, 8	
Measurements should be in English units	15 (pg. 20)	
Identify all funding sources for plan implementation	23 (App. G-SB)	
Abalone biologist in Santa Barbara area	32 (pg. 1)	

Table G-2. List of people providing public comments		
Commenter number	**Name**	**Comment type (W=written, O=oral)**
1, 1a	Don Thompson	W, O
2	Edward A. Flynn	W, O
3	Kristin Phillips	W
4	Earl Reid	W
5	Ed Schultze	W, O
6	Richard Pogre (RAAC)	W, O
7	Harry Vogl	W
8	Hank Lindemann	W
9	Jim Goodwin	W
10	Steve Campi (CenCal Divers, RAAC)	W, O
11	Tim Setnicka (CINP)	W
12	Jim Marshall	W, O
13	Mayor Jere Melo (Fort Bragg)	W
14, 14a	Steve Rebuck	W, O
15, 15a	Paul Weakland	W, O
16	John Fonseca	O
17	Mike Wilkins	O
18	Gene Kramer	O
19	Mary Lorenz	O
20	Bob Juntz	O
21	Mark Becker	O
22	Jim Finch	O
23	Mike Shane	O
24	David Kushner	O
25	Bob Duncan	O
26	John Colgate (RAAC)	O
27	Rocky Danniels (RAAC)	O
28	Steve Benevides (RAAC)	O
29	Robert Spencer	O
30	Kate Wing (NRDC)	W
31	Linda Meyer	W
32	Harry Liquornik	W

G.4 Formal Public Comments

G.4.1 Formal Public Comment Meetings

After submission of the draft ARMP to the Fish and Game Commission in late 2002, four formal public comment meetings were held to receive public comment on the draft plan. Two of the public comment meetings were held during regular Commission meetings, and two special Commission meetings were held specifically to receive public comment. The meetings were held at four separate venues throughout the state, and included Monterey (Nov. 19, 2003, special Commission meeting), Long Beach (Feb. 5, 2004, regular Commission meeting), Santa Rosa (April 20, 2004, special Commission meeting), and Crescent City (June 24, 2004, regular Commission meeting). At each meeting the Department provided a presentation that outlined the contents of the draft ARMP. The presentation was followed by a public comment and discussion period.

G.4.2 Written Comments

Written formal comments on the ARMP came in the form of letters, faxes, and e-mail. All written comments were documented and are included in the "Summary of Formal Public Comment", Section G.3.3.

G.4.3 Summary of Formal Public Comments

All of the written comments, and oral comments received at the four public meetings, were recorded and considered by Department staff. A response to each comment was provided. Comments that resonated with the Commission or the Department, and suggestions that would improve the draft plan were incorporated into the plan. A tabular format was used to process and organize all comments, and was divided into sections that correspond with each public meeting and a separate section for written comments. Within a particular section of the table, each person commenting was given an speaker code number (i.e. speaker one = S-1, speaker two = S-2, etc.) and each comment for that speaker was given a comment number (i.e. comment one = C-1 etc.). Some speakers provided supporting documents to their oral comments. The supporting documents were assigned a different comment code which is signified by an "E" rather than a "C" (i.e. support document, Comment one = E-1).

The following is the summary table of formal public comment. All comments were responded to individually. All comments that resulted in a change in the ARMP are signified by a "yes" in the "Revision Needed" column. The specific section that was revised is listed in the last column of the table.

Table G-3. Summary of Formal Public Comments on the draft ARMP				
Abalone Recovery and Management Plan Comments and Response to Comments Fish and Game Commission Special Meeting, November 19, 2003, Monterey, CA				
Speaker/ Comment Number	**Comment**	**Department Response**	**Revision Needed?**	**Revised Section**
S-1: Don Thompson				
C-1	The recovery goals and criteria are not realistic. Using northern California population survey data as a proxy for southern California density is not representative of the southern California stock which never was at that level (6600 abalone/ha).	Although it is possible that abalone abundance in southern California was less than that in northern California, there is no good estimate of what that abundance may have been in the past. The Department is currently using northern California red abalone densities as an estimate of abalone densities that can support a fishery. As southern California abalone populations recover and more data is collected, the Department may adjust the estimate. There is no data that indicates that southern California abalone populations could not reach densities seen in the north. Since abalone had been commercially fished in southern California for over 50 years and millions of pounds had been taken from the area, it is possible that abalone densities there initially were similar to that in the north.	No	
C-2	There should be some mitigation for fishermen who were impacted by the closure. The original intent of Department and Commission was to an abalone fishery, and not to eliminate all harvest.	Efforts were made to find suitable mitigation for impacted abalone fishermen, however nothing found was appropriate. There are no guarantees that any fishery will provide sufficient stock to support fishermen taking from those public resources. In May 1997, the Fish and Game Commission closed the abalone fishery because the best available scientific evidence indicated that the resource was at very low stock levels throughout the range. Later in 1997, the Legislature, in establishing the moratorium, addressed as a priority the recovery of a resource recognized as imperiled, not the management of a sustainable fishery. The critical need for protecting the abalone resource was further underscored when the white abalone (in 1997) and the black abalone (in 1999) were listed as candidate species under the federal Endangered Species Act (white abalone was subsequently listed as endangered in 2001). The Legislature closed the commercial and recreational abalone fisheries south of San Francisco Bay, and made the commercial fishery subject to additional closures north of that line (FGC § 5521.5). Thus, if the operation of a fishery presumes some level of "take" and take is expressly prohibited by the abalone statute, then the resource can no longer be considered a fishery. Consistent with its general public trust responsibilities and its specific responsibilities under the abalone statute, the primary focus of the Department's activities is on the conservation, protection, and management of biologically sustainable abalone populations.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-3	The Department should come up with a biomass estimate and a level of confidence in that estimate. The acceptable rate of exploitation should be based on the biomass estimate.	Ideally, biomass estimates would be a good basis for determining a total allowable catch, but for abalone, as in most fisheries, such estimates are not available. The intent of the recovery part of the ARMP includes the determination of a biomass estimate, which will provide the kind of information needed to consider reopening a fishery for a species. However, biomass alone cannot be used as an indication of a fishery determination. The evaluation of the number of legal-size individuals needs to be addressed. For instance, in a recovering resource, the biomass would be expected to be increasing and maybe high, but few individuals would be of legal size for take.	No	
S-2: Steve Rebuck – comments based on exhibits submitted at the meeting are labeled "E"				
C-1	Red abalone populations are healthy state-wide, as was noted by former director of CDFG Jacqueline Schaffer in December 1996.	The comment refers to a memorandum from Director Schafer to the Executive Director Robert Treanor concerning an agenda item for the December 5, 1996 Fish and Game Commission meeting, a request by the Abalone and Marine Resources Council that the Commission issue no abalone diving permits until an abalone fishery management plan has been prepared. The Director's reference to the statewide health of red abalone resource is plainly qualified by quotation marks around the word "healthy" and is understood in context with the preceding paragraph, which refers to "the Commission's recent action to halt both commercial and recreational harvest of black, pink, green, and white abalone." Thus, "healthy" is properly read as meaning subjectively compared to the other abalone species (two of which were federally listed as candidates under the federal Endangered Species Act the following year), and not as an objective statement of overall biological robustness. In fact, the memorandum recognizes that red abalone populations are depressed around the Farallon Islands and San Francisco and San Mateo counties, and that, with the exception of San Miguel Island, red abalone stocks are depleted in most of the remainder of southern California. The Department has since acknowledged the severity of depleted red abalone populations statewide and supported not only the commercial closure but an estimated 40% reduction in the northern recreational catch as well.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-2	There are red abalone declines in sea otter range, but populations are in no threat of extinction. Humans are being held to a higher standard of take than otters in regards to abalone populations levels that can sustain take (or predation). The MVP should be 1,100 ab/ha, as in sea otter range, or compromise at 2,000 ab/ha.	The interim recovery goals of the ARMP are to reverse declines by stabilizing stocks and establish self-sustaining populations range-wide. The long-term goal is to attain resource levels that can sustain a fishery. Although abalone populations can survive at densities below 2,000 ab/ha, there is probably low recruitment at those densities and the number of abalone available for harvest would also be correspondingly low. At densities above 3,000 ab/ha, recruitment rates would be higher and allowable take would be higher. Closure at the 3,000 ab/ha level would likely allow more rapid recovery of the fishery than if population densities were allowed to drop to lower levels or to those seen in sea otter-dominated areas.	No	
C-3	Test alternatives incrementally to see if they work, especially Alternative 4.	Abalone densities in southern California are so low that an incremental test of Alternative 4 would not be practical. The permissible take would likely be too low to generate enough fees to cover the added enforcement and monitoring costs needed for the fishery.	No	
C-4	The final recovery criteria of 6600 ab/ha throughout whole range (or three-quarters of the range) will never happen.	The commenter is primarily concerned about the impossibility of recovery of 3/4th of the range due to encroachment by sea otters. Areas with sea otter populations will be excluded from calculations of recovered areas so the range will shrink with expansion of sea otter territory and it is feasible that 3/4th of the sea otter-free range could recover. There currently is no information which accurately estimates the level of recovery possible for areas free of sea otters. There is no reason to change the criteria at this time. See S-1, C-1 above.	No	
C-5	Based on CDFG data: 1.2% of abalone populations were taken as commercial legal in 1997 (or 200,000 lbs). By 1999, 5% of the population was commercial legal size. Therefore, 1 million lbs of abalone should be available for fishery. If these abalone are gone, where did they go? If they are there, need to consider fishing.	The comment misconstrues the 1.2 percent value, which is the percentage of the size frequency distributions that exceeded the commercial legal size (7.75 in.). The size frequency data was not collected in a random manner, thus it is not a representative sample of the size or abundance of the population or red abalone at San Miguel. The size frequency was collected during all kinds of dives made at SMI, including, and mostly, during roving diver surveys. Such data is used to build a size frequency distribution for cohort analysis, but it is not useful in estimating abundance.	No	
E-1	Submitted a written proposal advocating and outlining an Individual Transferable Quota (ITQ) and Annual Catch Entitlement (ACE) fishery for red abalone south of San Francisco using a tag system.	These conservation and management tools contemplate an established commercial fishery. While this is a long-term recovery goal, the interim recovery goals of reversing declines and establishing self-sustaining populations must first be achieved.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
E-2	Submitted a written statement to the Commission that provides explanations relating to comments 1-5 above.	Responses to comments 1-5 take written statement into consideration.	No	
E-2-a	The ARMP selectively uses information to give the false impression that commercial divers had overfished the resource. Department data presented as Exhibits 4 and 5 show sea otter impacts need to be represented.	The ARMP recognizes that, in addition to legal harvesting by both recreational and commercial fishers, sources of abalone mortality include poaching, pollution, habitat impacts, predation, disease and other environmental factors such as El Niño. All of these various causes were recognized by the Legislature when it enacted the moratorium in 1997 and directed the preparation of the ARMP. The ARMP was never intended to present a comprehensive compendium of all available data on abalone. However, consistent with the Legislature's direction, the ARMP contains an explanation of the scientific knowledge regarding the biology, habitat requirements, and threats to abalone, as well as information most relevant to the recovery and management strategies. Figures such as Exhibit 5 which show the effect of sea otters on the densities of red abalone in a very small area of central California are not included because other than central California, sea otters had limited affect on red abalone populations. ARMP Figure 2-2 shows commercial red abalone catches declining significantly by 1970 in all southern California areas except San Miguel and San Nicolas Islands. Although sea otters generally can have a tremendous effect on abalone populations, none of the southern California declines are largely attributable to sea otters, because they had either never reoccupied those areas or had not moved into those areas until well after red abalone populations had declined. This would include San Nicolas Island which had much higher catches in the mid-1970s than the years just before the start of sea otter translocations in 1987.	No	
E-2-b	The recovery criteria are overly complex and confusing, with no explanation of how models were created	In enacting the moratorium and mandating the preparation of the ARMP, the Legislature required the use of size frequency distribution criteria to determine whether the goals and objectives of the recovery strategy are being met. The ARMP contains no models, which are used to predict changes in population due to management actions, and the commenter may be confusing the Recovery Flowchart (Figure 6-1), which is presented to help the reader visualize the steps in the recovery process.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
E-2-c	Researchers are the only ones that benefit from the ARMP	In mandating the preparation of the ARMP, the Legislature has determined that the recovery and management of this public trust resource will benefit the people of the state, including those who participate in the commercial and recreational fisheries. Indeed, one of the objective measurable criteria required by the statute, "size frequency distributions exhibiting multiple size classes as necessary to ensure continued recruitment into fishable stock," clearly contemplates fishermen as beneficiaries of the ARMP. Thus the ARMP benefits recreational abalone fishermen by providing a mechanism to sustain the northern California fishery, while the long-term goals of the ARMP to restore abalone fisheries throughout the state will benefit fishermen south of San Francisco in the future.	No	
E-2-d	Plan makes references to "abalone" without specifying species.	The ARMP expressly specifies that the recovery portion of the plan will focus primarily on red, pink, green, black and white abalone.	No	
E-2-e	The goal of the plan seems to be to keep fisheries south of San Francisco closed. The reason for this is that the Directors Abalone Advisory Committee (DAAC) is made up primarily of people who favored the 1997 closure.	As required by statute, the ARMP summarizes the interim and long-term recovery goals, including a range of alternative interim and long-term conservation and management goals and activities, and explains why the Department prefers the recommended activities. The Legislature imposed the current moratorium, and subsequent decisions regarding whether the resource is sufficiently recovered to sustain a fishery will be made by the Fish and Game Commission. A goal of the ARMP is to promote the recovery of abalone populations south of San Francisco, which require closure for an unknown period. The Commercial Abalone Advisory Committee (CAAC) is composed of five commercial abalone divers (and one person who paid an abalone landing tax), all of whom were adversely impacted by the 1997 closure, and by the subsequent moratorium imposed by the Legislature. By law, two of the CAAC must be members of the California Abalone Association, which actively opposed the legislation mandating the ARMP. In approving the Department's formal recommendations before the Fish and Game Commission, the Director may consider the advice of the CAAC, but also takes into consideration the advice of the Recreational Abalone Advisory Committee, as well as the conclusions of the Department biologists and other relevant sources. Similarly, in deliberating on whether to accept all or in part the Department recommendations, the Commission considers input from diverse interests as well as the general public.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
E-3	Submitted exhibits labeled 1 through 8 with supporting documents including: - meeting notes from the December 1998 Commission meeting - data and graphics on commercial abalone landings - comments of the California Abalone Association on the amendments to the 1997 SB 463 - a scientific paper (Fenshawe et al. 2002) regarding MPAs, red abalone, and sea otters.		No	
S-3: Steve Shimek, Executive Director of the Otter Project				
C-1	There are high densities of red and black abalones that still remain in central California but they are in cryptic habitat out of reach of otter predation and humans.	The ARMP's resource recovery and management strategies will not address the densities of red and black abalones within the sea otter range in central California as long as there is no additional human catch to deteriorate populations further. The resource is apparently sustainable and likely reflects the situation that existed before sea otters were extirpated by hunters in the 18th and 19th centuries. What has changed is the fishery, which targeted large emergent (out and about) individuals whose populations had proliferated in the absence of the sea otter. It is generally accepted that a red or black abalone fishery cannot be conducted within the range occupied by sea otters.	No	
C-2	There is too much emphasis in the plan for restoring a commercial fishery. This causes unnecessary conflict between groups that want a fishery and those who advocate recovery of sea otters. The emphasis should be on restoration of abalone populations, not restoration of a fishery.	The ARMP emphasizes resource recovery, not commercial fishery restoration, but when it refers to fisheries, it includes both recreational and commercial sectors. For example, under Section 7.1.4.1, "Planning Process For Fishery Re-Opening", the ARMP states: "For fisheries in southern California, additional planning will occur. For example, resource allocation between sport and commercial fisheries will need to be determined and a network of no-take reserves should be established prior to re-opening any fishery." Although a restored commercial fishery is not in the immediate future, former commercial abalone fishermen want to know as much detail as possible about future management policies that would affect their livelihood, because priority for participation in any such fishery must by law be given to those who previously held a commercial permit before the moratorium.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
S4: Steve Campi, President of Central California Divers				
C-1	First priority should be for abalone population recovery.	Resource recovery is clearly the intent of the legislation that mandated the preparation of the ARMP, and that intent is evidenced in the plan's first recovery criterion.	No	
C-2	Recreational fishing should have preference in allocation of any abalone resource. If there is sufficient resource left, it can be allocated to commercial fishing.	In mandating the development of the ARMP, the Legislature required that it contain alternatives for allocating harvest between sport and commercial fishers if the allocation of the abalone harvest is warranted. However, allocation presumes a sustainable fishery, which can only occur after recovery of the resource. The issue of allocation can be revisited when a population of abalone has met the criteria for reopening a fishery. It cannot be resolved by the ARMP presently.	No	
C-3	Does not like Alternative 1 and the amendment to it; does not like the commercial slot limit at San Miguel Island. Stocks from areas that recover first should be used to boost recovery in other areas.	The legislation that mandates the ARMP contemplates recovery in multiple areas before a fishery is reopened. This is reflected in the ARMP's description of recovery areas (Chapter 6 section 6.2.1.1) Translocating abalone to restore populations would be a legitimate use of surplus abalone in recovered areas.	No	
C-4	The Department should put in an information table that has all metric numbers reported in the plan with the corresponding English conversion. This would make it easier for people to understand and grasp density targets (ie. convert abs./ha. to abs./ft.).	Comment noted and changes will be incorporated into ARMP.	Yes	Added "Conversion Tables for the ARMP" pg. xvii
S-5: Paul Weakland – comments based on exhibits submitted at the meeting are labeled "E-"				
C-1	Withering syndrome (WS) is the first and foremost reason that abalone were depleted. Some if not all areas are recovered and disease has run its course. We now have disease resistant abalone populations.	Withering syndrome (WS) was an important part of the decline in the populations of black abalone, together with continued landing of black abalone when WS was expanding. There is no evidence that pink, green, white, or red abalones were significantly affected by WS. The other species are susceptible to WS, but there is no evidence for WS as a cause of decline. These species were depleted well before WS was first noticed. The extent of recovery and the resistance of remaining abalone populations to WS have not been documented.	No	
C-2	Public comments submitted over the last six years have not been answered.	The purpose of this section is to efficiently respond to all relevant comments regarding the ARMP all at once, rather than piecemeal.	No	
C-3	The red abalone fishery should be opened now.	See response to S-2, C-3 above.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-4	The MVP of 2,000 ab/ha is too precautionary and there is no chance of success. 1,000 ab/ha has been shown in many studies as a reasonable MVP. Suggest that the MVP should be 1,000 – 1,500.	See response to S-2, C-2 above.	No	
C-5	Having a limited fishery would help gather some of the information needed for managing sustainably.	Fishery-dependent data is of limited value in managing fisheries, because: (1) it provides information only on certain life stages of those species that are taken by specific fishing gear; (2) it provides limited information about ecosystem interactions, and (3) the accuracy and reliability of the data can vary for a variety of reasons, including mis-identification of species, under-reporting, or mis-reporting	No	
C-6	Data will never be attainable if grant money motivates research. This will always create more questions, controversy, and conflict	The development and implementation of the ARMP is not being funded by grant money. The Department's abalone recovery and management efforts will be supported by either non-dedicated or dedicated funds deposited in the Fish and Game Preservation Fund. Dedicated funds are collected from the recreational fishery's abalone permit report card fees, fines for abalone violations, and previously collected commercial landing taxes. These funds are specifically designated by statute to be spent on the abalone resource. Non-dedicated funds are obtained from general tax revenues, sport and commercial license fees, and federal funds. Moreover, the reality is that grant organizations carefully scrutinize proposals and would not fund projects which perpetuate unending studies. Department research is largely funded internally but grants can be valuable supplements to available funds.	No	
C-7	Why must all parts of Criterion 1 be met before Criteria 2 or 3 can be explored?	In actuality, given the person power, when an index site attains broad size range, increased numbers and types of studies can be initiated in order to obtain more biological information. One example is at San Miguel Island, which has a broad size-range of red abalone. Further studies are proposed, even though the surrounding sites have not recovered.	No	
C-8	Concerned about ability to count ab/ha given abalone movement	Abalone abundance, as reflected by the term "ab/ha", is determined by conducting a number of randomly placed transects along which counts are made, over a short period of time. The actual value of the abundance is calculated from the surveys. Movement of abalone among survey locations is not significant.	No	
C-9	Use limited fishery to judge, evaluate, and collect data on populations.	Fishery-dependent data is limited in usefulness in population studies. See response to S-5, C-5 above.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-10	Suggests increasing the size limit to 7¾ in. and reducing the bag limit.	This suggestion can be addressed by the plan, but the actual regulation is in the purview of the Commission.	No	
C-11	Abalone resources were fine until introduction of Withering Syndrome (WS) by CDFG outplanting. Small cryptic abalone disappeared because of disease. The chronology and location of outplanting match the appearance of WS.	Only black abalone were affected by WS. See response to S-5, C-1 above. Outplanting programs previously used red abalone, which were grown at several culture facilities. WS was mostly a black abalone disease and was observed at many locations where outplanting was not conducted.	No	
C-12	Carolyn Friedman thought outplantings and agriculture might be to blame for spread of WS.	Dr. Friedman's comments were speculation of causes for the spread of the *Rickettsia* bacteria that causes WS and do not show conclusive evidence for the connection between aquaculture outplantings and the spread of the disease. Although *Rickettsia* has been detected, there have been no cases of WS in northern California. The Department will take this into consideration before any future actions involving outplantings and agriculture.	No	
E-1	Submitted exhibits. See written comments W-3 below.			

Abalone Recovery and Management Plan Comments and Response to Comments Fish and Game Commission Meeting, February 5, 2004, Long Beach, CA				
Speaker/ Comment Number	**Comment**	**Department Response**	**Revision Needed?**	**Revised Section**
S-1: Paul Weakland				
C-1	With systematic pruning the abalone fishery should grow and prosper. Withering Syndrome (WS) is cause for decline. Repeat of written comment W-3, C-16 and S-5, C-1 (Monterey Meeting).	Size and bag limits were unable to control depletion of abalone populations in southern California. Withering Syndrome mainly affected black abalone. See responses to W-3, C-16 and S-5, C-1 (Monterey Meeting).	No	
C-2	There is a direct correlation between outplantings and WS. WS killed the abalone that used to be in the cracks and crevices and supported the fishery. Repeat of S-5, C-11 (Monterey Meeting) and W-3, C-13.	No correlation has been established between outplantings and WS. The disappearance of small abalone is more likely the result of poor recruitment. See responses to S-5, C-11 (Monterey Meeting) and W-3, C-13.	No	
C-3	We have introduced hatchery raised abalone into the resource. Abalone died because there has been too much genetic diversity present. Repeat of W-3, C18 and C20.	There is no credible scientific evidence that outplantings hurt populations by introducing too much genetic diversity in the population. See W-3, C18 and C20.	No	
C-4	Larger, older abalone become necrotic and their spawn is no longer viable. Abalone between 2½ and 5½ in. are necessary, not the larger ones past 7¾ inches. Harvest would have no effect on MVP. Size limits would control any damage of over harvesting. Repeat of W-3, C-16.	Although larger abalone can have a higher frequency of necrotic eggs, their overall production is greater than smaller abalone. Size limits did not prevent depletion of abalone populations throughout southern California. See W-3, C-16.	No	
C-5	Comments regarding Option 1 under Alternative 1: The new material added to the plan has not been peer reviewed. Transponders on fishing boats will not work because there is no insurance that it will effectively prevent poaching. Who is going to pay for the transponders? The suggested minimum size limit of 7¾ inches for all (recreational as well as commercial) is good. The suggested summer season happens when red abalone are spawning and thus is not a good idea. The three summer months should be closed and the rest of the year should be open. TAC will not work. Proposed tax (*cont.)*	Option 1, Alternative 1 was added at the request of commercial fishermen and is largely based on abalone management practices that are currently being used in Australia. The Department believes these are practices that deserve discussion when the decision has been made to re-open the abalone. The alternatives will not be peer reviewed since they are not preferred alternatives and were added to broaden options for the Commission to consider.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
	should only be dedicated to abalone and not used for other things. The Farallon Islands should also be included in Option 1.			
C-6	We should find a truthful, cost-effective method such as adding up the number of abalones landed to be able to see and judge, gauge, and evaluate the health of the resource.	Catch data is not reliable for indicating the health of the abalone resource. See S-5, C-5 (Monterey Meeting). Reliance on such data in the past was one of the factors responsible for the depletion of abalone populations throughout most of southern California.	No	
S-2: Don Gilbert				
C-1	Recovery program will take decades and we may not see it during our lifetimes. Rather than waiting for natural process to occur, he would like to seed larval abalone into the environment and expects recovery could occur in 5 to 6 years. He finished a draft Environmental Impact Report (EIR) to seed Point Loma. He would like to speed the EIR process up.	Larval out-planting is covered in the ARMP and is viewed as a possible method for enhancing natural recovery (Section 6.4.2.2). Even if larval out-planting is successful, recovery of a fishery would likely take longer than 5 to 6 years (ARMP Table 2-3). Comments regarding speeding up an EIR are not relevant to the ARMP.	No	
C-2	In contrast to the last speaker (S-1, C-4, Long Beach Meeting), the majority of the reproduction is in older animals. Younger abalone put out very few eggs while older ones put out millions.	Department agrees. See S-1, C-4 (Long Beach Meeting).	No	
S-3: Dallas Weaver				
C-1	The Withering Syndrome (WS) section seemed very weak and had an implicit assumption that WS will not be a controlling factor in recovery. If WS is a controlling factor then most of the plan is irrelevant. The rickettsia-like prokaryote (RLP) is very effectively transmitted by eating infected tissue and the slow movement of the disease northward against currents suggests human involvement in transmission. Without handling the WS problem, we may be wasting our time.	In Sections 2.1.9.2, 6.4.3.2 and 6.5.1, the ARMP recognizes that WS can be a threat to the recovery of abalone populations. The northward movement of WS does not require human involvement. Currents along the California coast change directions seasonally and water flows northward during El Niño conditions. The Department recognizes the severity of the WS situation and its continuance in the ocean environment may hinder recovery efforts. Additional discussion regarding continued WS assessment in all surveys will be added to Sections 6.6.1.1 and 6.6.1.2.	Yes	Sections 6.6.1.1 and 6.6.1.2 amended

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-2	Recommends that the viscera and waste products not be discarded in the ocean. Department has done nothing to educate the diving community about this basic bio-security. Mexico appears to be way ahead us with strict regulations on disposal of all waste tissues and allowance of take of sick, undersized abalone. Preliminary data show that Mexican procedures are having an impact on the disease.	Currently, RLP is largely restricted to areas closed to abalone fishing so the discarding of abalone viscera in the ocean is not a major factor. Mexico's ability to develop procedures impacting WS is largely dependent on having a commercial abalone fishery in which a limited number of fishermen take abalone. Since there is no commercial fishery in California, therefore Mexican procedures cannot be followed. Allowing the general public to take sick abalone in the closure area will likely harm abalone populations since healthy abalone will likely be removed as well.	No	
S-4: Don Thompson				
C-1	Would like the red abalone fishery to be re-opened. See S-2, C-3 (Monterey Meeting).	Most abalone populations in southern California are too low to sustain a fishery. The current red abalone population has not recovered at enough sites to ensure a sustainable fishery. Also see S-2, C-3 (Monterey Meeting).	No	
C-2	When no suitable mitigation could be found for fishermen who were impacted by the closure, the mandatory 10-year moratorium was changed to a permissive moratorium that allows the Commission to re-open the fishery when the ARMP is completed. According to Fred Keely, a SB 463 co-author, the legislative intent of the bill was to result in a recovery and sustainability plan for abalone which will then allow the fishery to be re-opened. The Department's plan is not consistent with the legislative intent. The criteria are so high they basically would be impossible to achieve.	The statute does not allow the Commission to re-open the fishery when the ARMP is completed, but provides that following adoption of the ARMP, the CDFG *may* apply to the Commission to re-open the fisheries. If the CDFG takes this discretionary action based on substantial evidence, the Commission must then make a formal finding that the resource can support additional harvest, consistent with the ARMP (FGC § 5522(d).). The criteria proposed in the ARMP are based on the ongoing recreational abalone fishery in northern California. As more data is collected for southern California, the Department may adjust goals and criteria. Also see S-1, C-1 (Monterey Meeting).	No	
C-3	The Department should come up with a biomass estimate and a level of confidence in that estimate. Repeat of S-1, C-3 (Monterey Meeting).	Ideally biomass estimates would be a good basis for determining a total allowable catch, but for abalone, as in most fisheries, such estimates are difficult to accurately calculate and are not available. See S-1, C-3 (Monterey Meeting).	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
S-5: Steve Rebuck				
C-1	Jacqueline Schaffer, former Department Director, stated in December 1996 that red abalone populations were healthy state-wide. How did we go from a healthy resource statewide in 1996 to this created crisis? Repeat of S-2, C-1 (Monterey Meeting).	The comment takes Director Schaffer's statement out of context. See S-2, C-1 (Monterey Meeting).	No	
C-2	Annual commercial catch of abalone was 200,000 lb at the closure. Based on lack of take in recent years there should be in excess of 1 million pounds of abalone available for take. Repeat of S-2, C-5 (Monterey Meeting).	The data used are not adequate for determining the amount of red abalone available for a fishery. See S-2, C-5 (Monterey Meeting).	No	
C-3	The goal of 6,600 ab/ha is extremely unrealistic. Abalone populations are patchy at best and for many years the fishery operated at populations much less than this. Repeat of S-1, C-1 and S-2, C-2 and C-4 (Monterey Meeting).	Although the fishery operated at low population levels, the fishery was not sustainable. Continued harvest at low population levels likely contributed to the serious depletion of abalone populations throughout southern California except for perhaps at San Miguel Island. See ARMP Figure 2-2, Santa Cruz and Santa Rosa Islands. See also S-1, C-1 and S-2, C-2 and C-4 (Monterey Meeting).	No	
C-4	The abalone fishery operated at 2 million pounds per year for about 6 decades. What has changed is a recovering sea otter population. Within the sea otter range, abalone are at 70 to 1,100 animals per hectare. Why do humans need a higher standard? Repeat of S-2, C-2 and E-2-a (Monterey Meeting).	In enacting its moratorium, the Legislature noted that abalone numbers all along the coast have declined drastically since the early 1970s, and attributed the decline to the cumulative impacts of commercial taking, a growing market demand, expanding sport fisheries, growing sea otter populations, pollution, loss of kelp beds, El Niño, and disease. Sea otters were not the sole cause of abalone depletion in southern California. Abalone densities seen in sea otter range are unlikely to support a commercial fishery. See S-2, C-2 and E-2-a (Monterey Meeting).	No	
C-5	Supports ARMP alternative 4 but would prefer a blend of alternatives. A small experimental fishery could be conducted with about 50 participants. Repeat of S-2, C-3 (Monterey Meeting).	Abalone densities in southern California are so low that an incremental test of Alternative 4 would not be practical. See S-2, C-3 (Monterey Meeting).	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-6	Part of the reason for the abalone closure was the resentment by recreational fishermen of export of the commercial catch to Asia. This could be solved by export bans which have been used in the past.	The key factor in closing abalone fisheries south of San Francisco is the depleted condition of nearly all abalone populations and a ban on exports is not relevant to the main problem.	No	

Abalone Recovery and Management Plan Comments and Response to Comments
Fish and Game Commission Special Meeting, April 20, 2004, Santa Rosa, CA

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
S-1: Jeff Baldwin – comments based on exhibits submitted at the meeting are labeled "E-"				
C-1	Proposes to re-open the commercial red abalone fishery in southern California and also open the North Coast to commercial fishing. The fishery would work on a rotational fishing area basis between northern and southern California. Additional details are listed on the handout submitted by Mr. Baldwin.	Based on the best scientific information available and other relevant information, the red abalone population has not adequately recovered to sustain a commercial fishery. The Commission has no authority to re-open the northern California red abalone commercial fishery, which is closed by statute (FGC § 5521.5(a).).	No	
E-1	1. Northern & Southern California Rotation Abalone Market Fishery 2. Seven (7) dozen per day 3. Ten (10) days per month 4. Ten (10) months per year 5. Closed August and February 6. Fishery opens in Northern California for four (4) years 7. Northern California is divided into ten (10) blocks ranging from Farallon Islands to Oregon border 8. Rotates to Southern California for the next four (4) years 9. Southern California, San Miguel Island, backside from Adam's Cove to sand (*cont*.)	These comments will be considered when the Department determines that the resource has recovered to the point where it can support a sustainable commercial fishery.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
	spit; Santa Rosa Island, back side to East Point, front side to Talcott Shoals; Rocky Point to Point Conception and San Clemente Island (?) 10. Return to transferability permits, two for one buy-out 11. $5.00 per lb tax paid by abalone market divers via abalone processors, paid to CDFG for law enforcement and abalone research and monitoring 12. Size limit 8 in. 13. Divers with permits prior to moratorium receive new permits 14. No new licenses issued until divers number less than 75 15. New divers eligible to purchase license if they have worked as an abalone tender or have had an active abalone permit in the past for at least three (3) years 16. Once the number of divers is below 75 and there are not two available licenses for sale, the CDFG can opt to generate the sale of new licenses for $50,000			
S-2: George Lawry				
C-1	Enforcing MPAs in remote areas as suggested in the plan for southern California will be difficult.	Although marine law enforcement poses unique challenges, the Department believes that these areas can be adequately protected through a coordinated inter-agency strategy such as that already in place at the Channel Islands.	No	
C-2	The reason the northern California abalone fishery is sustainable because harvest is limited to breath-hold diving.	The Department agrees that regulations prohibiting the use of SCUBA and surface-supplied air while catching abalone is an important factor in providing a reserve population that is removed from sport harvest.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
S-3: Paul Weakland				
C-1	With systematic pruning the abalone fishery should grow and prosper. Withering Syndrome (WS) is cause for decline. Repeat of written comment W-3, C-16 and S-5, C-1 (Monterey Meeting).	Size and bag limits were unable to control depletion of abalone populations in southern California. Withering Syndrome mainly affected black abalone. See responses to W-3, C-16 and S-5, C-1 (Monterey Meeting).	No	
C-2	Larger, older abalone can become necrotic and their spawn no longer viable. Abalone between 2½ and 5½ in. are necessary, not the larger ones past 7¾ in. Harvest would have no effect on MVP. Size limits would control any damage of over harvesting. Repeat of W-3, C-16.	Although larger abalone can have a higher frequency of necrotic eggs, their overall production is greater than smaller abalone. Size limits did not prevent depletion of abalone populations throughout southern California. See response to W-3, C-16.	No	
C-3	Expressed concern about not counting or measuring the number of small recruits (<100 mm). How can we effectively measure recruitment if the small recruits are not assessed?	Small abalone are counted and measured using invasive transects. See response to W-3, C-33.	No	
C-4	Abalone is a public resource and currently not all Californians can benefit from this resource. By allowing a commercial fishery for a strictly Californian market, more people can enjoy abalone and not just a select few that can recreationally dive to get them.	A commercial fishery would not significantly increase the number of people who could enjoy abalone. A “California only” market would impermissibly interfere with interstate commerce. See responses to W-3, C-10 and W-3, C-86.	No	
C-5	Specifically in regards to the plan, having only four index sites is not representative of all of California if you use the density numbers for criteria in central and southern California.	Four index sites are not representative of all of California, but provide the best available data for fishery density estimates.	No	
C-6	Size limits are not effective if you consider the number of mortalities that occur from short abalone mortally injured and put back when trying to get legal-size abalone.	Size limits are effective at protecting most short abalone, but near the size limit there is incidental mortality due to take. More public outreach and education would convey the importance of divers measuring abalone before take. A combination of size, bag, and season limits and gear restrictions appear to be an effective management strategy in the interim plan.	No	
C-7	San Francisco south is the largest Marine Protected Area in the world. The black abalone fishery has been closed for 10 years without any benefit. Why should we continue to fail with that concept?	1997 legislation closed the area south of San Francisco and contemplates an *initial* recovery period of 10 years. As with any slow growing, overfished species, the rebuilding period could actually be much longer. The critical need for protecting the abalone resource was further underscored when white abalone (in 1997) and (*cont*.)	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
		the black abalone (in 1999) were listed as candidate species under the federal Endangered Species Act (white abalone was subsequently listed as endangered in 2001). Closure has stopped fishing mortality on species which are severely depleted. Even if recovery has not yet occurred, the closure cannot be considered a failure since it prevented abalone populations from dropping to lower levels than those seen at the close of the fishery.		
S-4: Gene Kramer				
C-1	Opposes commercial abalone fishery in northern California. Does not see how a commercial catch could be justified since the recreational limits have been lowered in recent years.	See S-1, C-1 (Santa Rosa meeting).	No	
C-2	The use of density criteria in adjusting management of the fishery is good, but how can density be accurately measured in a highly rugose habitat?	Density estimates are based on stratified random surveys in all types of habitat, including highly rugose areas. Therefore, the overall density estimate does reflect some of the densities in that habitat type. To provide a much more detailed density estimate for rugose habitat and other abalone habitat would require more intensive surveying and accurate habitat maps, which would be stratified for sampling. Unfortunately the Department does not have the resources for more intensive surveys and accurate habitat maps are not available at this time.	No	
C-3	How does the plan address areas like Humboldt County which never had 6,600 abalone per hectare. Will these sites be closed?	Under the interim plan, Humboldt County is included in the entire north coast fishery management area. Humboldt County would not be closed unless fishery-dependent creel data from Shelter Cove reveals a significant decline in stocks and subsequent dive surveys showed low densities of abalone (refer to table 7-4).	No	
C-4	San Mateo County should be opened to abalone fishing before sea otters reoccupy the area.	The action is addressed in FGC § 5522 (d) as far as re-opening a fishery. Abalone populations in San Mateo County face a number of serious threats to their populations including WS disease and future predation by sea otters. Adding a fishery catch to these threats could cause localized population failures. Furthermore, to re-open a fishery in anticipation of sea otter reoccupation would likely (*cont*.)	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
		have implications for the management of an endangered species and would require consultation with the USFWS.		
S-5: Harry Vogl – comments based on exhibits submitted at the meeting are labeled "E-"				
C-1	Proposes opening the commercial fishery (including northern CA.) with the previous regulations and some additions and changes.	See response to S-1, C-1 Santa Rosa meeting.	No	
E-1	This (commercial abalone) closure in 1997 was based on very little documented research due to lack of funds and qualified researchers. Since the time of closure to this date, no stock assessments have been made by expert researchers in most areas of the California Coast and very little is documented in a small portion again due to lack of funds and researchers.	In enacting its moratorium, the Legislature noted that abalone numbers all along the coast have declined drastically since the early 1970s, and attributed the decline to commercial taking, a growing market demand, expanding sport fisheries, growing sea otter populations, pollution, loss of kelp beds, El Niño, and disease. Moreover, as a logical corollary of its power to regulate and protect its environmental assets, the State should be able to take preemptive measures to protect its natural resources even before those resources appear threatened with extinction or before it incurs significant costs in maintaining or rehabilitating the resource. Although stock assessments specific to abalone have been limited, there are numerous monitoring programs throughout the area which would have detected a large-scale recovery of abalone populations. There has not been any report of significant abalone recovery.	No	
E-2	Otter predation on abalone has not been addressed. The idea of keeping a fishery closed in order to rebuild the stocks in the areas adjacent to the known as [*sic*] otter zones is a waste of this California resource.	Rebuilding abalone stocks before reoccupation by sea otters would help to ensure that abalone populations are healthy enough to withstand the resumption of sea otter predation. Also see response to S-4, C-4 Santa Rosa meeting.	No	
E-3	Why is it that State researchers claim that abalone densities ranging at 1,000 ab/ha are considered normal in areas populated with otters for centuries and less than 6,000 ab/ha is considered depleted in the unpopulated otter zones used only by sport divers?	Abalone populations would not be considered depleted until they dropped to 3,000 ab/ha (Table 7-4). The difference between densities found in the sea otter zone and the closure level in the ARMP is because the ARMP closure level supports an active fishery. The numbers of abalone produced at densities with sea otters would be much less than those produced at the ARMP closure level. Also see response to S-2, C-2 Monterey meeting.	No	
E-4	It is time to restart the commercial abalone fishery with a conservative safe harvest limit…A restart of this fishery will create several tax revenues to the State…I along with many displaced fishermen would also agree to (*cont*.)	Fish and wildlife resources are held in public trust by and through the Department, which has jurisdiction over the conservation, protection, and management of fish and habitat necessary for biologically sustainable populations of those species. Although, consistent with that authority, the primary fisheries management goal is (*cont*.)	No	

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	a landing tax per abalone or 10% of the ex-vessel price and landing, which is now estimated to be $60.00 or $6.00 per… An open fishery would not only bring employment and tax revenue through permit divers but also to tenders working on the vessels, dock workers, processors and brokers. It also benefits the State economy indirectly through marine supplies sales tax, fuel dock sales tax, food markets, and restaurants. If a re-start of the fishery is to occur, a good rule to enact in the fishery would be to eliminate abalone export out of the U.S. or State.	sustainability. The economic aspect of sustainability is appropriately considered only if a fishery is first determined to be biologically sustainable.		
E-5	If a small bag limit to TAC was set at 300,000 lb, the yearly landing tax would generate a tax revenue to the State of $500,000 to aid in research. This TAC would still be 10 times less than what is now estimated landed by sport divers and the black market of the North Coast.	These comments will be considered at such time the Department determines that the resource has recovered to the point where is can support a sustainable commercial fishery. The suggested TAC would be considerably more than 1/10 what is estimated to be taken by sport divers and poachers.	No	
E-6	Much assistance can be given to the research community by the abalone divers: 1. Monitoring of area sites could be set up in the usual harvested areas. Size, growth and movement information could be obtained through a tagging program where and while harvest is in operation. 2. Artificial recruitment modules could help answer questions concerning basic growth rates and settlement differences in ocean conditions. 3. Tracking transponder placed on each commercial boat can give valuable research information and can aid in enforcement. 4. Daily trip plans can be filed with the CDFG office, telephone, and hot line. 5. Daily log and landing ticket information as before closure is always a resource tool.	These comments will be considered at such time the Department determines that the resource has recovered to the point where is can support a sustainable commercial fishery.	No	

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E-7	My suggestions for a fair conservative abalone fishery are as follows: 1. Allow a conservative yearly TAC with a daily individual permit bag limit of 4 dozen. 2. Have a minimum 7¾ in. and maximum 9 in. size limit. This allows the sport diver sole access to trophy-size abalone. 3. Provide a better working relationship with resource management by using tracking transponders, tagging devices, daily trip plans, and telephone daily log information to CDFG. 4. Provide a 10% ex-vessel landing tax to help support the cost of research and enforcement. 5. Provide a weekly closure as used in the sea urchin fishery to gain closer working relations with State researchers and enforcement. 6. Keep all other rules and regulations as written before closure of the fishery in 1997.	See response to S-5, E-6 Santa Rosa Meeting.	No	
S-6: Charles Lorenz				
C-1	Wanted to know whether there will be any more meetings such as this to discuss the plan.	There have been four public comment meetings for the draft ARMP. In the future, after the Commission adopts the plan, there will be opportunities to make further public comment as the plan is implemented and amended. The public will also have opportunities to specifically comment on the northern California abalone sport fishery as part of the Commission's biennial review of its sport fishing regulations.	No	
S-7: Jeff Gritsch				
C-1	Abalone populations (pink and green, as well as black) were decimated by the disease in southern California	There is ample documentation of the decline of black abalone due to WS. However, similar evidence does not exist for pink and green abalone. All three species are susceptible to WS, but the mortality for each species may vary.	No	

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C-2	Suggests that using density criteria is not a good way to manage resource. Often times in his experience highly dense areas were not the best fishing areas, but were what they call stunt beds where the abalone never grew in size. Management should be by size, season and number of abalone caught.	Using density criteria is a traditional method for management, and will be an integral part of managing and evaluating the resource. The sole use of size, season, and number of abalone caught was not effective at maintaining a sustainable fishery in southern California.	No	
C-3	Suggests opening the commercial fishery at SMI, the Farallones, and in northern California with a 2 dozen per day bag limit and free dive only.	Opening of abalone fisheries in the moratorium area may be considered once all recovery criteria in the ARMP for a given species have been achieved (refer to Chapter 6 for criteria). For the north coast see S-1, C-1 (Santa Rosa meeting).	No	
C-4	Reduction of daily limit to 3 caused campgrounds to be empty as many people decided the trip was not worth making for 3 abalone.	Tourism nationwide was greatly reduced in 2002 and it would be unlikely that any reduction in northern California campgrounds was solely due to the change in the abalone bag limit, which was a necessary effort reduction measure. Yearly abalone stamp sales declined by 12% after reducing the bag limit in 2002. However, the number of permits sold in 2003 increased slightly to approximately 37,000. Qualitative evidence for the current 2004 year indicates that access points along the coast continue to be heavily used.	No	
C-5	Should have stricter penalties for not turning in punch cards by not allowing the issuance of another card unless the one for the previous year is turned in.	The Department may consider this once its computerized point of sale license system is implemented.	No	
S-8: Curtis Degler				
C-1	Mr. Degler is opposed to any commercial fishing for abalone in northern California. Allowing commercial fishing in northern California will create fishery compaction, i.e., what happened in S. California as described in the presentation. The deep water refuge exist, and allowing a commercial dive fishery would threaten the continuance of this refuge. Commercial fishing could become a good cover for increased poaching. Currently the recreational fishery in northern California provides tourism dollars to local communities. He does not see how having a commercial fishery would increase or add to (*cont*.)	FGC § 5521.5 (a) prohibits any commercial fishing north of San Francisco. See comment S-1, C-1 (Santa Rosa meeting).	No	

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	the existing tourism. The argument that non-divers do not have access to the abalone resource of the state is not entirely true. Farmed abalone is available for sale if people want to have abalone and can't dive for it themselves.			
S-9: Ed Schulze				
C-1	Would like to see the punch card system evolve into something similar to the deer tag system	Section 7.1.3.2 in the ARMP discusses the potential use of such a tag system under the long term management plan.	No	
S-10: Richard Pogre				
C-1	Objects to specific text in the plan that would disallow a commercial fishery in San Mateo Co. Repeat of written comment W-4, C-1.	This section inadvertently retained text from an earlier draft and will be amended. See response to W-4, C-1.	Yes	Section 7.2 amended
C-2	No valid reason to disallow commercial abalone fishing in San Mateo County. If ROV surveys are correct in identifying lack of abalone on the Farallons, there is a severe problem causing the disappearance of abalone since the closure. Commercial fishermen in San Mateo County and the Farallons are under constant observation from shore by different agencies that can verify activities.	The most current surveys of the San Mateo coast suggest that there are insufficient abalone densities to support a fishery (Karpov et al. 1997, Rogers-Bennett and Pierce 1998). The ROV survey is discussed in Section 2.2.1.2. We have no historical density data at the Farallons. But the 2000 survey indicates an insufficient density to conduct a fishery. We have no indications or cause for why the population is so low.	No	
S-11: Mike Malone				
C-1	Criteria for expanding the fishery looks to be unrealistically precautionary because it requires high density and high recruitment. High recruitment might not be possible if the habitat is already full. More research is needed.	A precautionary approach is the preferred fishery management strategy in data-poor circumstances. Recruitment criteria can be found in Section 7.1.2.1. Recruitment is defined as individuals between 4 and 7 in. An increase in the TAC can only be implemented if there are more than 4,500 ab/ha of emergent 4 to 7 in. animals. Increasing the TAC without these sub-legal animals would not be precautionary because the replacement of fished abalone could not be assured. If the habitat is full of legal-size animals, then none are protected by the size limit, and increasing the TAC would be risky. The Department supports the need for more research on (*cont.)*	No	

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		stock recruitment relationships for abalone. Having more increased knowledge of the resource may allow less precautionary management in the future.		
C-2	Opposes any commercial fishery for abalone in northern California because of enforcement problems. The current recreational fishery has a high value and should remain the same.	See response to S-8, C-1 (Santa Rosa meeting)	No	
C-3	Need to consider other alternatives to geographically- or area-based closures. Rather than complete closure of defined areas consider severe limitations on take. Most likely areas of closure will be the easy access points to the coast; by closing those areas you are reducing the overall public access to the coast for the purpose of abalone fishing.	Refer to Section 7.1.2.4 where the site closure mechanism is discussed. The use of the site closure decision frame work is meant to be used only in the interim plan, and is designed to close areas as a last resort to avoid local population collapse. In the long term plan under Section 7.1.3.1 the commenter's suggestion would allow for limited take in low density zones through the use of the tag system.	No	
S-12: Bill Bernard				
C-1	The index sites are too small to be representative of the rest of northern California. These heavily fished sites will experience serial depletion and will always be on the edge of falling below sustainable sport fishing thresholds.	In the absence of the ability to monitor more index sites to better represent all of northern California, the interim plan is based on monitoring four highly used index sites (which would be most sensitive to fishing pressure). Past and recent surveys at all four index sites are well above the 3,000 ab/ha threshold for closure.	No	
C-2	The proposed trigger for closure of the entire fishery (average densities at index sites fall below 3,000 ab/ha) is too precautionary and is only 50% away from closure.	See Section 6.2.2.1 for a description of the scientific basis for MVP. Although the threshold for closure is roughly at 50% of the sustainable fishery level, it is based on published data for MVP levels that are required for successful reproduction. Falling below MVP levels may trigger recruitment failure, thus the threshold for closure was set at a buffer level above the MVP. If an abalone fishery is sustainable, then the number of recruits should be equal to the number of abalone caught by the fishery or dying from natural causes. In a sustainable fishery, there should be no drop in abalone density. Under a sustainable fishery scenario, a 50% drop in density is reason for great concern.	No	
C-3	Table 7-2, Action 4 should be amended to read: Fishery closure only on approval of the Commission until stocks are recovered according to the recovery criteria or enough data are collected to shift to the long-term management plan and after input and (*cont*.)	See Section 4.1.2 which describes the Commission's regulatory power, and Appendix B section B.2.2.2 (first paragraph) of the ARMP. The Commission will be guided by the ARMP. The long-term plan (Section 7.1.3) includes more survey areas (such as low-use sites), however the interim plan is constrained by limited data and resources and is therefore based on four high-use index sites.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
	evidence is received from four other selected low-use index sites. The four low-use index sites must be selected from any of the 51 coded creel sites in the northern recreational abalone fishery zone. Only after input and evidence are received shall a closure be allowed if the evidence suggests that the abalone population level is at low levels.			
C-4	Text should be amended to read: The fishery will close only upon approval of the Commission until stocks are recovered according to the recovery criteria or enough data are collected to shift to the long-term management plan and after input and evidence is received from four other selected low-use index sites selected from any of the 51 coded creel sites in the northern recreational abalone fishery zone. Only after input and evidence are received shall a closure be allowed if the evidence suggests that the abalone population level is at low levels.	See response to S-12, C-3 above.	No	
C-5	Notice of the intent to close the abalone fishery by the Commission must be given 180 days prior to any closure. The 180 day notice is for any group or any individual to review the evidence for supporting or disputing the closure of the fishery.	The Fish and Game Code authorizes both the Department Director and the Commission to take emergency action to close a fishery. (FGC § 240, § 7710). Commission action to permanently close the fishery would follow the Administrative Procedures Act (APA) regulatory process, which would allow for a 45-day public review and comment. A 180-day notice period would delay the closure for six months, is not precautionary, and could imperil remaining stocks.	No	
C-6	Use of index sites to determine fishery closure should be removed from the ARMP and only specific site closures would be in effect for the ARMP. The current ARMP is the first time that a fishery closure could take place automatically due to a trigger such as 3,000 ab/ha. The Commissioners would not, for the first time in history, have the say of whether to keep the fishery open or closed.	The use of index sites is the basis for monitoring the fishery within the ARMP. The index sites provide fishery-independent evaluation of the resource and also supply a historical overview for comparison. Reliance on site-specific closures could result in the serial depletion of the resource. A proposal to close the fishery would not be an automatic action. The proposal would follow the Commission's regulatory process.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
S-13: Roy Gordon				
C-1	Poaching is a very big issue and it is not adequately addressed in the plan. We need to stop poaching that happens within the punch card system by increasing funds to implement the automated system that will help reduce the number of cards purchased by individuals and allow wardens to electronically access information in the field.	See response to S-7, C-5 (Santa Rosa meeting). We agree poaching is an issue and we need to increase our enforcement capability. We also need to implement a system that prohibits the issuance of multiple punch cards to a single person.	No	
C-2	We need to double the portion of the abalone stamp funds that are allocated to enforcement. Criminals outside the report card system accomplish the major proportion of the poaching that is going on constantly in California. They often target small abalone which increases the impact to the fishery.	Stamp funds are allocated by the RAAC, and a substantial portion of the funds go towards enforcement as well as research and management of the fishery. The removal of short abalone by poaching undercuts the future production of abalone to the overall stocks.	No	
S-14: Al Karbousky				
C-1	Favors increasing the compliance for turning in punch cards by increasing penalties for not turning in cards.	Recent efforts have been directed towards improving compliance. Implementing a point of sale licensing system would help increase abalone permit report card compliance.	No	
C-2	Economic incentives could be used by establishing a bounty on poachers.	The CALTip program provides a system for reporting poaching activities and includes a financial reward system.	No	
C-3	Data needs to be improved to defend against lawsuits.	Data not only needs to be improved to help defend against lawsuits, it is also needed to improve management of the resource.	No	

Abalone Recovery and Management Plan Comments and Response to Comments Fish and Game Commission Regular Meeting, June 24, 2004, Crescent City, CA				
Speaker/ Comment Number	**Comment**	**Department Response**	**Revision Needed?**	**Revised Section**
S-1: Paul Weakland				
C-1	Black abalone closed in 1993, that is over ten years ago. Fish and Game has given millions of dollars, thousands of man hours, to answer the questions about this closure of black abalone. It's been ten years still we have no answers.	Department expenditures on abalone cover all species and are not solely focused on black abalone. Recovery of black abalone populations has been minimal.	No	
C-2	Recent landing information shows that abalone recovery is already underway. Just look at the commercial landings and the reduction in the bag limit and seasons from 1990-96. Using the CPUE in 1996 and increase in numbers of red abalone were landed from San Nicolas Island, San Clemente Island, Santa Rosa Island, San Miguel Island, Farallon Islands. This was before the closure. Because your scientists would not use CPUE upon any of the information used for reasons to close the fishery.	CPUE is not a reliable indicator of abundance in sedentary species such as abalone. Assumptions of using CPUE include random re-distribution of the stock after fishing, and randomness in the way the stock is fished. Neither of these assumptions apply to abalone, thus its use is inappropriate	No	
C-3	I would like to show you a flyer that I have kept that shows the foremost reason for closing the fishery, withering foot syndrome (WS). That was the reason CDFG gave for closing the fishery. Repeat of S-5, C-1 (Monterey Meeting)	See response to S-5, C-1 (Monterey Meeting)	No	
C-4	The best analogy is to consider the abalone fishery as a shrub or hedge. Harvesters or divers as gardeners or caretakers acting as stewards that guard the resource by trimming and stimulating uniform growth. What has happened is something has poisoned our fruits. That something is WS, an introduced infectious disease. Repeat of written comment W-3, C-16 and spoken comment S-5, C-1 (Monterey Meeting).	See response to written comment W-3, C-16 and spoken comment S-5, C-1 (Monterey Meeting).	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-5	We know one of the reasons CDFG does not want to open up the southern California fishery is because it will show the extent of WS and sabellid worm via aquaculture.	A re-opened southern California fishery will not provide additional data on the extent of WS or sabellid worms. WS is found throughout southern California and sabellid worms are not known in the wild. See also response to written comment W-3, C24.	No	
C-6	This evaluation criteria, the description of objective measurable criteria by which to determine whether the goals and objectives of a recovery strategy are being met. If you look at your numbers and the four sites in northern California that have been heavily fished you will see that Criteria 1 has already been met. Criteria 2 has been met. Criteria 3 is unattainable and will never be met.	The criteria are for an area that needs to be recovered. Northern California does not need recovery and passes all three recovery criteria. Criterion 3 was based on the average density of the three heavily fished sites that had been surveyed at the time the ARMP was written (See ARMP Sections 6.2.2.2 and 7.1.2.1).	No	
C-7	The peer review of the first abalone plan to come through (the only peer review) was scathing on the numbers and the measurable criteria for recovery. The peer review says that Criteria 3 with its unscientific number, the number that was grabbed out of the air. There is no science to implement 6,600 ab/ha. The peer review made that perfectly clear, and 650 and 800 ab/ha is the minimal viable population for red abalone. But to be precautionary we raise the number to 1,000. Now CDFG has doubled that number to 2,000 ab/ha. That is what they say is the minimal viable population. No science, they just grabbed that number. First peer review was never considered in the changes (see written comment W-3, C-93).	The peer reviewers did not criticize the 6,600 ab/ha figure. No recommended minimum viable population level was given by the peer reviewers. Also see response to written comment W-3, C-93.	No	
C-8	Size limit is what protects a minimum viable population for abalone. Many studies that have been done show that spawn from older abalones is necrotic and not viable. Size limits for the sport fishery of 7 in. and 7 ¾ in. for the commercial fishery was determined after many years of study of what mandates a minimum viable population and what size that abalone begin to propagate. Repeat of written comment W-3, C-16.	See response to written comment W-3, C-16.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-9	The only thing that is the credible and honorable to do is Alternative 4 and allow us to go back to what we had which was a sustainable fishery. Repeat of written comment W-3, C-66.	See response to written comment W-3, C-66.	No	
C-10	I would like to mention it says 24 abalone per season. That is incorrect. An abalone fisherman that has paid for a license and a tag is allowed 27 abalone a year. You're allowed 3 on free fishing day when you do not have to declare. So right away your paperwork is not accurate.	A free fishing day does not exempt fishermen from following regulations and does not add extra abalone to the annual limit. Regardless of whether fishermen are recording abalone taken on free fishing days, abalone permit report cards provide a more accurate estimate of abalone catch than has been possible in the past.	No	
C-11	Large numbers of abalone are being poached along the central California coast, but no one is allowed to fish there. The otters are leaving this area. They are moving farther south, but this area will never be considered for abalone fishing.	The existence of illegal fishing effort does not justify re-opening the central coast, where a fishery is precluded by sea otters	No	
C-12	We should be able to live along side the sea otter even though in the history of California and the Spanish exploration, Sir Francis Drake and many of the others who explored the California coast early on would write down meticulously all the plants and animals they encountered, never once did they describe large numbers of sea otters. Nowhere in California in any of the museums or ecological reserves have archaeologists found anything from any culture made of sea otters.	These statements are incorrect and are not relevant to the ARMP which must take into account the presence and impact of sea otters in regards to the management of abalone populations.	No	
C-13	If you want another site, I suggest the Farallon Islands. Your guys have never dove out there, they don't even know what the resource is, but that doesn't stop them from wanting to close.	The Department conducted a ROV survey which is discussed in Section 2.2.1.2. We have no historical density data at the Farallons. The 2000 ROV survey indicates an insufficient density to conduct a fishery.	No	

Speaker/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-14	Poaching in southern California is tremendous. Game wardens aren't looking. They figure no abalone, don't look. What about this guy just caught poaching abalones on the north coast, he even admitted poaching at San Clemente and San Diego.	Although poaching might occur in southern California, it does not constitute proof that local abalone populations could support a legal fishery.	No	
C-15	Californians should be allowed to have abalones. How does someone who does not dive, who is ill and old, does not have the finances to come to northern California and dive share in this public resource? Repeat of written comment W-3, C-86.	See reply to written comment W-3, C-86.	No	
C-16	Abalone has many medicinal qualities that make them highly prized.	The medicinal qualities of abalone are not substantiated.	No	

Abalone Recovery and Management Plan Written Comments (written comments are verbatim and not corrected for spelling, grammar, or typographical errors)				
Writer/ Comment Number	**Comment**	**Department Response**	**Revision Needed?**	**Revised Section**
W-1: Dan Wilson/Bob Strickland				
C-1	Suggested bag limit changes: A. Four per week, week ending on Sunday, north of Gualala River. B. Three per week, week ending on Sunday, south of Gualala River. C. No take south of Golden Gate Bridge. D. Thirty-six per year. E. Only people deemed the ability to have abalone card (10 years old?) shall take or possess abalone. Note: A&B should help stop the transferring of animals, thus reducing the overall take. E. will stop parties from taking mass quantities.	The Department would like to see what the effects of recently changed regulations are over the next few years before recommending bag limit changes to the Fish and Game Commission. If the Department believes further reductions are needed, these suggestions will be given consideration.	No	
C-2	Suggested punch card changes: A. Fill out on dry land or dry boat, whichever is closest. B. Fill out on dry land for wet boats or tube divers. i.e. (inflatable, open boats as in whalers or aluminum boats). Note, the cards are for monitoring and management data. They are not much use when they are not legible. Also there have been problems with wardens giving card holders a bad time over smeared ink.	The abalone permit report cards are also for enforcement of daily and annual limits. Although current regulations may impose requirements that are inconvenient for some fishermen, many people forget or neglect to complete cards when on dry land. Divers within 500 yards of their vehicles may keep their cards in the vehicle. Refer to W-1, C-1.	No	

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C-3	Suggest reinstating allowance of SCUBA equipment on boats with abalone: A. Punish abusers, not the compliers B. This is safe practice, less fatigue on divers, a tank on board can save a divers life that is hung up if that tank can get down to the diver in time. C. Cuts back on pollution going to and from docks. Boats do most polluting at idol while trying to get dock space, or starting up at launch. Note, if the wardens have a problem with lack of management ability towards this, then have a call in by the sportsman of when and where it will take place, like the commercial boats do on extended trips for 3 day limits.	There are not enough wardens to monitor the activities of all boats either while they are out fishing or when they are docking. Although current regulations may impose requirements that are inconvenient to some divers, the prohibition of SCUBA gear on boats with abalone is the most effective method of ensuring the abalone were not caught with the assistance of SCUBA gear. Refer to W-1, C-1.	No	
W-2: Edward A. Flynn				
C-1	Open San Mateo County to recreational ab hunting. There has been amazing recovery in the area. Bring bag limit down to 1 or 2 abs per day, 24 per season, raise size limit for recovery reasons.	An adequate survey of the area would have to be made before considering whether to re-open the fishery. The most recent (1993) survey in the area found so few abalone that it is doubtful there would have been enough of a recovery to support a fishery.	No	
C-2	Add 500 or so active sports hunters with good background checks to assist the Fish and Game wardens in reducing poaching.	The Department currently has insufficient enforcement staff to coordinate such an effort.	No	
C-3	If San Mateo county is opened to the take of sport abs, the Fish and Game Commission would gain a tremendous amount of information on the Recovery Plan, as of new they don't have enough personnel or money.	The allocation of enforcement and scientific staff that this action would require is not justified by the potential information that could be obtained. Opening San Mateo County, even on a limited basis, would risk quick depletion because of the proximity of very large population centers.	No	

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
W-3: Paul Weakland				
C-1	When will the questions be fully and honestly answered? Who is responsible for answers?	The Department is responsible for providing the Fish and Game Commission responses to all relevant comments it receives.	No	
C-2	When will the fishery south of San Francisco resume harvest? Is the excuse to leave the southern area forever closed so as not to allow the extent of the introduction via aquaculture of Withering Syndrome and the Sabellid Worm? If the worm has established itself in the wild in California a limited harvest would identify where and perhaps effects.	If the CDFG applies to the Commission to re-open the fisheries based on substantial evidence, the Commission must then make a formal finding that the resource can support additional harvest, consistent with the ARMP (FGC § 5522(d).). There is no plan to permanently close southern California nor is there any attempt to hide the extent of the spread of diseases or parasites. There is no evidence that the sabellid worm has been established in the wild.	No	
C-3	Not to allow commercial harvest in former area at a reduced bag limit is not the best way to gauge, judge, or evaluate the true conditions masked by misinterpreted, manufactured, less then accurate data….	A reduced commercial harvest will further endanger depleted abalone populations and will not significantly improve the accuracy of abalone population data.	No	
C-4	The dedication of this document shows beyond a shadow of a doubt a bias and slanted opinion of your abalone team.	Dr. Mia Tegner was greatly respected by researchers world-wide as well as by the State Legislature which honored her posthumously.	No	
C-5	The abalone team seems to be making great effort to confuse, not clarify persistent lingering questions, concerns, cares and worries. How can this approach of misleading the public be rational, logical, ethical or prudent?...Is it for liability, image, lawyers, corporate interest, and the grant process of never answering all the questions on purpose to get another grant?	The Department acknowledges the commentor's confusion. See response to W-5, C-1, above. The Department always endeavors to fully answer all relevant questions. See response to S-5, C-6, Monterey Meeting.	No	
C-6	The fishery was closed because of withering syndrome, the first and foremost reason given. Theory that Withering Syndrome has always been present and is only blooming or blossoming now is not correct. Was it introduced? What has been done to honestly show where this disease came from? Repeat of S-5, C1 (Monterey Meeting).	See response to S-5, C1, Monterey Meeting. The origins of the disease are unknown. By definition, a "syndrome" is group of symptoms that characterize a disease, and a disease may have various causes.	No	

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C-7	Why does the Dept of Fish and Game refuse to do an environmental impact report on abalone? Is it because all questions and conditions would have to be explained?...	EIRs are only required when specific "projects" (as defined in CEQA) are determined to potentially have significant adverse environmental impacts. Under the ARMP, different levels of CEQA analysis may apply to individual projects once that activity is approved and funded.	No	
C-8	How can you say abalone that grow at a rate of one inch a year take fourteen years to be seven inches?	Growth rates of 1 in. per year only occur during the first few years. See ARMP Section 2.1.6.	No	
C-9	Why have we become over cautious or to [*sic*] precautionary? This is poor management. To error [*sic*] on the side of conservation is to acknowledge a mistake.	The expert consensus is that precautionary approach is the preferred fishery management strategy in data-poor circumstances. Past management has not been cautious enough and has led to the depletion of many species, including abalone	No	
C-10	Only 40,000 out of 40 million are able to enjoy this public resource because of no commercial harvest. Preference for the majority of Californians should be given so they may buy at markets and restaurants.	The Legislature established the abalone sport fishery in the north, and banned commercial abalone fishing below San Francisco, and remains the appropriate forum for discussing those actions. A commercial fishery would not significantly increase the amount of abalone already available from foreign or aquaculture sources, nor would it necessarily lower its cost to the consumer.	No	
C-11	What impacts to habitat do you mean? Abalone habitat on the islands is not impacted like the coast. Even with perfect habitat W.S. is the serial depleater [*sic*]. You seem to want to confusion cumulatives [*sic*].	The statement in question is a general list of human causes of abalone mortality and does not mean to imply that all factors are active in all parts of the state. The amount of responsibility of each factor in the depletion of abalone populations is not known. See response to S-5, C-1, Monterey Meeting.	No	
C-12	Poor recruitment? Is this because of genetic problems from outplants? Flats and pintos are not uncommon but well camouflaged and hide well. Is it because of W.S.? Alternative 4 shows the dept using 2,000 abs per/HA as the number for Minimum Viable Population and still double precautionary.	Poor recruitment was observed in areas such as Point Cabrillo Marine Reserve and Fort Ross which had no out-plantings. There is no evidence of genetic problems with out-planted abalone. See W-3, C-18, and C-20 below. The MVP is a population level which can prevent extinction but will not sustain a fishery. See S-2, C-2 (Monterey Meeting).	No	
C-13	Rapid decline in landings 1969-1982. Outplantings started in 1965-1985. Is that the cause for decline? Withering Syndrome and Sabellid Worm along with genetic hybrids introduced during this period?	In enacting its moratorium, the Legislature noted that abalone numbers all along the coast have declined drastically since the early 1970s, and attributed the decline to commercial take, a growing market demand, expanding sport fisheries, growing sea otter populations, pollution, loss of kelp beds, El Niño, and disease. There is no evidence that out-planting abalone is the cause for rapid decline in landings through the dispersal of Withering Syndrome (WS), sabellid worms, or hybrid abalone. Both WS and sabellid worms were not noticed until after 1985. If out-plantings were a significant source of either affliction, they	No	

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		would have been discovered much earlier. There is no evidence that genetic hybrids could cause population declines and since the survival rate of out-planted abalone was very low, their possible impacts on populations would be correspondingly low.		
C-14	Is the shift from mainland to island harvesting due to habitat destruction on the mainland from pollution, construction? Poaching otters, Military operations, pharmacological companies, oil exploration interest not factored in?	In enacting its moratorium, the Legislature noted that abalone numbers all along the coast have declined drastically since the early 1970s, and attributed the decline to commercial take, a growing market demand, expanding sport fisheries, growing sea otter populations, pollution, loss of kelp beds, El Niño, and disease. Although the factors listed may have contributed to declines in abalone populations along the mainland, abalone populations on the islands are generally free from the listed impacts and have also collapsed. The ARMP includes factors contributing to abalone population declines to the extent of current knowledge. The most likely reason for the shift from the mainland to islands is overfishing (Karpov et. al. 2000).	No	
C-15	The value of the fishery is underestimated? Why false statements show you are not being honest. Value of fishery per year is between 21-35 million dollars. This was one of the most money making fisheries in California. The underestimation of the value of the fishery is not a true profile or potential of the fishery.	The value of the fishery used in the ARMP is estimated from ex-vessel landings, which is standard for all fisheries. Although the primary fisheries management goal is sustainability, the economic aspect of sustainability is appropriately considered only if a fishery is first determined to be biologically sustainable.	No	
C-16	How can harvesting the outside edge of population hurt? The older, larger abalone that have necrotic spawn or are not viable. Reproduction of these for broodstock or larvae is a Pandora's box. Proven past studies show seven and three quarter inch abalone and smaller are the best spawners.	Although, size and bag limits can be effective conservation and management measures, they did not adequately prevent abalone populations throughout southern California from collapsing. All abalone populations in southern California are seriously depleted and were not adequately protected by the size and bag limits in place. It is unreasonable to advocate ineffective management strategies by rationalizing them with size-related fecundity studies. Recent studies have shown that although larger abalone have a higher percentage of necrotic eggs, their higher egg production offsets the number of non-viable eggs, and their total reproductive contribution to the population is greater than smaller abalone.	No	

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C-17	What about Crescent City? Have there been outplants there?	Abalone have been outplanted near Crescent City and there is an aquaculture facility which tests positive for the *Rickesettia*-like prokaryote (RLP) which is a causative factor in WS. Five of 29 abalone collected in the Crescent City area have tested positive for RLP but none showed signs of WS.	No	
C-18	2.1.2.2 Spawning and fecundity A minimum density is essential…consider hydred [*sic*] contamination or lack of spawning success due to genetics? That nature is trying to cleanse or purify itself from hatchery reared outplanted abalone. Therefore we believe that the 'Alee [*sic*] Effect' may well be another illusion that the Fish and Game stated.	Genetically unfit out-plants would not survive to reproduce and contribute to the local gene pool. There is no credible scientific evidence that outplants have any negative effects on the spawning success of native populations. In general, the broadening of a gene pool is viewed as beneficial to depleted populations. A lack of genetic diversity is a greater danger to populations than increased diversity, because traits necessary to adaptation and survival are less likely to be passed on. This section was peer-reviewed by an independent panel of scientists including geneticists who made no comments concerning hybrid contamination or lack of spawning due to genetics.	No	
C-19	Criterion one will be met when all index sites have met the size category percentage values. Why all? And how when some are not counted?	Criterion 1 does not need to be met at all sites. See response to S-5, C-7 (Monterey Meeting). All abalone encountered are measured and counted. For Criterion 1, abalone below 100 mm are not considered because they are not adequately sampled by emergent surveys.	No	
C-20	2.1.4 Genetics Burto [*sic*] and Tegner (2000) No real effect or benefit to resource from outplants. Facts show outplanting hurt the populations by introducing to much diversity and stops or negates spawning? ….In nature when to much genetic diversity is present a mechanism creates mass mortality to cleanse or purify itself. Why will you not even consider this a possibility? Allee Effect here may be harmful.	There is no credible scientific evidence that outplanting abalone hurts populations by introducing too much genetic diversity that stops spawning, nor is there a mechanism that creates mass mortality to cleanse excess genetic diversity. See response to W-3, C-18 above.	No	
C-21	2.1.5.2 "Wide range of dispersal" occurs. This contradicts 'Allee Effect' does it not?	The Allee effect describes the reduction in successful broadcast spawning when adult densities are too low. It is not affected by dispersal range.	No	
C-22	2.1.6 Growth Abalone tend to grow comparatively quickly given favorable conditions. This contradicts 7" abalone takes 14 years.	The context of this statement in the ARMP is that abalone grow comparatively quickly before sexual maturity and growth slows thereafter. There is no contraction with the whole statement and the relatively slow estimated growth seen in this species.	No	

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C-23	2.1.8 Movement Abalone move and migrate. So to have a set site that abalone move from is not being real. How can you say since site has less abalone in it there are less abalone? Why not move with them? How can an index site or key location be the best way to monitor abalone?	Although some migration and movement of red abalone has been observed, most movement is limited and most abalone would remain within the index sites. Unlike the Channel Islands National Park sites which are limited in size, Department index sites would cover a wide area. Transects are randomly selected within index sites so that abalone moving within the index site have an equal chance of being counted no matter where they move. Enough transects are conducted within a site to adequately estimate abalone abundance.	No	
C-24	2.1.9.2 Diseases and Parasites How did outplants of abalone contribute to the introduction of Withering Syndrome to wild before outplantings in 1965 and full blown outplanting from 1974-1984. Ten Years. How can you eliminate this fact from the possibilities? You are telling the truth about Sabellid worm? It has already been found in the wild and around abalone farm outfalls and outplant sites.	No correlation has been established between outplantings and WS. Both WS and the Sabellid worm did not appear until after the outplanting program stopped. The section on sabellid worms is accurate and current. No sabellid worms (*Terebrasabella heterouncinata*) are known in the wild. A single incident in which sabellid worms were found near the outfall from one abalone farm is believed to have been eradicated.	No	
C-25	2.1.9.3 Is there anything man can do to stop or start the El Nino Effect? How can this be anything but another one of natures cycles? Abalone not much affected except for the spread of W.S. from outplants.	El Niño events can have detrimental effects to abalone populations as outlined in ARMP Section 2.1.9.3. The effect of WS on abalone populations is exacerbated by warm El Niño waters, but out-planted abalone are not the source of WS. See W-3,C-24.	No	
C-26	2.1.9.4 Sea Urchin harvest does not harm small juvenile abalone. They are in different habitats. Small juvenile abalone way back in cracks and holes were killed by W.S. The Serial Depleater [*sic*].	Sea urchin harvest can have negative effects on abalone populations. See ARMP Section 2.1.11. Also see S-5, C1and S-5, C-11 (Monterey meeting) concerning WS.	No	
C-27	2.2.1.1 Evidence of poor recruitment Is the poor reproduction in your study sites because these sites are outplant locations? And the mechanism of mass mortality from artificially propagated or hybrid hatchery reared abalone factored in? And or that abalones 100mm or smaller are not counted?	There is no correlation between out-planted or hybrid hatchery-reared abalone and poor reproduction in study sites. See responses to W-3, C-12 and W-3, C-18. Abalones 100 mm or smaller are adequately sampled by invasive transects (see ARMP Appendix E). Evidence of poor recruitment is based on data from invasive transects (see ARMP Table 2-4).	No	

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C-28	3.1.1.1 History lacking accuracy, what about 1820-1948? Evidence of commercial harvest north of San Francisco with no adverse effects to the resource? Landings were steady before outplantings. Why will you not tell the truth about the problems with outplants? Is it because of grant money, liability and image? 1997 -101 permits not 130. Why Lie? How many on list now that would buy permit? How many divers are optimum? Zero? Please explain the illusion that Fish and Game says now they experienced about landings. Was it Mia Tegner's Egg-Per-Recruitment model error that contributed to the illusion and contributes to poor recruitment reports?	The history of California abalone fisheries prior to 1942 largely involved areas currently occupied by sea otters and was not discussed in ARMP Section 3.1 because these areas are currently unlikely to support an abalone fishery. The commercial harvest north of San Francisco was too small and short-lived to adversely impact the resource (1942-1945 with a total catch of 525,000 lb). Abalone populations off San Mateo County were severely depleted by fishing activities. There is no data to show out-planted abalone were the cause of declining landings. See responses to W-3, C-12 and W-3, C-18. Speculation on the number of divers that would currently buy a permit is unnecessary until the sustainability of the fishery is confirmed. The optimum number of divers is variable depending on the total allowable catch and the economics of a re-opened fishery. The "illusion" referred to is that of apparently stable catch levels which were maintained by shifting to new species and locations while serially depleting both species and locations. Egg-per-recruit (EPR) models estimate the amount of reproduction to expect from abalone before they are subject to fishing pressure. EPR models are not connected to the illusion of stable catches or poor recruitment reports.	No	
C-29	3.2.1 How can there be any commercial value of abalone in the year 2000 when the fishery closed in 1996-7? Is it research or F&G selling brood stock?	There is no commercial value of abalone for the year 2000. In Section 3.2.1, the values given are for the fishery in 1995 and 1993. The phrase "in 2000 base year" means the value of the fishery for 1995 and 1993 in terms of dollar value for year 2000 adjusted for inflation.	No	
C-30	3.2.4 "Difficult to asses accurately" [*sic*] The whole thing, not just this part. Is the illegal take and W.S. the greatest takers or mortality? Are W.S. and hybrids outplanted the Serial Depleater [*sic*]?	The clandestine nature of illegal take makes it impossible to accurately determine what proportion of the population depletion is attributable to that activity. WS and hybrid abalone cannot be blamed for depletion of most abalone populations. See responses to S-5, C-1; W-3, C-12; and W-3, C-18 .	No	
C-31	6.2.1.1 Why use millimeters and hectares? Why not use US scale of inches acres and feet ... Here at least give both. Appendix E is in question of its accuracy and value. How can a ROV see abalone if they are not in deep water, ie. 28 feet or deeper? If dive conditions are not just right – good visibility and calm water – no reliable surveys will be accomplished. But Fish and Game go anyways. Did you or can you see well on all surveys? Admittedly not but had to dive because the day was scheduled. No matter, better we don't see?	The metric system of measurement is standard for all scientific writings because it is much less cumbersome than the US system. Conversion tables will be provided. The survey methods described in Appendix E are standard procedures that have been used for numerous peer-reviewed scientific publications. ROVs have been used in water as shallow as 15 feet and can provide data useful for surveys. ROVs provide video images which give a much more detailed record of habitat than the notes and observations recorded by divers. The Department does not conduct dive surveys when conditions are too poor to collect accurate data. Cruises are often cancelled because of poor weather conditions.	Yes	See "Conver-sion Table for the ARMP", page xvii

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C-32	6.2.1.1 (con't) How can estimates made in appendix E be checked for accuracy? Even with GPS tracking system abalone here today can crawl a long ways before you are back. Surveys are of much question. How can we guarantee accuracy or reliability?	Surveys are based on randomly selected transect sites which are adequate for sampling abalone density. See response to W-3, C-23.	No	
C-33	6.2.1.1 (con't) Why do you not count abalone smaller than 100mm? These small abalone are not being counted. Is this why your studies are skewed on recruitment? Or can this be why poor reproduction is being reported? If these small abalone are present and not being counted, how can we use any of this stuff? How many 100mm or smaller abalone are there in the study sites Did you underestimate?	Timed swim surveys are only used to determine whether there is a broad size distribution of abalone present. All abalone encountered are measured but for the purpose of analyses, abalone smaller than 100 mm (approximately 4 in.) are not included since animals that size are likely to be missed in timed swim surveys. As explained in Appendix E, these data are not used for either density or recruitment studies. Emergent transects (Appendix E) count and measure all visible abalone and are used for density studies. Small abalone are adequately sampled using invasive surveys (Appendix E).	No	
C-34	6.2.1.1 (con't) Locations for recovery area sites were determined by commercial block data. Are any of these multiple index locations? Are any of these sites outplant locations? Are any of these sites without Withering Syndrome?	Some blocks have more than one index location. Some of the index locations are likely to have been outplanting sites. WS is present throughout southern California and is likely to be present at index locations.	No	
C-35	6.2.1.1 (con't) Why will you not admit that abalone migrate, change locations, move travel, and crawl to new and different places? And even sometimes return?	Abalone movement is acknowledged and described in ARMP Section 2.1.8.	No	
C-36	6.2.1.1 (con't) Destruction of abalone has for ever been changed by habitat destruction. F&G has allowed many projects that have destroyed forever some abalone habitat. How can you say 50% of former habitat must be recovered or no plan for recovery can be achieved?	Contradicts C-11 above. The comment is too vague for a detailed reply. Most index locations are on islands which have had little habitat destruction. If less than 50% of the recovery areas are not recovered, abalone populations will not be adequate to sustain a fishery.	No	

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C-37	6.2.2 Population parameters and target densities have been already met in some if not all areas. If we use the precautionary number of 1,2000Ab [*sic*] per/HA for our M.V.P. Alternative 4 calls for 2,000 ab per /HA which is double precautionary. Why will you not admit it? Is it grant money? How much grant money and job security? Are you created to be a grant sucking parasite? This data will never be attainable if grant money motivates research. They will always create more questions, controversy, and conflict.	A density of 1,200 ab/ha is not precautionary because it is very close to densities which could not sustain fisheries on Santa Rosa Island. See response to S-2, C-2 above. Grant money is not a consideration in setting MVP density levels. See response to S-5,C-6 above.	No	
C-38	6.2.2.1 Criterion 2: Why must all parts of criterion 1 be completed to F&G liking before criterion 2 and 3 can be explored? The MVP (Minimum Viable Population) of 2000 ab/ha is way to [*sic*] precautionary. Studies of past show 1,000 M.V.P. 1,200 would be more rational, giving the best chance for success. And besides, how can you count per/ha if abalone only locate on part of the area? This concept is skewed. How, if abalone move and like people some places they go in large numbers and some places they yield no populations. This number is to [*sic*] high and has little chance of success. We do not believe that the density of 1,000 ab/ha would ever cause stock collapse. The studies stated here leave out the facts of poor understanding [*sic*] of a dynamic environment and outplants in the area. Past studies state 1,000 ab per/HA is M.V.P. and precautionary when published peer review.	Not all parts of Criterion 1 need to be completed before Criterion 2 and 3 can be explored. See response to S-5, C-7 (Monterey meeting). MVP of 2,000 ab/ha is not too precautionary. See response to W-3, C-37. A count per hectare is an average of many randomly placed transects that cover a wide area. See response to W-3, C-23. Although a density of 1,000 ab/ha may not lead to stock collapse, it would likely have a very low allowable catch. See response to S-2, C-2 (Monterey meeting).	No	

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C-39	6.2.2.2 Criterion 3: The number 6,600 ab/ha is to [*sic*] high and not realistic. This number needs to be reduced so that an expectation of achieving our goals can be attained. Criterion 2: 2,000 ab per/HA is double precautionary. Where in nature does such a thing occur? Let us go look, because we find it hard to conceive this anywhere. This number is of much importance and is of much question. Again, how can your index sites and key locations ever expect to get this accomplished? Outplanting? The density at which abalone are comfortable? There are many seasonal changes. Again, like people they move together for a while and apart. Some straying away.	The targeted emergent abundance of 6,600 ab/ha is based on data from surveys in 1999 and 2000 at sites impacted by the northern California recreational red abalone fishery and is the best available estimate of a sustainable density for an ongoing fishery. Researchers outside of the Department have observed similar densities of red abalone in northern California. See responses to S-1, C-1 (Monterey meeting). Movement of abalone is not a significant problem for estimating abalone densities. See responses to S-5, C-8 (Monterey meeting) and W-3, C23.	No	
C-40	6.4.1.1 Why not use a limited fishery so as to judge, gauge, evaluate, and collect data on populations and area? Increased size limit 7 ¾ inch and reduced bag limit 2 sport 2 doz. Commercial? Landing info would show all. But if afraid of W.S. and worm found [*sic*]? Then no fishing at all is what we get. Liability questions? Image? Lawyers?	Fishery dependent data has limited utility in population studies. See responses to S-2, C-3 and S-5, C-5 (Monterey meeting).	No	
C-41	6.4.2.1 Translocation is a bad idea. Abalone that try to get out of contaminated areas are brought back why? If brought from afar genetics problems. Let nature alone and it will cure itself. To bring abalone into areas with W.S. is death. Broodstock and translocations take some of the best chances of recovery out of the ocean….	Translocation enhances recovery by aggregating abalone to increase reproductive success. Genetic problems could result from long distance translocations but the Department will avoid such translocations. Since WS is found throughout southern California, translocation from one southern California site to another does not increase the chance of mortality from WS. Broodstock collections involve a small number of abalone and have no significant impact on abalone population densities.	No	
C-42	6.4.2.2 Larval Outplantings Genetic problems have already been identified. Why will you not recognize them or why ignore this grant money? Image?	There is no credible scientific evidence supporting this assertion. See W-3, C-18 above.	No	

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C-43	6.4.2.3 Captive Breeding It has already been proven that artificially spawned abalone can be considered hybrids; these have fouled the genetic reservoir, the gene pool of abalone and is a big part of the problem. But, Grant money is the motive. Will they succeed at all costs? Outplants are not for California. This program has already taken the most healthy disease resistant abalone out of the gene pool and made their offspring hybrids in a way that they will not admit. This denial has been the base of underlying problem. Poor recruitment due to nature trying to cleanse or purify itself. How many times must we learn the same lessons, over and over, for the grants. Taking the best chance for natural recovery out of our ocean is not the way. Leave the best chance for recovery alone. No permits for collection of any brood stock should be allowed. Repeat of W-3, C-18 and S-5, C-6 (Monterey Meeting).	There is no credible scientific evidence supporting this assertion. See W-3, C-18 above. Broodstock collections involve a small number of abalone and have no significant impact on abalone population densities. Most Department abalone research is not supported by grants. See S-5, C-6 (Monterey Meeting).	No	
C-44	6.4.2.4 Marine Protected Areas Abalone have and have had in many areas of California no take zones, for a long time in some. But no evidence of worth or value have been seen. From San Francisco to Mexican border for 7-5 years for some species. Black 7, red 6 and no recovery will be admitted by biologist? So, no recovery, no benefit to abalone why? Why would you want to continue to fail? No value or worth to the resource has been observed. Hard to enforce. Are you not allowed to make hard plain language to enforce regulations?	Refugia and other “no-take” areas, which are now known as Marine Protected Areas (MPAs), have often been too small to be effective. Low abalone population levels have prevented rapid recovery in areas recently closed to abalone fishing. The recovery process may need to be augmented by out-planting. Re-opening a fishery before recovery would endanger remaining abalone populations. The problem with enforcing MPAs is not in writing regulations, but in having enough personnel to adequately patrol the MPAs.	No	

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C-45	6.4.2.4 Marine Protected Areas (con't) How does M.V.P protect abalone from oil spills, pollution, sea otters, El Nino, Withering Syndrome, poaching, storms, botched experiments, mismanagement, those that crawl from or are outside of these areas? Would size limits, bag limits, seasons, areas be a good way to manage abalone? Partial repeat of W-3, C-16	One function of MPAs is to recharge fisheries and to help rebuild overfished stocks. Animals within an MPA might still be impacted by other problems which could adversely affect fished populations (i.e. oil spills or El Niños). However, since population levels will be higher within the MPA, there will be a greater chance that there will be survivors which can repopulate the affected area. The traditional management methods mentioned by the commenter did not prevent depletion of most of southern California and the San Mateo coast. Also see W-3, C-16	No	
C-46	6.4.3 What specific genetic and disease concerns are you referring to here? Why not be honest and tell of outplant problems? And introduction of aquaculture had already been done. Why lie? Repeat of W-3, C-18 and C-20 above.	Genetic and disease concerns are discussed in detail in Sections 6.4.3.1 and 6.4.3.2. Out-planting problems discussed earlier by the commenter are not valid. See W-3, C-18 and C-20 above.	No	
C-47	6.4.3.4 Genetics Research What genetic concerns are you talking about? Is it that there is a mechanism in nature that stops or negates all spawning when to much genetic diversity exists? Such as outplants, artificially stimulated to spawn hybrids. "Ocean Ranching" Repeat of W-3, C-18 and C-20 above.	There is no Section 6.4.3.4. Genetics Research is section 6.4.3.1. There is no credible scientific evidence supporting this assertion. See W-3, C-18 and C-20 above.	No	
C-48	6.4.3.5 Is it true that W.S. was created by Scripts [*sic*] and outplant [*sic*] with hatchery reared abalone? Where did it come from? The lack of honesty is disrespectful to California. Disease control member suggests removal of larger abalone would slow or eliminate the spread of W.S. – Commercial harvest to judge how far the problem has gone.	Origins of WS are unknown. It was certainly not a creation of Scripps Institution of Oceanography. Although removal of larger abalone may slow the spread of WS, there is no longer any area in southern California which has not been affected. Removal of larger abalone could also be detrimental to surviving abalone populations. One of the reasons for closing the black abalone fishery was to protect remaining animals that may have a genetically-based resistance to WS and thus allow recovery of resistant populations. There was concern that continued operation of a fishery would remove resistant abalone from the population.	No	

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C-49	6.5.1 How much money has been spent? Is it true Carolyn Friedman is related to the executor of Scripts [*sic*] and has kept the truth about W.S. from being known? Why are none of the studies trustworthy? Why must we wait till 2005 for the disease report? Can people get or host any problems from consuming W.S. abs? What other fish or mollusks, shell fish or organisms effected [*sic*]? Where have all the moon snails gone? Limpets? Others?	The annual Disease Lab budget related to abalone work is $124,000. All available information regarding WS is open to the public. The disease report scheduled for 2005 covers disease resistance which requires time for carefully controlled experiments. There are no known medical problems resulting from people consuming WS-infected abalone. No other organisms are known to be affected by WS, which is not likely to have affected the marine species listed.	No	
C-50	6.6.1.1 What has been done since closure of fishery? We were promised time was needed to complete all this stuff you now say needs to be started? What, why, who, where has all this money gone?	As stated in Section 6.6.1.1 some of the exploratory surveys have already begun. Survey cruises have been conducted including ROV surveys for white abalone. A great deal of time has also been used in writing the ARMP.	No	
C-51	6.6.1.2 Feasibility Studies Study past studies. How many times must we learn the same lessons? Outplants started 1964, full blown 1974-1984. What did you learn? What about honest research? Why have these studies not been completed? No one wants to admit failure and silence gets more grants?	Experiences with past out-plantings are that few survive and great care must be taken to prevent spreading known disease and parasites. Past studies have been completed and are the subjected to peer-reviewed publications. Granters do not fund needless or redundant studies	No	
C-52	7.1.2.2 Contradictions in TAC Why, how can you first say 6,600 per/ha – now 8,300 per/ha? Where in California do you find an area with 6,600 per/ha? Studies show 1,000 per/HA M.V.P. We can not believe this is true or accurate. Show us where in nature this has ever been possible. Alternative 4 calls for 2,000 per/HA still to precautionary.	The 8,300 ab/ha in ARMP Table 7-2 is the level for increasing the TAC. Van Damme and Salt Point both have average abalone densities above 6,600 ab/ha. Researchers outside the Department have also found abalone densities in excess of 6,600 ab/ha. Fanshawe et al. (2003) found densities of abalone off Sonoma County ranged from 11.5 to 18.1 abalone per 2 x 10 m plot, which is equivalent to 5,750 to 9,050 ab/ ha.	No	
C-53	7.1.2.5 What is or how long is biennial? Where is your honesty now? Why not be truthful and say 5 years.	Biennial is a commonly used term which is found in most dictionaries. It means every two years.	No	

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C-54	7.1.2.6 Why would only large increments for adjustments be used? How can that be considered precautionary? We continue to hear 'Fine Tune Our Management Techniques' Is this another contradiction?	Relatively large increments for adjustments are used because fine controls are impractical. The process of changing regulations is very time-consuming and should not be used to make a series of minor adjustments when a single larger adjustment can be made. The large increment changes can still be considered precautionary by making changes before problems become extensive. The Department endeavors to make management techniques as responsive to changes in the fishery as possible. While current techniques might not be ideal, they are improvements over past practices in abalone management.	No	
C-55	7.1.2.7 If sites are not sampled then how can you say 'Detecting actual declines in stock and recruitment estimates need to be more precautionary'?	The commenter misinterprets what was written in this section. The scenario described in Section 7.1.2.7 calls for a precautionary reduction in the TAC if monitoring is reduced. The precautionary reduction does not depend upon whether declines in stock and recruitment are detected, which is what the phrase in quotes indicates.	No	
C-56	7.1.3 Why would long term plan not be back dated to first action taken? Closure of fishery in 1995?	The fishery was closed by 1997 legislation. Back-dating would not affect the implementation of the long-term plan since implementation depends upon accomplishing enough monitoring to establish management zones.	No	
C-57	7.1.3.3 Data There are only four index sites all in northern California. All are past outplant sites and high use sports areas. How can that even give an accurate accounting?	Fisheries and resource management decisions must often be made in data-poor circumstances. While more data is always desirable, decisions must be made with what is readily available, and these sites do provide an indication of the condition of the resource. High use sport fishing areas are used because they will be the most likely places to show local depletion. The Department recognizes the limitations of low sampling coverage and compensates by using precautionary TACs.	No	
C-58	7.1.3.4 75% of the zones? Are these zones index sites and is 75% 3 sites? What zones have even been established? So are you talking about fantasy? What if no funding is available? Lacking honesty here.	This section discusses proposed management under the long-term plan. Zones have not yet been established. Index sites would be included within zones. Creation of zones would be one of the tasks that need to be accomplished before the long-term plan is implemented. Implementation of the long-term plan is subject to available funding.	No	
C-59	7.1.4.1 Three quarters of sites. What is that? Why not be honest and say 3 sites since there are only 4 index sites? Why must every species be met by criteria for all? If reds are abundant, why not harvest them? Confusion misleading way?	The long-term plan is not limited by the current number of index sites. The ARMP does not require the recovery of all species before any species can be harvested. See ARMP Section 6.3.	No	

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C-60	7.1.4.3 Why if central California is so much different than southern California do you want to use criteria for southern California on central California? This makes no sense. Alternate 4 with 2,000 per/HA use may open it up to other criteria for central may be needed [*sic*]?	The main differences between central and southern California is the presence of sea otters and the reduced number of fished abalone species in central California. Allowing for these differences, the overall management of these areas can be similar including, when appropriate, the allocation of harvest between recreational and commercial fishermen.	No	
C-61	7.2 How can you say no recovery can occur? Where is the truth?	This section makes the point that if "sea otters reoccupy this area (the San Mateo coast), recovery to fishery levels cannot occur." The problem of sea otters is discussed in ARMP Sections 2.1.9.1 and 6.5.2.	No	
C-62	7.2.5 Why Is information on the Socio-Economic data non-existent? What about jobs an [*sic*] economy? Worth and value of fishery underestimated. Partial repeat of W-3, C-15.	Although, the primary fisheries management goal is sustainability, the economic aspect of sustainability is appropriately considered only if a fishery is first determined to be biologically sustainable. The Legislature has made it clear that resource recovery, not socio-economic impacts, is the primary consideration. See W-3, C-15.	No	
C-63	7.3.1 Alternative 1 The number 6,600 ab/ha is not necessary to achieve population goals. Criteria 3 may never be fully achieved and alternative 1 recognizes this. Limited fishing is accomplishment of goal. With increased 7 ¾" size limit and reduced bag limit 2 sport 2doz. Commercial, seasonal closures and increased enforcement. How can a precautionary approach like that have a negative effect? Only the outside population would be candidate for fishery. The old, the worst spawners or those that spawn is not longer need of MVP or those that spawn is negative or no longer viable or important [*sic*]? Repeat of S-1, C-1; S-2, C-2; and S-5, C-10 (Monterey Meeting) and written comments W-3, C-16 and C-39.	A range of alternatives are required by the ARMP legislation and are not an acknowledgement of problems with the preferred management plan (FGC § 5522(a)(2)). The proposed regulations were not adequate to protect abalone populations in most of southern California. Necrotic spawn of older abalone is not well documented. See responses to S-1, C-1; S-2, C-2; and S-5, C-10 (Monterey Meeting) and written comments W-3, C-16 and C-39.	No	
C-64	7.3.2 Alternative 2 The number 6,600 per/ha of abalone would be reduced to 3,000 ab/ha still high [*sic*]. Criterion 2 2,000 per/HA. But F&G admits here it is to [*sic*] high by how much? 3,600 ab/ha and still to [*sic*] high. Why make 6,600 ab/ha criterion 4? It is a number to be eliminated for ever. It is unattainable when studies show 1,000 per/HA is M.V.P. To (*cont*.)	Alternatives are required by the ARMP legislation and are not an acknowledgement of problems with the preferred management plan (FGC § 5522(a)(2)). A density of 3,000 ab/ha is a minimum level for a fishery. See S-2, C-2 (Monterey meeting). Attaining Criterion 4 would allow increased fishing effort. Although more frequent assessments will provide more monitoring, this will divert resources from other needed recovery activities such as aggregation, larval out-planting, habitat and genetics studies.	No	

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	change parameters for criterion 3 to 3,000 ab/ha and leave the rest the same is not logical. If you change the number you recognize a problem. It is not the only one. At least ¾ of recovery areas will now go by that new number. Criterion 1,2,3 can be accomplished now with 1,000 ab per/HA. Creating a new category or criterion 4 is not rational or reasonable is it? Criterion 4 would never be attained or achieved, would it? Why require it if it can not be done? Eliminate Criterion 4 or more requirements That will not allow for success, or limited fishing. Pro is: Assessments will have to be done more frequently, every 2 years instead of every 5 years. This keeps you guys busy and it allows for more monitoring. This is a Pro not a Con. The more abs landed the more money from landing tax.			
C-65	7.3.3 Why will areas soon be reoccupied by sea otters? The otter recovery plan is a failure. Again, modification of criteria 3, WHY? Is it because 2,000 per/HA is double precautionary? What specific criteria for implementation do you mean? 2,000 per/HA is more like it. Change criterion 3 to 2,000 ab/ha is closer to real, but close area when 20 or more otters, NO. Compaction of fishery a problem. We must all share. Otters should not be moved anymore. It always fails.	Alternatives are required by the ARMP legislation and are not an acknowledgement of problems with the preferred management plan (FGC § 5522(a)(2)). Alternative 3 only applies if areas are being reoccupied by sea otters; it does not say that sea otter reoccupation will happen soon. The 20-otter trigger is one of the criteria for allowing the fishery and not for closing it. There are no plans for sea otter translocations.	No	
C-66	7.3.4 Why only short term fishing opportunities? How can this alternative drive abalone to extinction? With precautionary size limits, bag limits, season and increased enforcement. Only the outside edge of population would be fishery qualified. Those that their most productive spawning days are gone. Withering Syndrome was the first and foremost reason for closure. How would you violate any part of recovery and (*cont.*)	Alternative 4 will likely result in short term fishing opportunities because it will result in depletion of abalone populations. WS was not significant in reduction of abalone populations except for black abalone. See responses to written comments W-3, C-16 and S-5, C-1 (Monterey meeting).	No	

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	with [*sic*] a number 2,000 ab/ha? That is double precautionary. Use 1,000 per/HA. This allows for multiple site recovery. Repeats comments W-3, C-16 and S-5, C-1 (Monterey meeting).			
C-67	7.3.5 Alternative 5 If you can not accurately estimate illegal take into the TAC, why use flawed concept. TAC is unenforceable. You can not enforce TAC as well as daily bag limits. TAC is more opportunity for illegal take. Daily bag limits are easily enforced. May be idea for numbers game but bad management. You have already caused many lives to suffer from moratorium. So many ways can be used to have more illusion and is not easily enforceable. Easy to get around it.	The Department recognizes that poaching is difficult to estimate and that the TAC in the ARMP is not strictly enforceable. Alternative 5 provides an option that could be used if poaching is a major concern of the Commission. The TAC is a guideline for regulating catch and not a firm TAC used to close fisheries when it has been exceeded.	No	
C-68	7.3.6 Closure would cause unnecessary economic loss.	Although, the primary fisheries management goal is sustainability, the economic aspect of sustainability is appropriately considered only if a fishery is first determined to be biologically sustainable. The Legislature has made it clear that resource recovery, not socio-economic impacts, is the primary consideration. The power to regulate fishing has always existed as an aspect of the inherent power of the Legislature to regulate the terms under which a public resource may be taken by private citizens.	No	
C-69	7.3.7 TAC is not the best management, is it?	TACs are widely used fishery management tools and an integral part of successful abalone fisheries in Australia.	No	
C-70	8.2 Enforcement Lack of enforcement has contributed to poaching. Poachers have no size, bag, season, or closed areas. This contributes to Serial Depletion [*sic*] Please explain in precise and exact details of undercover wardens? How are they organized? What requirements or rules do they follow? Who are these wardens? What training qualifies them? How many busts a year are they supposed to make?	The Department understands the relationship between enforcement and poaching as well as the effects of poaching on the fishery. Abalone report card funds support one undercover (Special Operations Unit or SOU) warden. SOU wardens have a high degree of specialized training and have no requirement for number of arrests in a year. More details of SOU wardens are not relevant to the ARMP.	No	

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C-71	8.3 How can we be sure wardens would prosecute unethical biologists? Why is aquaculture exempt from laws, or why are aquaculture requirements not adequate for enforcement? Monitoring of ab farms for broodstock etc. Poaching, contamination of areas.	Wardens enforce laws regardless of the occupation of the violators. The aquaculture questions are not relevant to the ARMP.	No	
C-72	8.3 (con't) Abalone punch report cards are not being returned, people are trying to tell you something. Punch cards or yearly limits are not enforceable. TAC is not enforceable. Abalone stamp was for number of sport divers. We have that. The questionable worth or value of information gathered is not equal to the public resentment. What if info not received? Rid us of such unenforceable clause or conflict. These 40,000 out of 40 Million are the only Californians allowed to enjoy abalone. Why not all? 40,000 @ 24/year is more then [*sic*] the commercial harvest ever in a year.	The number of complaints about the requirement for possession of an abalone permit report card has been insignificant. Although difficult to enforce, wardens have found the cards to be valuable tools in preventing people from taking too many abalone day after day. The Department believes abalone permit report cards will provide valuable information on the number of abalone caught and the location of catch. Together with a random telephone survey, the cards provide a more accurate picture of effort and location than was previously possible. There is no intention of having 40,000 people harvest 24 abalone per year. Relatively few people take 24 abalone per year. The TAC proposed in ARMP Section 7.1.2.2 is 400,000, an average of 10 per person. If large numbers of people began to catch the annual limit of 24 abalone, the Department would take action to reduce the annual catch.	No	
C-73	9.1 Activities How much has been spent on all activities associated with abalone? How about exact breakdown? How much grant money, public funds? What worth or value? Are we getting our monies worth?	ARMP Table 9.3 has a summary of current costs. Before the abalone stamp and abalone permit report card fee, much less funding was available. Most of the dedicated money comes from abalone permit report card fees. The Department does not have a more detailed breakdown of expenditures than is reflected in ARMP Table 9.3.	No	
C-74	9.1.1 Assessment How much has been done? Why do you not discuss this honestly? How do you increase efficiency of data collection? Chapter 6 and 7 are lacking details. How about more detailed landing receipts and commercial harvest?	Assessment activities to monitor current abalone population status are ongoing. Data collection is made more efficient when agencies and interested parties cooperate to gather data of common interest using comparable methods. Detailed landing receipts alone are inadequate sources of fishery management data. See response to S-5, C-5 (Monterey meeting).	No	
C-75	9.1.2 Research How much of this has been done? Why not do homework on past studies? What genetic research needs do we still have? Why since 1975 questions of gene pool contamination and fouling of genetic reservoir not completed? Are those given these duties skilled or qualified enough to carry out (*cont.*)	None of the research listed has been completed although most are currently underway. Department biologists take into consideration past studies when designing their research plan to ensure past work is not needlessly repeated. Gene pool contamination was not a concern expressed by the peer review panel, which included geneticists. See response to written comment W-3, C-18. The peer-reviewed results mentioned in this section are part of the process of publishing a (*cont.*)	No	

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	honest work? Where is the peer-reviewed results from this work? Abalone Enhancement program 1974-1984?	research article in a scientific journal. However, the actual comments during the review are not directly included in the publication, but are incorporated into the article to the extent recommended by the journal editors.		
C-76	9.2 Why must we wait for honesty about situation and agenda for aquaculture? Why wait until 2009 to initiate recovery assessment? What about all the feasibility studies already done? Scheme for grants? Excuses?	Aquaculture management is not within the scope of the ARMP. Exploratory surveys will be undertaken before 2009. Recovery assessment can be initiated if exploratory surveys indicate abalone populations show signs of recovery. There have been no feasibility studies on the scale needed for recovery activities.	No	
C-77	9.2.1 Black abalone resistance to W.S. was started in 1993 by pathologist, F&G, and others. Why not produce summary of efforts of Carolyn Friedman? Why wait until 2005, when we were told in 1997 we must wait until 2003? 2005 does nothing for plan. Recommendations on a potential plan to go to Commission? What about last 6 years to develop this plan? The F&G has studied black abalone to death and will not admit that any of their actions may possibly contribute to the decline or mass mortality from outplantings. Introduction of W.S., Sabellid Worm, gene pool fouling?	The analysis of the results of the disease resistance studies in abalone are not anticipated before 2005. The results of most of Dr. Carolyn Friedman's research have been published and are available to the public. The recommendations that will be presented to the Commission in 2005 are the only amendments to the ARMP which should be in place before then.	No	
C-78	9.2.2 Beginning in 2006, what? F&G said in 1997 how things would go. Not once were they honest about any of it. Based on 5 year reports only if resources are available. That is no commitment, sounds like never with no alternatives. TAG system is another enforcement nightmare. A daily bag limit is the most enforceable way to limit take. TAG and TAC will be a quagmire of controversy for ever. Why deal with the uncertainties? Experiment has been done but why not be honest of past efforts? Studies, analysis, projects, and failures? How can this help if not here?	The Legislature enacted the provisions mandating the preparation of the ARMP in 1997. Implementation of the proposed long-term plan is contingent upon the availability of funds appropriated by the Legislature through the budget process. The Department is committed to the effective management of the abalone resources within the budgetary constraints to which all State agencies are subject. The implementation of a tag system has enforcement advantages as well as disadvantages. There is no reason to summarily dismiss the use of tags prior to a thorough review of this potential management tool which has been used successfully for other game species.	No	
C-79	9.2.3 When will enforcement staff release summary of efforts and review?	The preparation of summary reports of enforcement activities for individual fisheries is not statutorily required and is not a priority task of marine enforcement policy. There are neither personnel nor budgeted funds available for such a program.	No	

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C-80	9.2.1[*sic*] How can it cost that much? Are you being precautionary and inflating the cost? It seems obvious the estimates of cost are to [*sic*] high. Eliminate the cost of punch card info if that is of no true value or statistical significance, it will save a lot. Commercial landing tax could pay for it all. Landing tax of landed abalone for monitoring of fishery. Allow Californians to buy at markets and restaurants.	The correct section number is 9.3.1. The costs listed are based on current budget tables and there is no precautionary inflation of figures. The costs of implementing the abalone permit report card are small ($12,000 for printing) and are not significant in the overall budget. Although limited, the information received through cards is valuable and when used in conjunction with random telephone surveys can be made more useful than the fishery-dependent information gathered previously. Commercial landing taxes for abalone were never adequate to cover Department expenditures for abalone monitoring and enforcement in the past.	No	
C-81	9.3.1.1 Table 9-1 What has been done for the last 5 or 6 years? Why if genetic testing DNA and feasibility studies already done not included? Tasks 1,2,3,4 and follow-ups were to be completed by Jan 1, 2002. What happened? This timeline ends in 2009 with listing as endangered all abalone, and more MPA's. How can that be true or warranted?	Table 9-1 is a summary of future activities and does not include past activities. The legislation only required that the ARMP be submitted to the Commission by January 1, 2003 (FGC § 5522(a)). The 7-year timeline for implementing interim recovery and management activities started in 2003. The Legislature stated that the ARMP *may* include a network of no-take abalone reserves (FGC § 5522(b)(1)). Table 9-1 only recommends more MPAs if *warranted*, and that authority rests with the Commission. Table 9-1 will be amended to recommend endangered species listings if warranted. Actions under the federal Endangered Species Act are outside the scope of the ARMP.	Yes	Table 9-1
C-82	9.3.1.1 (con't) Table 9-2 Report Assessment With less than 20% of cards and great public resentment, how can it all depend on that? TAC adjustments not sound management? Eliminate punch card data and flawed TAC and TAG concepts or controversy of this data will always be a draw back.	The abalone permit report card assessment is only used to identify potential problem sites. No closure provisions depend solely on card data. Despite flaws, abalone permit report card data and TAC calculations are much better than previous monitoring efforts. Card data covers many more sites than just the eight creel sites. The Department needs to develop better methods of monitoring and regulating abalone catch. TACs are widely used in other fisheries including abalone fisheries. Tags are a method of easily identifying legally taken abalone which has the support of divers as well as biologists and wardens.	No	
C-83	9.3.1.1 Table 9-3 These costs seem extraordinarily high. How can we double-check and be sure increases are not being to [*sic*] precautionary? How can enforcement of abalone alone have such costs? And or is it not true that these standard costs are for multiple ocean species? What controls on spending are there?	The costs in Table 9-3 are based on current budget tables and there is no precautionary inflation of estimates. Wardens patrolling northern California dedicate a significant amount of their time enforcing abalone sport fishing regulations. The wardens' daily record, the time spent on abalone enforcement, and their average salary are calculated in determining the cost of abalone enforcement. A summary of enforcement costs is shown in Section 9.3.1.2. Spending is controlled by an annual budget process along with all other State spending.	No	

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C-84	9.3.2 How can long term costs even be a factor with no fishing or no management of abalone allowed south of San Francisco? Commercial landing tax could fund a great deal of F&G. And give managers incentives to try and allow more fish to be landed, as was before.	Past commercial landing taxes on abalone have not come close to covering costs for monitoring the fishery. The peer review committee criticized the concept of managers depending upon landing taxes because it can create a conflict of interest in which managers would be reluctant to reduce catch since it would affect revenue.	No	
C-85	Appendix A If the F&G was given authority to regulate commercial abalone harvest since 1939, what happened? Mismanagement? W.S.? Aquaculture?	Appendix A is a summary of abalone regulations and is not meant to discuss the results of the regulations. The Fish and Game Commission was given authority to regulate the commercial abalone fishery in 1939, not the Department. In enacting its moratorium, the Legislature noted that abalone numbers all along the coast have declined drastically since the early 1970s, and attributed the decline to commercial take, a growing market demand, expanding sport fisheries, growing sea otter populations, pollution, loss of kelp beds, El Niño, and disease.	No	
C-86	Appendix B How does [*sic*] someone, a Californian, able to share in abalone resource if they do not dive or have someone willing to give up catch? Not willing to eat aquaculture products? How does [*sic*] this public resource that is renewable with no by-catch able to be available all Californians? Contradictions and hypocrisy.	Abalone, like deer and other sport fish and game, are not equally accessible to all members of the public. Commercializing these species can increase the threat to their populations by increasing the numbers caught. If a commercial fishery were re-opened, abalone would be very costly, and thus probably not equally accessible to all Californians.	No	
C-87	Appendix B (con't) How can adequate funding be achieved without commercial landing taxes? Why not let all Californians share in cost of studying, monitoring by allowing them to buy at markeys [*sic*] and restaurants? B.3.3 Commercial? What are the benefits?	Increased revenue from a commercial abalone fishery would not offset the added expenses for monitoring and enforcement that would be incurred if the fishery was re-opened.	No	
C-88	Appendix C F.G.C. section 5522(a)(6)? What is it? Why not tell us? Confusing cross reference?	FGC Section 5522(a)(6) is a summary. The details are in the three sub-sections which follow, 5522(a)(6)(A), (B), and (C).	No	

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C-89	Appendix D Farallones left out. Why? Most prolific abalone population on earth. What about 1850-1950? Northern area harvested with no ill effects. Commercial harvest north of San Francisco for many years, why not now?	The Farallon Islands are included. Recent Department ROV surveys at the Farallons, covering waters as shallow as 15 feet, did not find substantial numbers of red abalone in areas recommended by former commercial abalone fishermen. Legal commercial abalone harvest in northern California only occurred from 1942 to 1945 and was too small in scale to damage population levels. See response to written comment W-3, C-28.	No	
C-90	Appendix E Appendix is questioned on its reliability, honesty, and accuracy. Some of this [*sic*] manufactured, misleading, biased, and opinionated. Surveys are admittedly skewed and not rational or prudent.	All surveys methods have limitations; however, the proposed methods for the ARMP were found to be acceptable by the peer review panel.	No	
C-91	Appendix G Fort Bragg Meeting My comments are not correct or complete. This is how you mislead the public and show lack of honesty. In 1997 F&G had an abalone document put out and begged for comments. I produced comments for 45 day time limit. Title Calamity Californian as a response. No answers ever given. I also stated if F&G would answer past questions, we would no longer have to keep asking the questions over and over. Not that no more public meetings needed. None of the verbal comments on genetic problems are included and none on the origin of W.S.? nothing mentioned about written comments.	Appendix G is a summary and the Department endeavors to correctly capture all relevant comments. The 1997 document and comments related to it were superceded by the 1997 legislation which mandated the ARMP. Comments on WS were summarized and included in the text in Section G.2.1.1 and in table G-1. Comments on genetics problems will be added to Table G-1. See responses to written comments W-3, C-18 and C-48. Written comments are summarized in Section G.2.4, Table G-1.	Yes	Table G-1 amended
C-92	Santa Barbara Town Meeting Once again, F&G is not being honest about the meeting. None of my concerns about size limits or genetics are included. No where does it state anything about written comments, even though others are fully credited for theirs.	Appendix G is a summary and the Department endeavors to correctly capture all relevant comments. All written comments were summarized into categories in the Comment column table (Table G-1). Summary of concerns of size limits were addressed in Table G-1. Genetics comments will be added to the table.	Yes	Table G-1
C-93	Appendix F What? Where are the Peer Review comments? According to Fred Wendell, they are subtle and incorporated into the document.	The latest draft of the ARMP incorporates the peer review panel comments. A summary of comments and the Department response to the comments was submitted to the Commission.	No	

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C-94	Appendix G My comments are not complete nor are my written comments included. Some of the most important about W.S., Sabellid Worm, genetics, etc: How much money has been spent on study of abalone? Where is the worth or value of these expenditures and so called research? Where did W.S. come from? Was it outplanted with hatchery reared hybrids, artificially spawned for the scheme of 'Ocean Ranching'? We know that some mysteries of the ocean will never be understood if we keep grant money flowing. Grants have created much condemnation. Genetics? Is it not true that when to much genetic diversity is present, nature tends to cleanse or purify itself by mass mortality of introduced or all such hybrids? And why will F&G not consider or recognize this? It is not nice to fool with mother nature. Outplanting of abalone, hatchery reared, hybrid or artificially spawned is the reason for lack of recruitment of young. Why are these not included?	Appendix G is a summary and the Department endeavors to correctly capture all relevant comments. All other comments have been addressed in written comments W-3.	No	
W-4: Richard Pogre				
C-1	Section 7.2 Research Protocols – Managing a Sustainable Fishery What I find most disturbing about this section is that it is an attempt to displace the commercial abalone divers from the North Central coast. This dive fishery that has existed for close to a century and as of its closure had maintained consistent landings. To address the monitoring of the fishery we had divers provided landing tickets providing numbers taken and area of take. This provided current information of the abalone resource. These records provided information that we had consistent landings through the years. (*cont*.)	This section inadvertently retained parts of an earlier draft of the ARMP which proposed that if the central California region was re-opened, it would be managed similarly to the northern region with no commercial or SCUBA catch of abalone. This proposal was changed in a later draft ARMP to manage central California similarly to southern California in recognition that this would be a controversial management decision that required detailed discussion. Landing records are inadequate indicators of the health of a fishery and cannot be the sole basis for reopening San Mateo or the Farallon Islands to fishing.	Yes	Section 7.2 amended

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	The Farallon Islands have maintained a sustainable abalone population with little or no take from the sport divers and to open it to only sport diving would only prove that this section is tainted towards removing commercial divers from there rightful place in the abalone fishery. This section is not acceptable to the commercial divers of the San Mateo County Coast. It serves no purpose except to displace working people for the benefit of a special a interest group. If landing records were use today as a gauge the San Mateo coast and Farallon Islands a fishery could be reopened soon after the ARMP was implemented.			
C-2	The ARMP seems to incorporate a number of assumptions or presumptions by some of the Plan's authors that are incorrect. The Plan set a standard for the State based on the premise that all of the State waters are the same. It does not strongly recognize that some areas are highly impacted by pollution and human population density. It recognizes the impact of sea otters on the remaining abalone resources but takes no position on failure to contain sea otters north of Point Conception.	Because this is a data-poor situation, interim management treats large portions of California's coast as one entity. More data is needed to be able to manage resource recovery on a finer scale which considers the different nuances of each part of the coast. The USFWS has authority over the management of sea otters. However we do recognize the incompatibility of having sea otters and an abundant invertebrate resource for fishery use.	No	
C-3	The Plan seems to address harvesting limits for human consumption only, even though size and bag limits exist. The Plan sets a double standard as to acceptable population density in and out of the sea otter zones.	The plan addresses and directs the human utilization of the abalone resource through size, bag, and season limits. The plan uses emergent abalone density as a criterion in the recovery and management of the abalone resource. Within the sea otter range this density is essentially zero because of otter predation. Abalone densities in otter-occupied areas are cryptic. Thus there is no double standard. Cryptic populations within the otter range are not sufficient to support a fishery.	No	
C-4	The Plan fails to justify density numbers for recruitment and fails on its own assumption in Northern California, with lack of recruitment even with abalone density numbers sited as at optimum levels. [lowering of sport limit to 3].	Recruitment data is derived from the four index sites' size frequency information. We recognize the need for more of this type of data from more sites. Currently the amount of resources and funding limits our ability to collect this additional data and therefore our management scheme must be precautionary.	No	

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C-5	Statements are made that show little knowledge of current abalone habitat and populations. False information is incorporated into the Plan, which could be mistaken as factual if one had know [*sic*] prior knowledge of the subject.	Response to this comment is not possible without specific reference to the supposed "false information" in the plan.	No	
C-6	Commercial landing records exist with block numbers showing exactly where abalone habitats exist and the number harvested in previous years. Plan authors fail to use this information to deny that sustainable populations exist and have been harvested for decades. [San Mateo County Coast, Farrallon Islands] This seems to me as an attempt to deny commercial access to the abalone resource. A.B 229 [Burton] was the first attempt to curtail commercial diving. It was brought about by a group of self-serving sport divers and failed because it had no merit. S.B. 223 [Thompson] later incorporated Southern California into politically motivated legislation and the sport and commercial fishery was closed south of San Francisco.	Reliance on fishery-dependent data, such as landing receipts, is a poor indicator of stock health. The ARMP is based on a mixture of both dependent and independent fishery data to derive management and recovery criteria. Having two sources of data provides a more accurate picture of the health of the resource.	No	
C-7	I believe that the ARMP has to many implanted bias to be a fair overview of the abalone fishery in California.	The draft ARMP has been independently peer reviewed by a panel of scientists coordinated by California Sea Grant independently of the Department.	No	
C-8	The Plan should be reviewed by a [*sic*] unbiased arbitrator, who will review all aspects impacting the abalone marine resource. Some of which would be: geographical, political, human population density, pollution, sea otter perdition, reasonable sustainable densities, and social-economic impact, only then would we get a fair overview of the fishery and its future.	The ARMP is not a fishery management plan; it is a plan to guide the recovery of a seriously imperiled marine resource which, if successful, might sometime in the future be able to sustain a fishery. See response to W-5, C-6.	No	

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-9	As of this time the ARMP has shown little change since introduced to the public. It is still fragmented, biased and lacks the common sense approach to good resource management. Too many people are pushing their own agenda. This is why I feel that an outside arbitrator should be used to level the playing field.	See response to W-5, C-6.	No	
W-6: Richard Vannelli				
C-1	…The problem has been exacerbated substantially in the last 10 years or so with the large increase in Asian abalone fishermen. I have seen, and continue to see, entire families of Asians…both hand picking and boating/diving for abalone along the coast … with bags full of abalone of all sizes…In my opinion, the problem is not with the honest people who love the sport, buy their stamps and pay their fees. The problem is with the poacher – those who have no regard for the abalone, those who wipe out entire beaches for monetary gain. If you penalize the honest fishermen too much by reducing the limit, to the point where it will not be worth their while to even make the trip, then you may ultimately be reducing the money generated through license fees and stamp purchases – money desperately needed to protect the abalone. Most poachers, especial [*sic*] the type I mentioned, don't buy fishing licenses or abalone stamps.	The legal catch of abalone indicated on abalone permit report cards is still substantial and rivals the higher levels of the commercial catch. There are not enough wardens to monitor all recreational fishing activities in northern California. The public can be of enormous help by notifying the Department of any violations by calling (888) 334-2258 or (916) 358-1300.	No	
C-2	Do not reduce the limit below the present limit of 3 abalone	Although the Department will try to avoid recommending further reductions in bag limits to the Commission, such reductions are more effective at reducing total catch than changes in annual limits or seasons.	No	
C-3	Shorten the Abalone Season to May and June, August and September	A shorter season would not necessarily reduce the amount of abalone taken if it only concentrates the effort in the remaining months. Businesses based on abalone fishing-related tourism along the northern California coast would suffer with additional closed months.	No	

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-4	Raise the price of the Abalone Stamp to $25.00	The price of an abalone permit report card was increased this year from $12.00 to $15.00 along with an increase in fishing license fees. An increase to $25.00 could cause an overall decrease in revenues and a large amount of negative publicity if a significant number of abalone fishermen believe the increase fees are excessive.	No	
C-5	All monies generated from Abalone Stamps to be used by CDFG on Abalone and Game wardens – 2 full time men and 2 full time women. The money would NOT go into the general fund	Funds generated from abalone permit report card sales go to a dedicated account within the Fish and Game Preservation Fund and do not go into the general fund.	No	
C-6	An alternative license would be $100 to $150 license fees, 4 abalone limit per day, 24 per season, and 8 in possession. This would help busy people who can only go a few times per season, but can afford to pay more money.	The addition of a separate, more expensive card would be complicated to administer, and might create a more privileged class of fishermen based on ability to pay, which would be difficult to justify.	No	
W-7: Harry Vogl				
C-1	At the special Fish & Game Commission meeting held April 20, 2004 …Commissioner Flores proposed a management plan for a very limited fishery. In that plan, it was recommended that the fishery be opened to only 15 permits…to be distributed on a lottery basis. Each and every owner of a commercial abalone transferable permit was financially impacted when the fishery was brought to a sudden closure in 1997…I believe it is unfair to the fleet as a whole to leave out any permit holder at the time of the closure. I believe all permit holders when the closure began should be re-issued a permit. Each permit holder can then decide to share the TAC, no matter how small a bag limit, or decide not to fish of turn in the permit [*sic*].	Commissioner Flores' proposal was for discussion purposes only; it was not an agenda item or voted on, and so cannot be considered a formal management plan for re-opening the fishery. These comments will be taken into consideration when plans are made for reopening a fishery.	No	

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
W-8: Donald R. Gilbert, CEO Maritech Ocean Ranching				
C-1	Since the beginning of life, species are shaped by environmental pressures. For our cultured animals and plants we choose the biggest and best and breed them with the biggest and best to obtain a superior offspring; a process called selective breeding. When man places a minimum size limit on the harvest of an animal such as abalone it induces an environmental pressure for the animal to never attain that legal size or to grow real slow. The gene characteristic for fast growing animals is rapidly removed from the broodstock.	The concerns expressed have some basis in theory but there is no proof that size limits actually result in stunted populations. The long lifespan of abalone would make them less vulnerable to such selection and the selective pressures that encourage quick growth are not known.	No	
C-2	…abalone will not naturally sustain the significant harvesting that man can accomplish. The Maritech Ocean Ranching aquaculture project is an alternative to the recovery of abalone populations rather than the decades of time nature will take.	Out-planting operations in southern California were found to be uneconomical due to the small numbers of survivors. The value of an ocean ranching operation in speeding recovery of abalone populations is unknown.	No	
W-9: Richard Pogre				
C-1	I would like to propose that the area known as North Central California, San Francisco county coastline including the Farallon Islands, San Mateo county coastline to Pigeon Point be made a “Commercial Only” area for the harvesting of abalone. I believe that the area would gain no economic advantage by reopening the area for sport divers. It would help curtail sport poaching in the area, by restricting access (which means) less enforcement would have to be on hand. A commercial only abalone area would provide a much needed access to the retail fish market which would diminish the illegal trade that is out of control.	These comments will be considered when the Department determines that the resource has recovered to the point where it can support a sustainable commercial fishery.	No	

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
W-10: Richard Pogre (letter to Governor Schwarzenegger)				
C-1	A management plan for a sustatinable fishery has been developing for seven years with no real results in sight. California Department of Fish and Game has made little progress and is in my opinion biased against the commercial taking of red abalone, since only sport fishing is allowed. I consider this unfair.	The northern California sport fishery for red abalone and the closure of all fisheries below San Francisco is the result of legislative action. The Department is not biased against commercial abalone fishing. The southern and central California commercial and recreational fisheries were closed because the stocks of all the abalones, not just red, were depleted. Landings had fallen to less than 10 percent of historic landings. The depletion was a result of several factors, including excessive take, sea otter expansion, disease, and pollution. In contrast, the northern fishery remained open because most of those factors affecting the southern and central resource did not impact northern California.		
C-2	… please give the commercial abalone divers access to an unbiased arbitrator to look at all the facts and information and to render a decision as to our ability to harvest abalone at a sustainable level now. At this time the position of the California Department of Fish and Game is to deny the commercial harvest of abalone, this denies equal public access to a historical sport and commercial fishery that belongs to all Californians.	The ARMP was submitted to the Commission in 2002. The process for preparing this document included consultation with representatives of the commercial, recreational, and conservation communities, followed by external scientific peer review. Such review is the normal method of assuring that the plan is appropriately scientifically based and unbiased.		

Abalone Recovery and Management Plan Email Comments				
Writer/ Comment Number	**Comment**	**Department Response**	**Revision Needed?**	**Revised Section**
Email-1: Jim Marshall				
C-1	We've been studying the ARMP in light of the new sections and we've noticed some disconnects. The amendment to Alternitive 1 that we submitted contains two phases. First, it presents options for monitoring/research. These suggestions for monitoring/research should be included in Chapter 6, 7. and 9 where discussion of monitoring/research is placed. Those sections of those chapters which contain descriptions of research both funded and unfunded are the proper place for discussion of our suggestions concerning gathering of data. Second, the amendment contains options for a future fishery that properly belong where it has been placed (Chapter 7) in the document. Our concern is that if consideration of these monitoring suggestions is tied to approval of a fishery they would not be considered until such approval.	To incorporate the changes into the document as suggested would cause confusion. Our strategy of monitoring/research (m/r), in the ARMP provides a general guideline for how we would like to proceed with m/r through recovery and management. This approach will allow flexibility in how the m/r is accomplished, and gives us the ability to change and develop more efficient ways of doing m/r as recovery continues. We would then be able to incorporate other parallel m/r programs or ideas (such as proposed) into the overall program for recovery without having to constantly amend the document. Your m/r proposal is captured in the document, and there is nothing that prevents us or you from moving forward on implementing it at any time. The key element here is to work together in planning and coordination so that we are not duplicating work but rather doing complimentary m/r that builds upon our goal of recovery.	No	
Email-2: Jim Marshall				
C-1	The descriptions of research, past, present, and future, in the ARMP are cryptic. Everyone might be better served if this information were brought together in one chapter as is outlined in the MLMA Master Plan for the development of FMPs. I find the sample Table of Contents of an FMP at www.CDFG.ca.gov/mrd/masterplan/appendix_b.pdf to be lucid. Access to research protocols and proposals for future work would be a straightforward process if this outline were followed. In it's present form, the ARMP is anything but straightforward in this respect.	Biologists writing the ARMP considered the Master Plan Appendix B format when writing the Research Protocols section and chose to go in a different direction for Chapter 7. Although titled Research Protocols, Chapter 7 of Appendix B had many sections which did not really come under the topic of research protocols. The chapter title was changed to Abalone Management which seemed to be a better description of the sections and a section for research protocols was kept in the chapter. The research protocols section had been much larger with descriptions of many research options but was subsequently edited down to what was relevant to the ARMP. The decision was made to keep the document brief and not include an extensive discussion of all research protocol options. Chapter 7 of Appendix B was not lucid to (*cont.*)	No	

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
		Department biologists because it muddled the definition of research protocol which they believe is much narrower than indicated in that outline.		
Email-3: Jim Marshall				
C-1	Section 7.2.6. of the ARMP was not changed to reflect the following comments made previously on ARMP section 7.2.6 Collaborative Research Efforts: This section ignores a whole area of collaborative research; collaboration with fishermen. The knowledge and experience of fishers can streamline and enhance project designs and implementations. Such collaborations are called for by FG Code 7060(c). Clearly, “collaboration” means more than the inter-agency collaboration described here. This section should include a discussion of “collaborative” efforts focusing on using fisher[1]s ecological knowledge (FEK) (Johannes et al, Fish and Fisheries, 2000, 1, 257-271.) Is the subject dealt with elsewhere in the Plan? If so, where?	The comment was interpreted as pertaining to recovery assessment, since it would be directly applicable to recovery first and then apply to the collaborative research for managing a sustainable fishery in the future (Section 7.2.6). The response given in Appendix G was to refer to Section 6.4.1, which deals with the periodic assessment of abalone and essential habitat during recovery. The second paragraph captures the comment of collaborative research.	No	
Email-4: Jim Marshall				
C-1	FGC 5522 says; "The plan shall contain all of the following:" 5522(a)(3) says, "Alternatives for allocating harvest between sport and commercial divers if the allocation of the abalone harvest is warranted." The law does not say that if harvest is warranted then allocation alternatives may be developed. It says that alternatives for allocation shall be included in the plan. If ever harvest is warranted a decision would be made using alternatives presented in the plan. (*cont.*)	The plain meaning of FGC Section 5522(a)(3) is that the identification of allocation alternatives is dependent on, and subject to, the Department’s determination that allocation is warranted. However, no allocation can be warranted unless there is a fishery, and the fishery cannot be re-opened unless the Department first makes a determination, based on substantial evidence on the record, that the resource can support a biologically sustainable fishery. Including an allocation recommendation with alternatives in the ARMP at this time would greatly restrict options in the future when the allocation needs would be better understood.	No	

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
	This issue has been sidestepped by saying, "Ultimately,resource allocation is a political decision that can most readily be addressed when stocks have recovered and the number of potential users is known." The Department is not asked to make a decision, it is asked to include alternatives. Though this issue is fraught with political overtones that does not release the Department from including allocation alternatives in the Plan as is called for by 5522(a)(3).			
Email-5: Jim Marshall				
C-1	In Section 7.2., a section that ostensibly deals with Research Protocols -Managing a Sustainable Fishery, there is the following statement. "The recommendation of moving the northern fishery boundary to Point Año Nuevo, including the Farallon Islands and the San Mateo County coast, will necessitate monitoring this area for recovery to a sport-only, no-SCUBA fishery." I find this rather odd, as it is mentioned no where else in the plan that I am able to see, and in light of the Department's stance in the previous paragraph's discussion of the political nature of resource allocation. If a fishery is warranted in this area then a discussion of allocation is also warranted as per 5522(a)(3). As per that statute, the Department is asked to include alternatives for allocation of any reopened area not make an arbitrary decision as to such allocation. Is the recommendation an alternative? If so, why isn't it included in section 7.3, Management Alternatives? Or is it part of the preferred alternative? If such a recommendation is preferred/sought will it not neccesitate CEQA protocol? (*cont*.)	This section will be amended. It was incorrectly retained from an earlier draft of the ARMP which contained a paragraph in Section 7.1.4.3 proposing that if the central California region was re-opened, it would be managed similarly to the northern region with no commercial or SCUBA catch of abalone. This proposal was changed in a later draft ARMP to manage central California similarly to southern California in recognition that this would be a controversial management decision that required detailed discussion. Also see response to W-4, C-1 above.	Yes	Section 7.2

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
	I would not like to see the agenda of the northern sportsmen carried forth in such a manner i.e. one sentence buried in an appearantly unrelated section of a document over 100 pages long.			
Email-6: Jim Marshall				
C-1	Speaking directly to this issue (fulfilling the ideal of "adaptive management" as defined in the MLMA), I quote the ARMP which says on page 4-3, 4.2.3 Marine Life Management Act (MLMA) The MLMA was signed into law and incorporated into the FGC (§7050 to §7090) in January, 1999. The act created state policies, goals, and objectives to govern the conservation, sustainable use and restoration of California[1]s marine living resources. Although many of these have been incorporated into the ARMP, the ARMP is mandated by legislation that preceded the MLMA, and has different goals and objectives from the MLMA. Because the ARMP is not intended to be a fishery management plan (FMP), it is not subject to the MLMA provisions governing the preparation of FMPs. This section reflects the Department[1]s legal opinion that the ARMP [3]has different goals and objectives[2] from an FMP that would be created under the MLMA. As the ARMP certainly deals with the [3]conservation, sustainable use and restoration of California[1]s marine living resources.[2] , I ask how can this be so? Further, exception must be taken with the contention that [3]the ARMP is not intended to be a fishery management plan (FMP)[2]. Chapter 7 of the ARMP is titled Abalone Management, section 7.1 is called Fishery Management Plan and deals with management of the existing fishery in Northern California as well as plans (*cont*.)	The ARMP and an FMP have different goals and objectives. One objective of the MLMA is to achieve the primary fishery management goal of sustainability. *Fishery* means "fishing for or harvesting marine fish populations." *Sustainability* addresses continuous replacement of resources and taking in a fishery that does not exceed optimum yield. The term *yield* is not expressly defined in the MLMA, but its use in the context of maximum sustainable yield and optimum yield are consistent with the plain dictionary usage of production from a natural resource. Thus, each of these concepts in some way contemplates an ongoing "take" of fish. By contrast, the abalone statute addresses the recovery of a resource recognized as imperiled, not the management of a sustainable fishery. Indeed, the imposition of the moratorium is prima facie evidence that the abalone resource is not sustainable. If "take" is integral to the MLMA but is expressly prohibited by the abalone statute, then the resource cannot reasonably be considered a fishery for MLMA management purposes. The ARMP and an FMP also have different content requirements. The MLMA identifies five general subjects that must be included in an FMP: fishing statistics, natural history, habitat, ecosystem role, and economic/social factors. The ARMP, while covering some similar subjects, emphasizes "interim and long-term recovery goals," makes provisions for the "review and amendment of the [recovery] strategy," and describes "objective measurable criteria by which to determine whether the goals and objectives of the recovery strategy are being met and procedures for recognition of successful recovery." This express emphasis on recovery indicates that what is being presently managed is basic health of the resource, not the fishery that results from a healthy (e.g. sustainable) resource.	No	

	for reopening other fisheries if and when restoration occurs. If the ARMP is not a fishery management plan, then what is it? I suggest that the Commission, upon adoption of the ARMP, acknowledge that the ARMP is indeed a fishery management plan and that future actions concerning it be carried out under MLMA guidelines dealing with FMPs.			

Abalone Recovery and Management Plan, Fish and Game Commissioner Comments				
Writer/ Comment Number	**Comment**	**Department Response**	**Revision Needed?**	**Revised Section**
Commissioner Michael Flores				
C-1	We ought to be assessing other sites to be able to get a good read on the entire population. We ought to think about spreading out and taking a look at some other sites. Basically your methodology is to assess a few heavily fished sites and then extrapolate your results to the rest of the population and make your decisions based on that. This doesn't sound reasonable unless you are incorporating other sites that are less harvested. In other words you are not getting a good read of what the real population is out there. What you are doing is studying areas that are heavily harvested. In the mean time there may be a large amount of abalone outside of those studied sites. I think what the public's concern was that we are looking at four sites that are heavily harvested, but outside of those sites there is a tremendous amount of resource that is available. So when we talk about shutting down we are basing it on those popular areas that are in trouble. There are other areas out there that may be still ok for fishing. We need to get a truer assessment of what is out there.	One of the great drawbacks to relying on fishery-dependent information is that abundant catch can lead to the incorrect assumption of continuing abundant reserves. Thus, the rate of harvest continues until the fishery is overfished. Fishery management in a data-poor situation such as this must recognize that a precautionary approach is best. The Department recognizes that survey data about the red abalone resource is limited both spatially (number of areas surveyed) and temporally (the frequency of the surveys). The fact that surveys are conducted in specific heavy-use areas is a matter of concern. This situation was addressed in the ARMP by addressing the absence of broad scale data along the northern California coast in a precautionary way. In a data poor situation, a high level of precaution must be taken to protect the resource. If more sites were to be established, there would be more and better information upon which to make decisions about the resource, and adjustments would not have to be as severe. The reason for the absence of relevant and sufficient data to manage the abalone fishery is funding and manpower, a lack which is often magnified by the remoteness and often severe conditions along the northern California coast. However, the issue of not having enough fishery index sites to adequately assess the entire fishery stock in more detail is important. Four additional, moderately used fishing sites will be added to the four existing index sites for assessment. Because of funding and manpower issues, these additional sites will be used if additional funds and resources are available to conduct the surveys.	Yes	Section 7.1.2.2 Index Sites, revised

Writer/ Comment Number	Comment	Department Response	Revision Needed?	Revised Section
C-2	We should be more inclusive in the data gathering process. We should let some of these dive clubs and public help out with gathering some of this data. This would make the process more transparent so that the public sees what you are saying is true.	The abalone team has been inclusive in collecting data about the north coast abalone fishery. Past efforts have included the contracting of dive surveys to Universities, i.e., Humboldt State and UC Davis. Efforts have also included commercial abalone and urchin divers to conduct surveys. Problems arise in using non-scientifically trained personnel to conduct surveys, which necessarily require specific scientific protocols to obtain valid data. Generally, data collected by non-scientists is not well received by peer review. Volunteers are used to collect data where they can be supervised by scientific staff or where data collected is straightforward, i.e., creel censuses. The use of volunteers in abalone surveys is complicated by the inability of untrained volunteers to dive under the auspices of scientific divers (as buddies), because of the lack of scientific diving certification, and Departmental liability. Data needs to be collected in a scientific manner using specific guidelines. It is the job of the scientist to conduct resource surveys in a systematic manner acceptable to the scientific community. The public is certainly interested in the data, and often want to be involved in its collection, until the necessary rigor becomes evident. The public does participate by the purchase of abalone stamps and licenses, and should be commended for supporting the abalone permit report card. The data collected is summarized at Recreational Abalone Advisory Committee meetings and eventually published in scientific journals.	No	

Appendix H. Proposed Amendment to Alternative 1 in the ARMP as submitted by Abalone Commercial Constituents to the Fish and Game Commission

H.1 An Amendment to the Abalone Recovery and Management Plan's Alternative 1

H.1.1 Introduction

California Department of Fish and Game (CDFG) biologists have the responsibility of managing the state's spatially complex abalone populations. Due to minimal financial resources, collecting the data necessary for successful management makes their task impossible. Other than by continued closure, the framework for management proposed in the Abalone Recovery and Management Plan (ARMP) will be unable to address the challenge of assessing and managing Southern California's spatially intricate renewable abalone resource.

There is an opportunity to manage red abalone stocks at San Miguel Island (SMI) with an experimental fishery modeled after a successful program in Australia. In Western Australia, Cape Leeuwin abalone divers rehabilitated an area of approximately 1,500 hectares and have raised their Total Allowable Catch (TAC) from 7 tons to 30 tons. This program shows what can be done by fishers if proper incentives for the fishers are in place. This program is described by Dr. Jeremy Prince in *Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management* 1998, and *The Bare-foot Ecologist's Toolbox*, 2001.

Prince's published findings on the Western Australian success show what might be done at San Miguel Island in the Northern Channel Islands. He refers to "Tyranny of Scale" in his papers on optimizing Australia's abalone management. This term describes the mistake of managing discrete stocks sometimes comprised of less than a square mile with management strategies applied over a scale of hundreds of miles. A "Tyranny of Scale" operates in California's abalone management today with continued area depletions occurring within a management zone comprising half the state. Unfortunately, the Abalone Recovery and Management Plan (ARMP) and a lack of funding will perpetuate this "tyranny."

The information to micro-manage the Channel Island abalone stocks is available and can be gathered from and by the fisher/divers who formerly harvested abalone in this area. These fishers, many of whom are still diving the area for sea urchins, have intimate knowledge of SMI; the reefs, habitats and habits of red abalone, including biology, spawning, and the effects of temperature and food availability. This information has not been accessed and made available to managers.

As has been shown at Cape Leeuwin, it is economically feasible to manage abalone populations intensively. While the intensive assessment needed to manage SMI is beyond the level of resources available to CDFG biologists, the infrastructure (boats, equipment, and divers) required for such assessment is already in place and used daily by the diver/fishers.

H.1.2 Proposal

Initially, the index sites called for in the Abalone Recovery and Management Plan (ARMP) would be placed at SMI. The monitoring sites at SMI would be installed by the California Abalone Association (CAA) using Abalone Resources Restoration and Enhancement Program funds administered by the Director's Abalone Advisory Committee (DAAC). These sites would conform to National Park Service Kelp Forest Monitoring (NPS KFM) and CAA site already in place and follow the KFM Handbook data gathering protocols. Sites would be chosen by CAA divers to reflect areas of good abalone habitat. Additionally, these sites would be chosen from areas that were formally "heavily fished." Such "heavily fished" sites are currently being used by CDFG in Northern California to monitor and manage abalone populations. While in Southern California, other than the one SMI CAA site, there are no sites placed specifically for monitoring red abalone.

Data has been gathered at the existing CAA SMI Tyler Bight site as a joint effort between NPS and CAA. Future data gathering efforts for red abalone at SMI from CAA sites would involve collaboration between CDFG biologists and possibly university biologists.

It is proposed that the installation of these monitoring sites be initiated using DAAC funds. In the future, such monitoring sites could also be installed at Santa Rosa Island (SRI) and Santa Cruz Island (SCI). As discussed below in the section on MPAs, these sites would also aid in tracking the efficacy of proposed MPAs and could be placed inside or outside of MPAs to augment existing monitoring sites.

When data indicates that red abalone densities and size frequencies warrant and while continued protection remains in place for all species in all other areas, an experimental Total Allowable Catch (TAC) harvest would be allowed for Red Abalone at SMI.

H.1.3 Discussion

The harvest of red abalone at SMI was consistent over time (Figure 1).

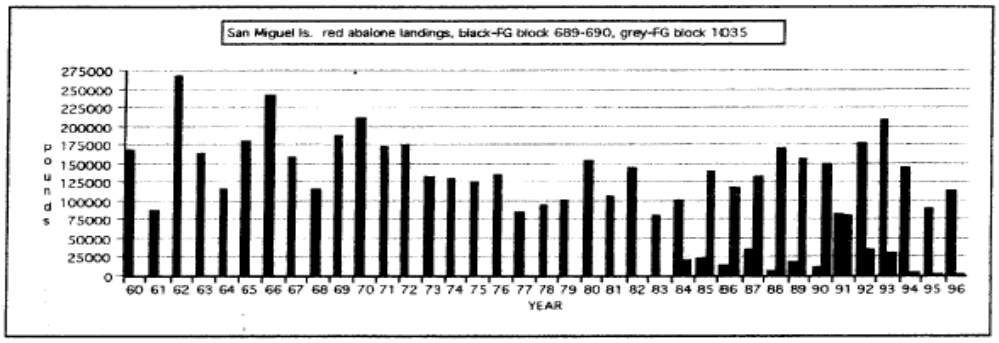
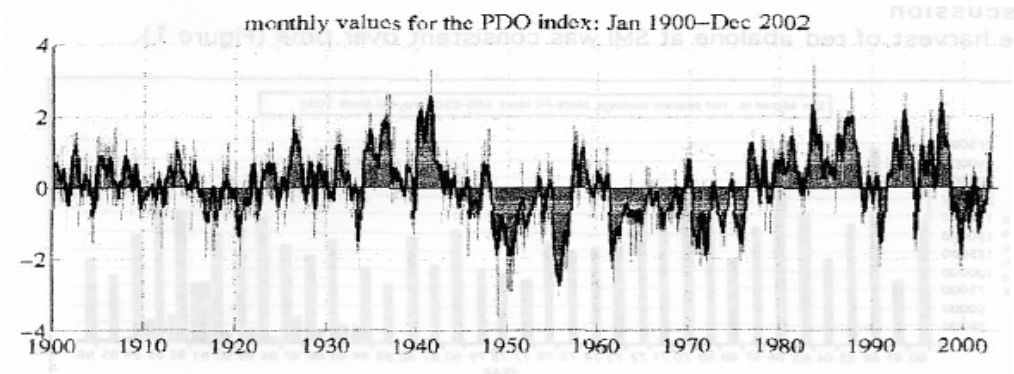


Figure 1

It is postulated that the slower growing abalone at SMI were successfully protected by the 7 ¾ inches (197 mm) commercial size restriction and the exploitation rate which was influenced by many factors. Red abalone

populations at islands to the east of SMI exhibit faster growing characteristics which effectively shortened the time available for breeding opportunities of individual abalone (Prince, personal communication). The remoteness of SMI inhibited added detriment of a large sport take as occurred at the Channel Islands further to the east. SMI was affected less by the onset of Withering Syndrome (WS) which was a major factor in the declines at the eastern Channel Island abalone populations. Those eastern islands experienced warmer water in the 1980's and 1990's which caused subsequent greater loss of food sources for abalone increasing stress, reproductive dysfunction and the occurrence of WS (Tegner et al., 2001).

The Pacific Decadal Oscillation Index, an index of ocean temperature, (Figure 2) correlates with the failure of red abalone stocks at SCI, which occurred after the onset of much warmer ocean temperatures after 1977.



The red abalone population decline at SCI is indicated here in graph of commercial red abalone landings from SCI (Figure 3). These figures demonstrate the inability of red abalone stocks to recover from unrelenting sport and commercial harvest compounded by warm water perturbations.

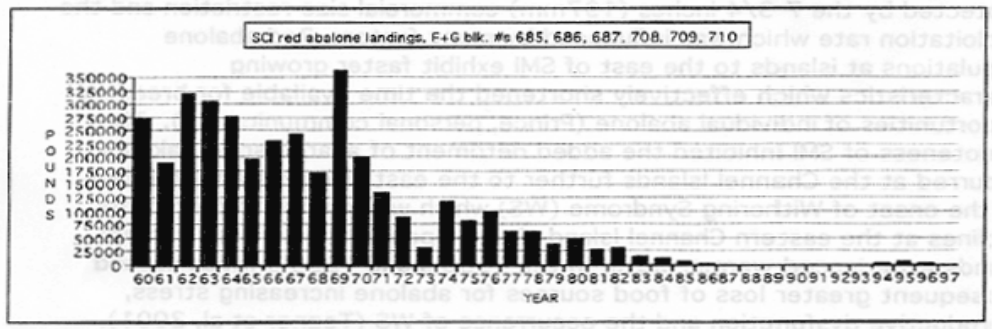


Figure 3

The conditions that drove the failure of stocks at SCI did not occur at SMI. At the time of the closure in 1997, there were still abundant populations of red abalone at SMI and harvest continued until the day the fishery was closed. Colder ocean temperatures since the 1997-1998 El Nino have facilitated recruitment and growth there. The ARMP deems management changes

predicted by population density and size frequency; however at this time there is insufficient data available to manage with confidence, other than with fishery closure.

FG Code 5522(6)(C) stipulates that the ARMP shall contain, "*The reproductive importance of the entire ecosystem of those areas proposed for reopening to harvest and the potential impact of each reopening on the recovery of abalone populations in adjacent areas.*"

The question, "How far can larvae travel?" is of interest to biogeographers and others interested in colonization occurring on geologic time scales. Fishery managers, who should be interested in time scales approximating human life, might better ask, "Where will most of the recruitment occur?" Should a fishery be managed for the minority of individuals and larvae that might travel record distance or should it be managed for the majority that don't travel far at all (Prince 1989)?

The exact reproductive importance of a proposed harvest of 15,000 individuals from an estimated population of 3 million emergent abalone at SMI is difficult to assess. The areas to remain closed adjacent to SMI are a minimum of 3 miles from the island. Prince et al. (1987, 1988) measured larval dispersal of *H. rubra* at less than 50 meters. McShane et al. (1988) concluded recruitment must derive principally from local parents. In a review of abalone ecology (McShane, 1992) considered that wider dispersal was possible. Shepherd et al (1992a) concluded larval transport of *H. laevigata* of hundreds of meters was possible. Tegner (1992) concluded that *H. fulgens* larvae were transported hundreds of meters to kilometers. All of these studies implied local recruitment (Shepherd and Brown, 1993).

Considering the literature cited above and the small percentage of the estimated population harvested, the risk to recruitment and impact on stocks at Santa Rosa Island, Santa Cruz Island, and mainland areas from such a harvest at SMI would be low.

H.1.3.1 San Miguel Island Experimental Red Abalone Fishery

Monitoring

It is proposed that DAAC funds be used to set up permanent abalone monitoring sites at Adams Cover, Castle Rock, and Crook Point. These sites would be consistent with the CAA site at Tyler Bight which was constructed to conform with the NPS Kelp Forest Monitoring sites. While CAA's concern is with abalone, the protocols exist in the NPS KFM Handbook to monitor many species from such sites. Since an MPA has been established at Adams Cove a monitoring site there would be an experimental control that would supply data from an unfished area.

The NPS monitoring site at Hare Rock is within the MPA on the east side of SMI. A monitoring site was proposed for the east side in an area of similar habitat outside MPA boundaries. However, the east side reserve at SMI has taken the whole area so this is not feasible.

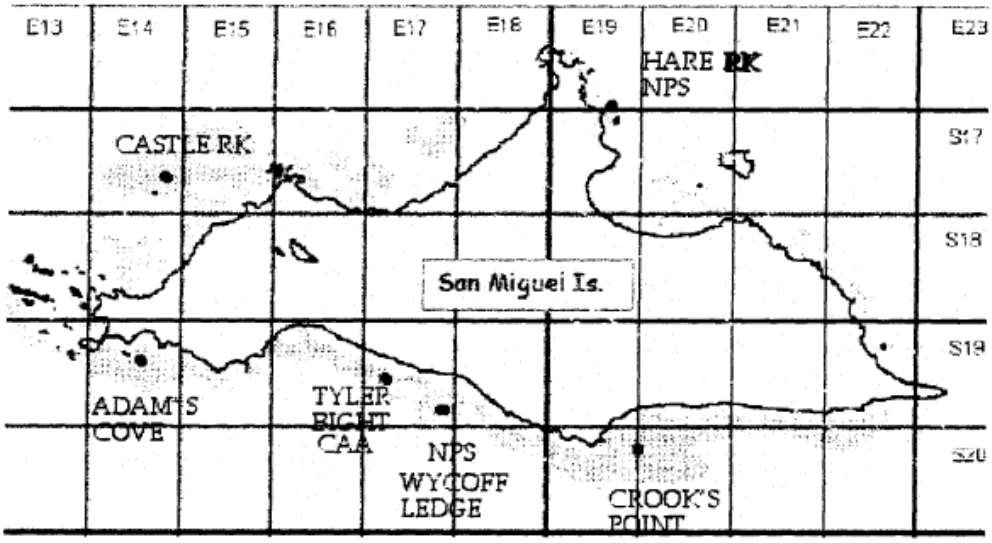


Figure 4. SMI showing maximal extent of surface kelp canopy(stippled area) and existing and proposed monitoring sites. Grid is one nautical mile.

CAA has installed one monitoring site at Tyler Bight (California Abalone Association, 2002). That project showed the ability of fisher/divers to construct such sites at reduced cost and work with NPS divers to collect data over time. The CAA recently assisted in the construction of sites modeled after NPS KFM sites at San Clemente Island for the Navy's environmental monitoring program.

Collaborative Abalone Research Program (CARP)

Index sites at Castle Rock, Adams Cove, Tyler Bight (in place), and Crook Point would be installed by CAA. These sites would anchor the CARP's activities. Monitoring of size frequency and density would be augmented with Artificial Recruitment Modules and other experiments to help answer basic questions concerning aspects of red abalone population structure, habits, and limits.

Experiments including growth/tagging, settlement tracking, and basic oceanographic condition monitoring could be accomplished. Government agencies and academia could use the monitoring sites for their research and would be encouraged to do so. The CAA/DAAC could provide basic logistics and In-Kind support for a wide range of projects.

The CAA has already installed a site at Tyler Bight on SMI. This site is being monitored by the NPS Kelp Forest Monitoring team in conjunction with CAA divers. They recently acquired data for the second year from the site.

It is proposed that the installation of these monitoring sites be initiated using DAAC funds regardless of the decision concerning the proposed experimental fishery. Such monitoring sites should also be installed at Chickasaw Wreck, Santa Rosa Island and Forney's Cove, Santa Cruz Island. As discussed in the section on MPAs, such sites would also aid in tracking the efficacy of MPAs and could be placed inside or outside of MPAs to augment existing monitoring sites.

Management Plan

When densities warrant and while continued protection remains in place for all species in all other areas, a Total Allowable Catch (TAC) harvest would be allowed for Red Abalone at SMI. SMI has been shown to have a viable population able to withstand continued commercial and recreational harvest for *forty-five years*. The commercial fishery at SMI consisted of 125,000 pounds of approximately 32,000 red abalone per year (CDFG conversion rate of 3.75 pounds per red abalone). In the five years since closure an estimated 600,000 pounds or 160,000 abalone have remained unharvested at SMI (see Figure 1).

Size frequency data from SMI indicate 2.5% - 5% of emergent abalone are harvestable using a slot limit of 197mm-203mm (CDFG cruise reports, CAA San Miguel Island Red Abalone Project). A biomass estimate of 3 million emergent abalone indicate a harvestable population of 75,000 to 150,000 abalone in the slot size range of 197mm-203mm.

This alternative would allow a harvest to occur at SMI when data indicates sufficient density. The harvest would be restricted by a TAC. A slot size would be used, i.e. maximum as well as minimum size restriction. Position indicating transponders would be used on all vessels participating in the harvest. Trip plans would be telephonically recorded and logbooks detailing fishing effort would be kept. A method of recording and keeping track of individual fishermen and their contribution to filing the TAC would be styled after the abalone fishery plan for Tasmania where such methods have been in use for many years (Review of the Management Plan of the Tasmanian Abalone Fishery, 1999). A "resource rent" of 10% would be levied on the ex-vessel value of the harvest. These funds would pay not only for the maintenance of the fishery but also for a program of collaborative monitoring and research involving the harvesters.

A portion of the harvest at SMI could be allocated to the sport sector. It could be administered with a special tag sale and reporting system. The sport size limit would be the same as the commercial.

Restarting the fishery will serve to maintain the fishing community, which can help in increasing understanding of the fishery through data collected during harvest and collaborative research sponsored by the "resource rent." The incentive of a restarted fishery will encourage fishermen's participation in the program and invest them with a stake in the outcome of successful abalone fishery management. A restarted fishery will also provide funds to operate the research program necessary to sustainably harvest this valuable resource.

Marine Protected Areas (MPAs)

MPAs for the Channel Islands have been implemented by the Fish and Game Commission. There are two MPAs that will effect abalone populations at SMI. The Judith Rock MPA will enclose the area from Judith Rock to near Point Bennett. This area, which includes Adams Cove, contains prime abalone habitat and former harvest ground. It figured large in the former fishery and continues to show large populations of red abalone. An MPA in this location will meet the MPA objective of protecting representative southern shore SMI habitat and inshore species such as red abalone.

The other MPA at SMI is on the Eastern side. The area of this MPA, while containing some abalone does not enclose large red abalone populations and was not a large factor in the former fishery. NPS Kelp Forest Monitoring data for Hare Rock, a monitoring site which lies within the boundary of the MPA, has never shown emergent red abalone (David Kushner, personal communication).

One of the stated purposes of MPAs is fisheries management. In the case of abalone fishery management the efficacy of no-take areas is questionable. Benthic, sedentary species such as abalone that have little larval dispersal are good candidates for achieving near virgin biomass levels inside reserves. However, they are not likely species for improvement of fishery yields outside reserves through reserve or closed-area management (Parrish, 1999). Nonetheless, these reserves can provide needed data from an unfished area and assurance against population collapse should overfishing occur outside of reserves in a restarted fishery.

Management Measures

Harvesting only the zone comprised of SMI would be assured by the installation of a Position Indicating Transponder (PIT) aboard vessels participating in the fishery. The cost of PITs, their installation and monitoring would be borne by the participants.

Species-specific Considerations

Only red abalone at SMI would be harvested under this plan.

Gear Restriction

Hookah gear would be used by the commercial sector and SCUBA or breath hold by recreationalists. Former restrictions on abalone picking bars would remain.

Size Limits

For both commercial and sport sectors the minimum size would be 7 ¾ inches (197 mm) while the maximum size would be 8 inches (203 mm). Such a "slot size limit" would ensure conservation of both small and large individuals within aggregations, while still allowing harvest.

The reproductive capacity of large abalone is well known. While there may be an issue of fecundity of such large, old abalone it is believed that the presence of large individuals helps create conditions conducive for settlement and recruitment.

Another option for determining harvest size is "concept fishing" as practiced by ab divers in the Cape Leeuwin area of Western Australia. These fishers only harvest abalone that have finished their rapid growth phase (in terms of both shell length and volume), which is judged by shell depth and roundness. The use of such a size index allows more breeding time for individual abalones. The "concept fishers" only harvest an area once a year and refrain from harvesting if the aggregation has not rebuilt since the previous year. They also harvest no more than 30% of an aggregation. They harvest abalone from across

the size range available rather than just taking the largest. These concepts were developed by the fishers themselves and demonstrate the sophistication possible from such home-grown ideas (Prince, 1988).

Seasonal Closures

A three month season in the summer (July, August, and September) would allow for ample time to fill the TAC, facilitate monitoring of the TAC, and allow for an orderly fishery.

Total Allowable Catch, San Miguel Island

There are 3.57 square nautical miles of macrocystis kelp canopy during maximum coverage at SMI. Using maximum kelp canopy as a proxy for rocky substrate and adding another square mile of rocky substrate not covered with *macrocystis* gives 4.57 square nautical miles of red abalone habitat at SMI.

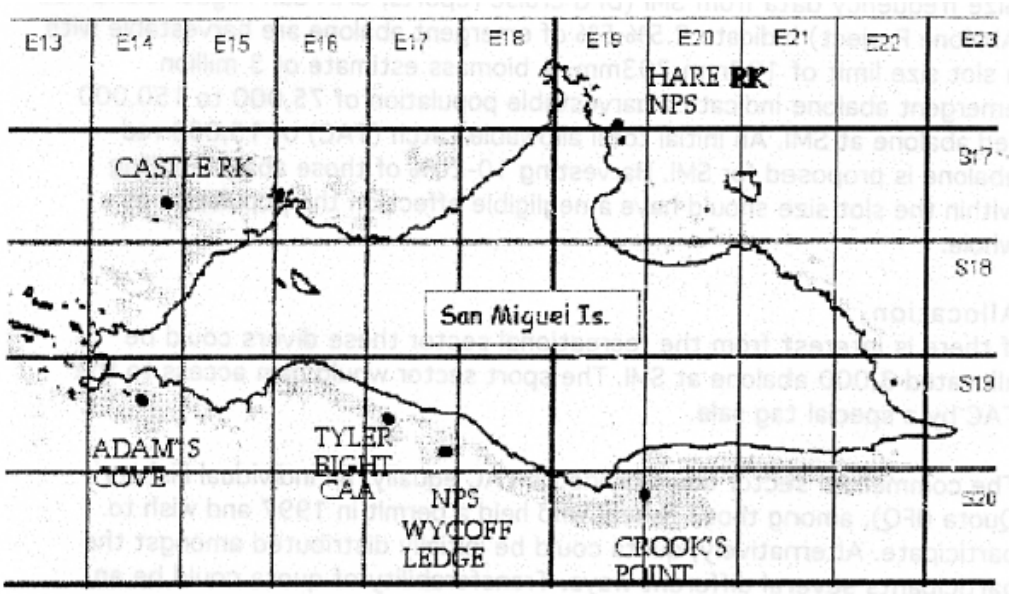


Figure 4. SMI showing maximal extent of surface kelp canopy(stippled area).

The former fishery harvested 20,000 to 35,000 red abalone per year from this area. Data from fishery independent research (CDFG cruise reports, 97-M-5 and 97-M-1) shows 1% of red abalone at SMI were of legal size (193 mm) in early 1997 at the end of the fishery. Landings from SMI in the three months (March, April and May) that were fished in 1997 were 113,000 pounds or 30,000 (3.75 pounds per red abalone, CDFG conversion rate). It should be noted that the assessment cruises made by CDFG in 1997 were accompanied by CAA members and that the areas surveyed were all heavily-fished areas.

The landing records and size frequency data indicate there were 3,000,000 emergent red abalone at SMI in 1997. In the five years since closure approximately 120,000 individual abalone were not harvested. Data from CDFG cruise report, 99-M-5, and Artificial Recruitment Modules at the Tyler Bight monitoring site indicate that recruitment has been occurring. Today 11.6% of

emergent red abalone at SMI are commercial legal size (197 mm) or greater (CDFG cruise report, 01-M-3).

Size frequency data from SMI (CDFG cruise reports, CAA San Miguel Island Red Abalone Project) indicate 2.5%-5% of emergent abalone are harvestable with a slot size limit of 197 – 203 mm. A biomass estimate of 3 million emergent abalone indicate a harvestable population of 75,000 to 150,000 red abalone at SMI. An initial total allowable catch (TAC) of 15,000 red abalone is proposed for SMI. Harvesting 10-20% of those abalone falling within the slot size should have a negligible effect on the population as a whole.

Allocation

If there is interest from the recreational sector these divers could be allocated 3,000 abalone at SMI. The sport sector would gain access to the TAC by a special tag sale.

The commercial sector could divide its TAC equally, an Individual Fishery Quota (IFQ), among those fishers who held a permit in 1997 and wish to participate. Alternatively, quota could be initially distributed amongst the participants several different ways. Transferability of quota could be an added mechanism to reduce the number of participants by allowing consolidation of quota shares if desirable. Harvest rights of some form would be decisive in the success of any future fishery plan by providing the incentives necessary to invest the fishers with a stake in the outcome of successful fishery management. Such issues should be decided by the fishers themselves with government oversight and approval.

Abalone Take Reporting System

Commercial participants would notify CDFG to lodge a recorded phone message of intention to fish before leaving on a fishing trip. Fishers would also report 1-2 hours prior to reaching port/unloading, giving estimated weights and estimated time of arrival. This would make fishers subject to spot checks and would encourage a higher degree of compliance. Logbooks containing information on specific location fished, conditions encountered and time spent diving would be sent to fishery managers within one week. Normal CDFG fish landing tickets, including price paid, would also be required. All red abalone taken commercially at SMI would be landed at Santa Barbara Harbor.

All abalone harvested would have a plastic tag (Scan Systems, Canada) attached upon harvest. Different color tags would be used for commercial and sport catches. The tags would carry a tracking number relating to fisher information. This tag would be attached to the gill hole apertures of the abalone when boated. The tracking number of each tag would be recorded on the commercial fish landing receipt, commercial logbook and sport catch report slips.

Sport sector participants would return report slips issued for each tag detailing area fished, conditions encountered, and time spent making catch within one week.

Resource Rent

Commercial sector - In addition to the 0.0125 cents and 19.5 cents per pound already required on commercial abalone landings (FG Code 8051 and 8051.3), an additional "resource rent" of ten percent of the landed value will be collected. This money would first be used to administer the commercial segment of the fishery. Any funds left over would be deposited in the Fish and Game Preservation Fund and be used in the Abalone Resources Restoration and Enhancement Program defined by FG Code 8051.4.

The estimated ex-vessel price of $60 per abalone would yield $6 per abalone. A commercial catch of 12,000 abs at SMI would produce $72,000 in "rent."

Sport Sector - For any sport sector a flat fee for each tag purchased would be assessed. Any participant would also possess a sport fishing license with abalone stamp. Proceeds from sport sector tag sales would be used to administer the fishery. Funds left after administration costs would be deposited in the Abalone Restoration and Preservation Account within the Fish and Game Preservation Fund and used as defined by FG Code 7149.9.

A similar charge of $6 per abalone would yield $18,000 for administration of tag sale for 3,000 sport-caught red abalone from SMI.

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Glossary of Terms and Abbreviations

Abalone seed - Abalone reared in captivity and ranging in size from a fraction of an inch to several inches. Used primarily for out-planting to recover depleted populations.

Absolute abundance - The total number of abalone in a population. This is rarely known and is typically an estimate.

Abundance - The number of abalone counted or estimated. See *relative* and *absolute abundance*.

Adaptive management - In regard to a marine fishery, it means a scientific policy that seeks to improve management of biological resources, particularly in areas of scientific uncertainty, by viewing program actions as tools for learning. Actions shall be designed so that even if they fail, they will provide useful information for future actions. Monitoring and evaluation shall be emphasized so that the interaction of different elements within the system can be better understood.

Allee effect - A minimum density of abalone spawners is essential for successful broadcast spawning. When densities drop below a critical threshold, spawning success declines, resulting in population declines and even localized extinctions.

Allocation - Dividing the take of a resource between recreational, commercial and ecosystem needs.

Annual limit - The number of abalone that can be legally taken by one person in a year.

Aquaculture - The propagation, cultivation, maintenance and harvest of aquatic plants and animals.

Assessment - A formal study and review of a population based on a standardized method.

Management Authority - The power to adopt and implement regulations delegated by law to the Fish and Game Commission or the California Department of Fish and Game. Specifically, it means “the provision of law which permits or obligates the agency to adopt, amend, or repeal a regulation” [Government Code §11349(b)].

Bag limit - The number of abalone that can be legally taken per person per day.

Benthic - On or relating to the bottom of a sea or ocean.

Biological reference points - Limits within which abalone take should be constrained in order to maintain sustainability.

Biomass (B) - The total weight of a stock or population of organisms at a given point in time.

Broodstock - Individuals from a natural population that are to be used as parent stock in aquaculture facilities.

California current - A southward moving, cold water current along the California coast.

Catch-per-unit-of-effort (CPUE) - The catch obtained per unit of fishing effort (for example: number of abalone taken per dive).

Central California Region - Area between San Francisco Bay and Point Conception, including the Farallon Islands.

Cohort - A group of individuals of a species of approximately the same age that resulted from a single spawning event, period, or season.

Commercial fishing - The act of fishing with the intent of selling the catch.

Commission - Fish and Game Commission.

Community maps - Maps displaying information on habitat and species distribution.

Constituent - Any individual interested in or affected by fishery recovery and management decisions. Constituents include the general public, consumptive and non-consumptive resource users, and members of the scientific community.

Coralline algae - Coralline algaes are calcified (containing hard calcium-based structures) red algae that are typically divided into two groups: articulated and encrusting. Articulated corallines are branching and tree-like, and are attached to the substrate by root-like holdfasts. The encrusting corallines form crusts over the substrate and contain a substance that induces settlement of larval abalone.

Creel survey - Survey to gather catch information from recreational fishermen.

Cryptic - Animals that live in hidden locations, as in crevices or under rocks.

Daily limit- Same as bag limit: The number of abalone that can legally be taken per person per day.

Data-limited - A situation where essential fisheries information is lacking and a precautionary approach to resource management decisions is warranted.

Data-poor - Having insufficient essential fishery information to make informed management decisions.

Data-rich - Having sufficient essential fishery information to make informed management decisions.

Density - Number of organisms per unit of area.

Depleted fishery - The reduction of a population to low levels that can no longer support a fishery.

Depressed fisheries - A fishery for which the best available scientific information and other relevant information that the Commission or Department possesses or receives, indicates that a declining population trend has occurred that may result in a non-sustainable condition.

Depressed stock - A stock whose abundance has declined to a level below which maximum long-term productivity cannot be achieved or which may adversely affect the health of the ecosystem.

Drift algae (or drift kelp) - Marine algae fragments that are carried on currents toward the ocean bottom where they may be more accessible to abalone and other herbivores.

Effort - A measure of time or number of units (fishermen, boats, etc.) used in fishing. Fishing effort is usually expressed as time fished but may include the number of people fishing.

El Niño - A periodic warming of the ocean surface waters at the equator in the Pacific Ocean. It can affect upwelling of cold, nutrient-rich waters nearshore.

Emergent - Being in plain view on the surface of the substrate; the opposite of cryptic. Emergent abalone is defined as abalone that can be surveyed without moving habitat or using artificial lights.

Essential fishery information (EFI) - As defined by the Marine Life Management Act, it is the information necessary to permit management of fisheries according to the requirement of this Act. EFI includes information about fish life history and habitat requirements and any other information related to the biology of a fish species, the status and trends of fish populations, fishing effort and catch levels, and fishery effects on fish age structure and on other marine living resources and users.

Extirpate - To cause extinction (used in the ARMP for localized extinction).

Ex-vessel value - The value of fish at first sale by fishermen at the dock (as opposed to wholesale or retail value).

Fecundity - The reproductive capacity of an individual female animal, generally expressed as the number of eggs or larvae per unit weight or per individual.

Fishery-dependent - Describes information collected directly from a fishery (such as creel survey data, report card information, etc.).

Fishery-independent - Describes information collected from non-fishery related surveys (such as dive surveys).

Gastropod - A type of mollusk in the class Gastropoda, the largest and most successful class of mollusks.

Genetic bottleneck - A reduction of a breeding population's size to a few individuals, which leads the loss of genetic variability.

Genetic diversity - The range of genetic variability of a species that occurs throughout its population.

Genetic markers - A characteristic segment of DNA material that identifies a group of closely related individuals.

Geographic information system (GIS) **-** Computerized mapping systems used to relate demographic, biological, habitat, and other characterization database information to location.

Global Positioning System - (GPS) A satellite based system which provides very accurate longitude and latitude.

Hectare - A metric unit of measure equal to 10,000 square meters.

Index sites - Locations within key areas where assessment of criteria is conducted periodically.

Intertidal area - The part of the shore that lies between the low and high water lines.

Key areas - Areas of abalone habitat that have experienced high use in former or current fisheries.

Key locations - Specified areas where a species is known to live, based on survey data and landing records. These are used to identify areas for recovery.

Landings - The number or weight of abalone taken by fishermen.

Landing receipt - A document provided by the Department to commercial fish markets for recording landing information. Information required includes date, port of landing, species or market category of fish, pounds landed, and price paid. It is also called market receipt.

Macroalgae - Multicellular algae (visible without using a microscope) such as giant kelp and bull kelp; having a filamentous, sheet, or mat-like appearance.

Management - In the ARMP, management is defined as assessment, research, or development and implementation of regulations pertaining to abalone fishing. Currently, management applies to northern California red abalone, but ultimately will apply to any area or species reopened to fishing.

Management regions - The California coast has historically been managed for abalone in three separate regions: northern, central, and southern. If the central region is reopened for fishing, however, it may be combined with the northern region into a single region.

Management zones - Under the long-term management plan, management regions will be further subdivided into zones for each species to allow area-specific allocation of take.

Mandates - Something required by a statute or regulation.

Mariculture - The commercial raising of fish, crustaceans, and other oceanic species.

Marine Protected Areas (MPAs) - Areas closed to all fishing, or to specific user groups, or to the take of certain species; they are used to geographically limit effort and to protect portions of stocks.

Maximum sustainable yield (MSY) - The highest average yield over time that does not result in a continuing reduction in stock abundance. Determination of MSY must take into account fluctuations in abundance and environmental variability.

Minimum Viable Population (MVP) - A population that is sustained over time, balancing reproduction and mortality, in the absence of a fishery. The ARMP target density for MVP is 2,000 abalone per hectare.

Moratorium - A legally authorized suspension of activity (such as ending the issue of new permits or the closure of all fishing for a particular species).

Nautical mile - A measure of distance used in marine navigation equal to 6,080 ft (1.15 miles).

Northern California Region - Area between the California-Oregon border and San Francisco Bay, excluding the Farallon Islands.

Non-consumptive uses - Activities that involve a resource without take or consumption.

Optimum yield (OY) - An adjustment of the maximum sustainable yield that provides the greatest overall benefit to the public, particularly with respect to food production and recreational opportunities, by taking into account the relevant economic, social, or ecological factors. In the case of an overfished fishery, the OY allows rebuilding to occur to a level consistent with producing maximum sustainable yield in the fishery.

Overfishing - A rate or level of take that the best available scientific information indicates is not sustainable.

Pathology - The study of the essential nature of diseases and of the structural and functional changes produced by them.

Poaching - The taking of game or fish by illegal methods. Abalone poaching includes: taking more than the daily or annual limit, taking undersize abalones, violating seasonal or area closures, using improper collecting-bars, taking additional limits for others (“dry-sacking”), and fishing without a license.

Population - A species, subspecies, or geographical grouping that is considered a unit for recovery or management.

Precautionary approach - A fishery management principle that implements conservation measures even in the absence of scientific certainty that fish stocks are being overexploited. A common element in the application of this approach is the definition of limits intended to safeguard the long-term productivity of a stock.

Random, spatially-stratified sampling - Statistical sampling procedure in which individual samples within a discrete habitat are drawn at random, and are also collected among different habitats to ensure that each habitat is adequately represented.

Recovery - In the ARMP, recovery is defined as assessment, research, or development and implementation of regulations pertaining to rebuilding depressed abalone populations. Recovery currently applies to five abalone species in central and southern California: red, pink, green, black, and white.

Recovery areas - Areas that were known to have supported a commercial and/or recreational fishery in the past, were determined from commercial landing block data and known recreational fishing areas.

Recruit - In common usage, this term refers to a newcomer to a field or activity. In biology, it typically refers to a larval or juvenile organism as it settles or moves into adult habitat, or to an organism entering the exploitable stage of its life cycle .

Recruitment - Recruitment is a broad term that includes settlement of young-of-the-year abalone (less than 31 mm), growth into reproductive sizes that contribute to spawning populations (greater than 50 mm), and entry into the fishery at sport legal size.

Relative abundance - An index of fish population numbers used to compare populations from year to year. This does not measure the actual numbers of fish but shows changes in the population over time.

Remotely operated vehicle (ROV) - A remotely-operated vehicle is an unmanned submarine that can be controlled from aboard a ship and can take video and still pictures.

Report cards - Cards issued to sportsmen for recording the location and number of abalone taken.

Research protocol - A defined methodology used to collect fisheries data and/or conduct fishery research.

Sabellid worm - A marine parasitic worm that lives on the growing edge of mollusc shells causing deformities. A South African species was introduced accidentally into California aquaculture facilities. To prevent introduction into the natural environment, a ban on out-planting of cultured abalone has been established, except from certified sabellid-free facilities.

Self-sustaining population - A resource that can provide sufficient reproductive potential necessary to replace individuals removed from the population.

Senescent - growing old, ageing.

Serial depletion - An event that happened in the combined abalone/sea urchin fishery. Abalone species were successively depleted, beginning with the most desirable and easily accessible, and progressing to the least desirable and accessible. Likewise, single species of abalone were sequentially depleted from areas near access points to those far from access points.

Settlement - In marine ecology, the process by which organisms change from an open ocean life history phase to assume a new mode of life as a member of a sea-floor community.

Size or length-frequency distributions - A graphical representation of the number of individuals by length.

Size limit - The minimum size an organism must have for it to be legally taken or possessed.

Sonar - A remote-sensing technology that uses underwater sound waves to locate or track objects.

Southern California Bight - Geographical area between Point Conception in Santa Barbara County and the Mexican border.

Southern California Region - Area between Point Conception to the U.S. - Mexico border, including the southern California offshore islands.

Species-specific - Applying only to a particular species.

Stock - A distinct, reproductively isolated population. In practice, the members of a species inhabiting a defined area that can be discreetly managed.

Stock collapse - The reduction of stock to very low levels.

Sublegal - Individuals smaller than the legal size of capture.

Sub-populations - Smaller groups or part of a larger population.

Subtidal - Areas (including the water column and bottom substrate) that are always beneath the surface of the ocean.

Sustainable, Sustainable use, and Sustainability - A population that is self-reproducing and able to maintain it's genetic diversity over a long period of time. In a fished population sustainability also involves social and economic benefits, maintaining biological diversity, and managing fisheries in a way that does not exceed optimum yield.

Total Allowable Catch (TAC) - The catch level, in number or weight of abalone, that is allowed each year under sport or commercial fishery regulations.

Transect - A fixed linear area where organisms are enumerated to estimate their density and distribution in relation to their habitat.

Upwelling - The upward movement of deep waters into the nearshore ecosystem due to springtime winds moving the topmost layers of water away from land.

Young-of-the-year (YOY) - Abalone less than 1 yr old, estimated at 30 mm or less in size.

Withering Syndrome (WS) - An abalone disease caused by a bacteria-like organism and characterized by shrinking of the foot, usually leading to death.