**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.

**Abalone Recovery and Management Plan**
**Table of Contents**

**Abalone Recovery and Management Plan**
**List of Figures**

**Abalone Recovery and Management Plan**
**List of Tables**

**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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