Appendix A: Fishery Management Options (A-D)

Option A
Red Abalone Demonstration Fishery at San Miguel Island (SMI)

Authors: Chris Voss and Jim Marshall

Part I. Background and Matrix Chart

	Workgroup Option A	Workgroup Option B	Workgroup Option C	Workgroup Option D
NAME of OPTION	Red Abalone Demonstration Fishery at San Miguel Island (SMI)			
DESCRIPTION	A Restricted Access Fishery for red abalone supported by a community-based fishermen's harvest cooperative that will assist the California Department of Fish and Game with the management, enforcement, monitoring, and data collection for the fishery.			
TOTAL ALLOWABLE CATCH	10,728 abalone in the Southwest Zone of SMI			
ALLOCATION	90% commercial 10% recreational			
COMMON ELEMENTS	8 inch size limit			

Option A
Red Abalone Demonstration Fishery at San Miguel Island (SMI)

Part II. Executive Summary

A. <u>Red Abalone Demonstration Fishery at San Miguel Island (SMI)</u>. The commercial sector, represented by the California Abalone Association (CAA), proposes a Restricted Access Fishery (RAF) for red abalone at SMI. A community-based fishermen's harvesting cooperative will be developed to accept a harvest allocation. If an allocation is granted to this cooperative it will assist the California Department of Fish and Game (CDFG) with the management, enforcement, monitoring, and data collection of this fishery. This will be achieved by entering into a Memorandum of Understanding (MOU) and developing supporting regulations to ensure that the State retains oversight and that the abalone population continues to recover. The commercial Option described here recognizes that responsible resource stewardship is inherently linked to the success of the cooperative which places the health and habitat of the abalone population above all other considerations.

B. <u>A Total Allowable Catch (TAC)</u> of 10,728 abalone over 8 inches (203mm) is recommended for the Southwest Zone of SMI. A bootstrap analysis[1] of the 2008 survey data was conducted to create a TAC Decision Table[2] that illuminates the tradeoffs associated with different population probabilities and catch. Using this analysis, there is a 95% probability that 10% of abalone larger than 8 inches in the Southwest Zone is equal to or greater than 10,728.

The CAA proposes that 90% of the TAC be allocated to the commercial sector as the Total Allowable Market Catch (TAMC) and the remaining 10% allocated to the recreational sector as the Total Allowable Recreational Catch (TARC). A change in the TAC would not affect these allocation percentages. These percentages reflect historical allocations based on CDFG catch records and the commercial sector believes this is an equitable division with the existence of a recreational-only fishery along the North coast. The commercial cooperative will divide its TAMC allocation among its members in an efficient, safe, and ecologically sustainable manner. The initial TAMC allocation will be divided equally among all participating cooperative members.

The TAC recommended in this Option is based on a conservative estimate that preserves over 80% of the population's spawning potential, and is considered sustainable over both the short and long term. This Option's recommended TAC represents 1% of the total abalone estimated at SMI. Populations in the Northwest, Northeast, and Southeast Zones, as well as in the Judith Rock Marine Reserve (in the Southwest) will remain untouched.

[1] A detailed description of the bootstrap analysis is included in "A New Beginning for Abalone Management in California" can be found in Appendix G of the Market Red Abalone Fishery Operating Guidelines submitted under separate cover to the Fish and Game Commission on December 10, 2009

[2] The TAC Decision Table can be found in Section 2 of the Market Red Abalone Fishery Operating Guidelines

Precautions built into this Option include: 1) an increased size limit, 2) a conservative TAC, 3) eliminating incidental mortality of sub-legal abalone by only handling emergent abalone that can be easily measured, 4) harvesting 30% or less of abalone in a group to protect spawning aggregations and prevent potential Allee effects, and 5) using a conservative population estimate based on data from non-invasive survey protocols that do not detect cryptic abalone.

Uncertainty is inherent in managing natural resources. This Option reduces future uncertainty by collecting fishery independent data in both fished and unfished areas to closely monitor and adaptively manage abalone populations. This data will inform a Decision Tree Process, which sets the annual TAC in order to achieve long term target abundance, and allows for a TAC of zero if certain triggers are met.

C. Allocation Mechanisms. As described above, the initial TAC proposed in this Option is based on the TAC Decision Table. In following year's fishery dependent and independent data will inform a Decision Tree Assessment Process[3] to set the annual TAC. The Decision Tree Assessment Process will adjust the TAC up or down each year in response to Biological Reference Points (BRPs). These BRPs include ecological triggers such as sea surface temperature, kelp availability, and long-term abundance targets.

The Decision Tree framework will: 1) use harvest data collected by fishermen, 2) use unfished populations as a reference, 3) detect and respond to changes in population levels and environmental conditions, and 4) accommodate advances in knowledge regarding abalone management to maximize spawning biomass and recruitment. If certain triggers are met, the Decision Tree recommends a zero TAC until the data collected provides evidence that the population is capable of sustaining itself again. For example, if a disease outbreak occurs fishing can be curtailed or terminated to ensure that all surviving spawning abalone are preserved to rebuild the stock following the outbreak.

Annual allocation of a TAMC to the cooperative will be reviewed based on the cooperative meeting stated obligations each year. The State will determine if fishing should continue based on the health of the population.

Information Used to Support the TAC. Three years of collaborative surveys were conducted to assess the population at SMI. Data from the 2006 and 2007 surveys, along with historical catch and fishery-independent data was used by the AAG Technical Panel (TP) to construct a suite of fishery models to assess the population at SMI.

In February 2009 these modeling results and the associated TP reports along with data inputs were discussed and reviewed by an independent Review Committee (RC) composed of fishery scientists. The RC determined that the modeling work and the related reports were incomplete and a second round of modeling work was recommended, but not commissioned due to a lack of funding. It is difficult to draw conclusions from the TP model and reports, especially since the model did not project forward more than one year in each fishing scenario or provide information on the long-term growth potential of the SMI population, as the RC recommends.

[3] The Decision Tree Assessment Process is described in Section 2 of the Market Red Abalone Fishery Operating Guidelines

This Option focuses on the RC recommendation where "a program of experimental fishing should be considered for the Southwest Zone as an initial step in pursuing the option for removals." In pursuit of this experimental fishery, the RC also recommended that the size limit be raised to 8 inches, and that the initial TAC be set at 10% of the abalone over 8 inches in the Southwest Zone. The RC also stated, "given such a relatively high age at first capture, this 10% proportional take is well below standard fishing mortality reference points."

The CAA has developed this Option pursuant to the recommendations of the RC, examples set by a number of foreign abalone fisheries, and the best available science. This Option is further informed by the "A New Beginning for Abalone Management in California" by Dr. Jeremy Prince and Bren School PhD candidate Sarah Valencia that describes how the SMI fishery can be opened and adaptively managed using a TAC Decision Table phased to a Decision Tree Assessment Process.

D. Management Approach

Community-Based Harvest Cooperative: Development of a community based cooperative management structure is currently underway by the CAA. This cooperative will meet all the guidelines and requirements set forth by the State of California and the Federal Fishermen's Collective Marketing Act (FCMA). The cooperative's legal structure will be based on Articles of Incorporation, bylaws, membership applications, and marketing agreements provided by California attorney Kendall L. Manock of Baker Manock & Jensen in consultation with attorney Joseph M. Sullivan of Mundt MacGregor L.L.P. The cooperative will also take the necessary steps to qualify for the FCMA's limited antitrust exemption.

DFG Code 5522 (e) states "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." Therefore, all individuals who held an abalone diving permit in the 1996/97 fishing year will be invited to participate in this cooperative.

Shared Management Framework: A shared management framework will be developed with the CDFG through a combination of regulation and MOUs. This approach uses the harvesting cooperative to fulfill the necessary shared management activities and makes it possible to achieve comprehensive sustainable fishery management at a lower cost to the State. The harvesting cooperative will: 1) take responsibility for directing specific harvest and data collection activities, 2) ease the burden to the state associated with enforcement duties, and 3) assist with data management. In addition the cooperative will: 1) educate the fishing community on responsible marine resource stewardship, and 2) create a cohesive and motivated community of market abalone divers that will respond wisely to the challenges of sustainable fisheries management.

Under this shared management framework, the State will be responsible for: 1) setting the TAC, 2) providing licenses and permits, and 3) evaluating the fishery and cooperative performance through an annual review process.

Restricted Access Fishery (RAF): In general, the goal of the Fish & Game Commission Policy on "Restricted Access Commercial Fisheries"[4] is to enhance the State's ability to manage its commercial fishery resources and contribute to sustainable fisheries management. The RAF proposed for red abalone at SMI meets this goal by: 1) providing a means to match the level of effort in a fishery to the health of the fishery resources, 2) promoting sustainable fisheries and giving fishery participants a greater stake in maintaining sustainability, 3) providing a mechanism for funding fishery management, research, monitoring, and enforcement activities, 4) maintaining long-term economic viability in a fishery, 5) providing long-term social and economic benefits to the State and fishery participants, and 6) providing for an orderly fishery while expanding opportunities for the commercial fishing industry to share management responsibility with the CDFG.

Harvest: An annual fine scale harvest plan will be developed to effectively and accurately manage and assess the abalone resource. The cooperative will implement a regional management approach and direct specific harvest by assigning fishermen to individual micro blocks. This micro block system will foster "community stewardship" by instilling a sense of direct responsibility in fishermen for the blocks they harvest. This approach will link allocation to specific harvest blocks and each member will harvest their allocation according to this annual harvest plan developed by the cooperative in conjunction with CDFG. To achieve fine scale management that is information driven, harvest areas will be divided into $1/10^{th}$ mile blocks. Harvest and population data collected at this scale will provide spatially explicit information for refining management approaches.

Decision Tree Stock Assessment Process: The Decision Tree Assessment Process will remove much of the annual burden of management from CDFG by providing a prescriptive approach to setting the TAC based on scientific data. The CAA will work with fishery scientists to finalize a Decision Tree specific to red abalone at SMI. The Decision Tree will be in a user-friendly format and will be provided to both the cooperative management and the CDFG so that each party can independently verify the TAC recommended by the Decision Tree each year. A secure web-based data management system that can be accessed by the CAA, cooperative, and the CDFG will be set up to inform the stock assessment process.

Annual Evaluation and Report: An annual evaluation process will be established to determine success of the cooperative in fulfilling management objectives. The cooperative will be required to complete an annual report documenting its compliance with the terms and conditions stated by the MOU(s) in place and under which its annual allocation was issued. Another purpose of the report will be to determine how well the cooperative met its goals for the year. Some evaluation and report areas include: 1) population trends over time, 2) data collection and research, 3) fishery dependent data, 4) enhancement, 5) revenue generated from the fishery, and 6) management costs.

E. Enforcement Approach. This Option recognizes two levels of enforcement: government law enforcement agencies and the fishing community. Government enforcement can be seen as a joint effort between CDFG, Channel Islands National Parks Service, Channel Islands National Marine Sanctuary, and the Coast Guard. By vertically integrating the harvest activity and wholesale marketing of abalone with a cooperative, many enforcement concerns can

[4] The Commission policy can be found in Appendix A of the Market Red Abalone Fishery Operating Guidelines

be addressed by the fishing community. A comprehensive state and community enforcement approach also includes: a) tag tracking system, b) single port of landing, c) season restrictions, d) harsh penalties, e) vessel identification/monitoring systems, and f) Trace Register as the independent, third party "registry". The cooperative will enforce its community bylaws on its members and also aide and assist in enforcement of state regulations. The cooperative will implement an "Island Watch Program" within the existing commercial fisheries to look for suspicious behavior by commercial and recreational vessels. A cooperative funded reward program for information on poaching could also be considered.

Tags and Tracking System: Tags (ARMP Section 7.1.3.) are the cornerstone in connecting biological monitoring, management and enforcement. A system will be developed using a database supported by the tag and logbook system, which will identify individual abalone and connect them to a specific diver and area. The cooperative will set up a digital chain-of-custody system to help prevent illegal abalone from entering the marketplace and identifying them if they do. A simple web-based, automated database will be used to track abalone through the entire supply chain (fishery to consumer). It is proposed that the cooperative and all abalone handlers use Trace Register (www.traceregister.com) as the independent, third party "registry" into which product, source, and tracking information are entered, secured, and shared throughout the supply chain.

F. Monitoring Approach

Fishery Dependent Data Collection: Each fisherman in the cooperative will be required to complete a "Red Abalone Harvest Log" page for every harvest dive. Each Harvest Log will have sequentially numbered two-part carbon sheets and the format will provide fishery dependent data that will be used to track the TAMC, determine catch-per-unit-of-effort (CPUE), and enhance understanding of spatial distribution to assist in managing the resource.

Fishery Independent Data: The CAA and the cooperative will work with the CDFG to collaboratively train fishermen and design surveys to monitor: 1) BRPs, 2) spatial distribution, 3) size frequency, and 4) densities in both fished and unfished areas. This data will provide detailed information on the fisheries impact on population growth, and feed the yearly Decision Tree Assessment Process to set the TAC. The 2009 survey protocols will use a BACI design to monitor population trends at specified areas of SMI. This design will reduce costs and the density information can be used for setting future fishery parameters.

G. Funding Mechanisms. The cooperative will enter into an MOU with the State that describes the economic responsibilities and obligations of the cooperative. One goal of the cooperative will be to reduce CDFG costs and create its own revenue stream to pay for education and fishery related monitoring and enforcement.

H. Key Regulations Needed. Specific regulations needed to manage the TAMC are described in Appendix E of the "Market Red Abalone Fishery Operating Guidelines". These regulations include: 1) season, 2) 8 inch minimum size limit, 3) harvest zones, 4) restricted access, 5) gear, 6) landing receipts, 7) taxes and licensing, and 8) tamper proof tags. Additional regulations regarding the cooperative's ability to receive an allocation and the content of the necessary MOU(s) that outline the cooperative's responsibilities will also need to be developed.

Option A
Red Abalone Demonstration Fishery at San Miguel Island (SMI)

Part III. Additional Information

The "Market Red Abalone Fishery Operating Guidelines" contains additional information to support this Option.

Option B: San Miguel Island Conditional Demonstrational Fishery Abalone Advisory Group

Authors: Bill Bernard and Terry Maas

Part I: Background and Matrix Chart.

MATRIX CHART

	Workgroup Alternative A	Workgroup Alternative B	Workgroup Alternative C	Workgroup Alternative D
NAME of ALTERNATIVE		Conditional Demonstrational San Miguel Island Abalone Fishery.		
DESCRIPTION		The Conditional Demonstrational San Miguel Island Abalone Fishery seeks to provide an option for a recreational and a commercial red abalone fishery pursuant the provision of the ARMP, chapter 6 and its section relating to a limited entry abalone fishery at San Miguel Island by utilizing the information and products of the AAG process. Furthermore, the authors of the Conditional Demonstrational option recognize that present day maladies do exist with the abalone populations at San Miguel Island and that these maladies are considered in the development of this option by the authors of this proposal.		
TOTAL ALLOWABLE CATCH		Zero percent TAC pending completion of the risk analysis modeling for the		

		proposed demonstration fishery. Without completion of the risk analysis modeling work related for a demonstration fishery, the recommendation is a 0% TAC at this time.		
ALLOCATION		50% Recreational 50% Commercial		
ELEMENTS COMMON TO ALL ALTERNATIVES		Acceptance of the MLS limit of 203mm (eight inches) for both recreational and commercial fisheries. Use of Tags. The use of a seasonal period. Single point of commercial landing.		

Part II. Executive Summary

Name and Overview Description of alternative

The Conditional Demonstrational San Miguel Island Abalone Fishery represents a recreational consumptive, non-consumptive and commercial red abalone consideration option for the potential San Miguel Island Fishery. This option utilized the best readily available science indicative to address a potential abalone fishery with maladies. The development of this option was based upon the AAG Technical Panel (TP) report / final TP report, the Review Committee recommendations, deliberations of the AAG body, and the communications from constituents that were received and expressed by their respective AAG representatives.

Summary of model information and other data used to support a TAC

Four issues of biological importance relating to the red abalone populations at SMI are recognized by the authors of this option: 1) low population densities of red abalone at SMI; 2) biological concerns and considerations relating to the presence of Withering Syndrome (WS) agent (Ricketsiales bacterium) within the abalone stocks; 3) the AAG modeling report, "Improving the Stock Assessment of California Red Abalone (*Haliotis rufescens*) at San Miguel Island"; and 4) the genetic research findings concerning red abalone.

- The current average population densities, from the three SMI snapshot surveys (2006-2008) of red abalone found at the San Miguel Island site range from 1,500 to 2,400 abalone per hectare (ARMP (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. A minimum viable population (MVP) level was therefore established at 2,000 ab/ha for each species based on the best available red abalone density information[2]. Proceeding today or anytime with density levels below 2,000 ab/ha may result in a reduction of the protection factor against the collapse of the red abalone stocks at San Miguel Island.

- Concern for the degree and extent of infection of the red abalone stocks at SMI with the bacterium that causes WS during El Niño events. Current information on the possible impact of this disease to SMI abalone stocks suggests that survivorship maybe as low as thirty-eight percent during a severe El Niño event[3].

- Independent modeling work commission by the AAG, "Improving the Stock Assessment of California Red Abalone (*Haliotis rufescens*) at San Miguel Island." The results of the modeling stated: The probability of overfishing the SMI red abalone fishery and the probability of this fishery being overfished were considered in the risk assessment. Given the parameters used to calculate the corresponding TAC's given different risk levels and BRP's the end result of the modeling stated: The low recruitment in recent years created a high probability that the population will keep decreasing even if there is no fishery[5].

- Genetic research related to the AAG process and key findings may be suggesting that recruitment is highly localized and that the chance of outside recruitment to help replenish the existing stocks of red abalone at San Miguel Island is rare.[4]

Recommendation for TAC (and allocation)

Without the completion of the proposed risk assessment modeling the recommendation of Option B is for a zero TAC at this time. Pending completion of the recommendations contained in the Review Committee

Report "a way forward[6]" and the support for the proposed risk assessment modeling, the Conditional Demonstrational fishery supports a TAC allocation of 8,300 for the SMI red abalone resource. If the additional risk assessment modeling concludes that a different TAC (from a zero TAC to an infinite TAC) is more appropriate, Option B would support these findings.

Rationale for the Harvest Rate and sustainability
Total Allowable Catch (TAC) references the AAG Review Committee Report and the AAG Final Technical Report "Developing a Total Allowable Catch for Red Abalone at San Miguel Island" recommendations for completion of a risk assessment modeling work to support a TAC of 6,700 to 8,300 for a demonstration abalone fishery in the southwest zone of the Island.

This option proposes an annual evaluation of the demonstrational fishery. This fishery would be limited entry and strictly managed to ensure populations do not drop below the minimum viable population (MVP), as established in the ARMP, and overall recovery continues.

The evaluation of the demonstration abalone fishery has several considerations. The goal of the demonstrational fishery should be to achieve a sustainable fishery at low density populations, not necessarily an economically viable fishery. Viability of a commercial fishery and the viability of a recreational fishery may not be one in the same. Other considerations are to avoid risking the entire Island's abalone resource while allowing for some abalone fishing activities; monitoring for recruitment replacement rates vs. extraction rates (harvest) and the adjustments thereof in an operating fishery, and incorporating the best determined biological reference points (BRP) to inform an adjustable TAC on a yearly consideration for adaptive management purposes.

Specific information that will be used to guide the evaluation of the fishery include: 1) A working risk assessment model where various TAC inputs, i.e. 0 to ∞ could be used to determine the risk to the Islands south west and south east zones abalone populations to be stable, increasing, decreasing or placing the abalone populations in risk of collapsing; 2) A MLS of 8"; 3) Ocean temperatures likely to cause the manifestations of W.S. would equal a suspension of the fishery, pending an assessment period; 4) Insufficient, measured growth rates, of the abalone populations in the fished and unfished areas that do not support a TAC or allow for the continued recovery of the abalone populations would equal a zero TAC; 4) Insufficient frequency of surveys to improve the power analysis of the risk assessment modeling in a on going fishery, equals a zero TAC; 5) Gonad indexing; 6) Use of the SMI decision tree as informative tool, not a decision device.

Allocation of the TAC
Since the ARMP did not provide guidance on TAC allocation in any new or reopened abalone fisheries, merits of the MLMA guidance on fishery management plans (FMPs) are founded in accordance of equal allocation. The MLMA emphasizes that in achieving its goals in managing California's sport and commercial marine fisheries require fishery management plans [7070; 7072(a)]. These plans, or FMPs, are to be based on the best scientific information available, as well as other relevant information [7072(b)]. FMP are to allocate any increases or decreases in allowable catches fairly between commercial and recreational fishermen [7072(c)].

- A TAC allocation of 50% recreational and 50% commercial meets the current fish and game laws. The DFG will assign the recreational harvest using an application and distribution process (comparable to the system used for hunting of deer or big horn sheep). This option is supportive of assigning the commercial and recreational harvest as recommended by the Commission.
- Historical recreational abalone lands at SMI were limited to charter boat logs. Private boat landings of abalone at SMI are non-existent. The total reported recreational landings of abalone at SMI are unknown. What is known is that recreational harvesters were limited to a daily landing limit of 180 (15 dozen) abalone of each species or a total of 360 abalone per vessel.

Description of Management Considerations for implementing the Alternative including Management approaches recreational and commercial

The use of tags is currently an accepted practice in the northern recreational abalone fishery. Slight modifications of these tags can be employed for a recreational abalone fishery at SMI to achieve management of the recreational interest by issuance of the number of tags, printed instructions as to the harvest location and harvest rules, allowed daily catch and bag limits, and seasonal closures. Such modifications can provide a reasonable means to meet the needs of a limited-entry, experimental or demonstration abalone fishery by providing the information needed to collect biological data, habitat observations, spatial data, aid enforcements needs and the monitoring considerations. The management approach proposed for the commercial fishery is the use of commercial tags, individual fishing quotas (IFQs), single point of landings, an annual evaluation process for both the recreational and commercial fishery, and harvest control rules relating to aggregations combined with a minimum legal size (MLS) limit of 203mm (eight inches) for both recreational and commercial participants.

Management of the fishery is retained with the Department of Fish and Game and the Commission utilizing an adaptive approach with continued stakeholder involvement. Option B proposes that a reconstituted Abalone Advisory Group serve as advisement on management, adaptive in nature and intended to advise and make recommendations to the Fish and Game Commission pertaining to an on going recreational and commercial consumptive demonstration abalone fishery. Management in a reconstituted AAG could mitigate any need for an MOU between the Commercial Abalone Association (CAA) and the State, thus avoiding the legal issues and the cost considerations to the State to engage in a MOU. Representatives of a reconstituted AAG body would under direction of the AAG Chair (appointed by the DFG). Their role would be to evaluate fishery dependent and fishery independent data, survey protocols and survey results, recommend modeling parameters and further research work to address new items of charge and any parameters deemed appropriate by the Commission and the Department. The findings and recommendations of a reconstituted AAG body shall be made to the Director of the Department of Fish and Game and the Fish and Game Commission.

Enforcement approaches and considerations for the proposed recreational and commercial fishery, SMI

1. All recreational SMI abalone Tags must be returned to the Department of Fish and Game. Clearly defined GPS coordinates of fishing areas should be printed and defined on the recreational harvest card.
2. Abalone Irons considerations; material of construction (i.e. suggest stainless steel, length, width, thickness and radius as currently specified in the F&G code for abalone.)
3. Season: recreational consumptive abalone season at SMI should be from April 1st through November 30th for the following reasons: a) Mimics the northern recreational abalone fishery season except the month of July should be open (ARMP Table 2.2 states that the spawning season for Southern California red abalone is year round.) and the commercial interest propose that the month of December be open to accommodate an interest and b) Many of the other type of sport diving harvest activities are concurrent during this period such as the WSB fishery, recreational halibut diving and the lobster diving fishery. Seasons reduce the risk of poaching, thus an aid to enforcement during the season and during off season
4. Only designated processors or the proposed cooperative will be allowed to receive abalone. Processors shall retain the abalone with the shell intact and the tag attached at all times while the abalone is in the processor's possession. Only upon the final retail sale of the SMI market abalone shall the tag be removed in the presence of the consumer and the tag should be placed in a DFG controlled keyed lock box. The processor might also be required to record all pertinent information about the sale and the consumer.
5. Abalone gauge considerations: recreational and commercial participants shall be required to use calipers capable of accurately measuring red abalone at SMI.
6. The ability or lack of enforcement at sea and on shore could place at risk the success of a proposed conditional demonstration fishery.

Monitoring approaches

Monitoring should be conducted per the recommendations of the Review Committee, using a methodology that can detect changes in abundance resulting from removals. Proposed monitoring approaches should include:

1. Recreational SMI tags purchased and applied for through appropriate DFG offices and commercial tags distributed to the awarded commercial divers by CDFG.
2. GPS latitude and longitude coordinates at anchor point of each dive, depth of dive-shallowest to greatest. A detailed harvest logbook is proposed for the commercial divers. The commercial diver log and recreational cards/tags would supply the following information: Grid area fished, GPS latitude and longitude at start/end of each dive (end of dive applicable to recreational), time spent harvesting/fishing, length of all harvested abalone, number of abalone, weight of abalone (not applicable to recreational card/tags), Estimate of abalone left un-harvested (not applicable to recreational) and status of aggregations (a harvest control rule to recreational divers defined and printed on recreational cards), Observations: bottom type/relief, algal cover, general conditions (i.e. water temperature and current direction – not applicable to recreational fishing.)
3. A secured funding source. The approximate cost to monitor was approximately $125,000 for each of the snapshot surveys. The frequency periods required to effectively monitor a demonstration fishery and the associated cost has not been fully explored by the AAG. Department of Fish and Game funding may be directly limited to proceeds from the Abalone Restoration and Preservation Account. The Recreational Abalone Advisory Committee (RAAC) makes recommendations for the expenditures of the dedicated funds to the Director of the Fish and Game Department who may or may not act on the recommendations of the RAAC.

Possible funding to pay for the proposed alternative

Assuming a TAC allocation of 4,150 (50% of the proposed TAC, reflecting option B) marketable SMI abalone at $50.00 wholesale price yields $ 207,000 per year – [$62,500 (50% of the cost of monitoring/yr.)] = $ 140,000 realized yield / 35 proposed commercial harvesters = $ 4,000 per commercial diver before operating expenses. Assuming a TAC allocation of 4,150 recreational SMI abalone at a 24 abalone yearly limit (current annual limit, per participant, for the northern recreational fishery), 173 recreational divers could participate in the proposed demonstrational fishery. Current day price of a recreational abalone card for the northern recreational fishery is $ 20.00 rounded to the whole dollar. ($173.00 X $20.00) = $ 3,460 generated revenues. The average recreational abalone landing per participant for the northern recreational abalone fishery based from the report card returns is twelve. Assuming a TAC allocation of 4,150 recreational SMI abalone and a 12 abalone yearly limit per recreational diver, 346 recreational divers could participate in the proposed demonstrational fishery and the yield at $ 20.00 per card would be $6,920 (346 recreational divers X $20.00). Various combinations and prices per recreational SMI abalone are possible and the estimated price for the willingness of recreational divers to participate in demonstrational abalone fishery needs to be further explored. However, it is important to note a few things. Ultimately the cost of monitoring would be paid from the entire revenue generated from both the recreational and commercial fishery and not just the recreational TAC. The Department of Fish and Game has estimated the northern recreational abalone fishery to be a $16 million per yearly industry. Approximately 35,000 to 40,000 recreational abalone divers participate annually in the northern recreational abalone fishery at a card price of $ 20.00. As such, recreational abalone divers yield $750,000 dollars annually ($20.00 X 37,500), which goes directly to the Department of Fish and Game in the form of abalone card sales. Arguments to the pursuit of SMI being a recreational abalone only fishery site may be made. Thus, the SMI abalone site could become another recreational abalone report card landing site with special harvest rules and regulations different from the northern recreational abalone sites for now.

Key Regulations Needed

1. Appropriate changes to the F&G code and Title 14 defining the methods, gear, season, area, and daily bag and yearly limits of harvest for recreational and commercial, as well as methods for collection of fishery revenue for management.
2. Possession limits and controlled rate of extraction needs development and defined for the commercial and recreational interest.
3. Applicable regulations including marketing, transportation and holding tanks related to preventing the potential spread of WS to the northern stocks of abalone from SMI abalone fishery stock.

Abalone Advisory Group Option C: Experimental Harvest to Aid Recovery: a Precautionary, Conservative Approach

Author: Jessie Altstatt

Part I: Background and Matrix Chart Name of Alternative: Option C: Experimental Harvest to Aid Recovery: a Precautionary, Conservative Approach

a. The precautionary, phased approach will first address the goals of the ARMP by using the harvested stock to create new population centers in other locations. This forward-looking approach is a way to move ahead in rebuilding red abalone stocks across a wider geographical area than currently exists, while experimentally testing the appropriateness of the TAC with less risk to the valuable resource.

b. The AAG was not in agreement in regards to establishing a TAC, due in part to the incomplete modeling and risk assessment work. However, the TAC (or some portion of) suggested by other alternatives could be experimentally tested under Alternative 3. The Alternative does not dictate that the entire TAC be harvested.

c. Phase 1 would have no landings and no commercial or recreational take, other than those abalone harvested for transplant purposes. Phase 2 would allow take to be determined by the Department or as within other Alternatives.

d. Common elements could include the size of the TAC, size regulations and enforcement strategies. An "Island Neighborhood Watch" program is a very good idea and could be enacted before the fishery re-opens, during Phase 1.

Part II: Executive Summary

Experimental Harvest To Aid Recovery: a Precautionary, Conservative Approach

This alternative provides a precautionary forward-looking approach to re-opening the San Miguel Red Abalone Fishery. This plan is a way to move ahead for rebuilding of red abalone stocks across a wider geographical area than currently exists. This plan will simultaneously provide critical new information that the Department needs for progressive management, and will aid in rebuilding depleted stocks as spelled out by the Abalone Recovery & Management Plan (ARMP) (as required by the DFG Commission and state conservation policy), *"Enhancement activities may be the only way to fulfill the interim recovery goals[5]"*.

As noted by the Review Committee, *"modeling cannot compensate for a lack of reliable data[6]"* which is why this proposal advocates a cautious and conservative experimental approach. There is a unique opportunity to test both harvest and recovery strategies simultaneously. The two-pronged approach will test harvest of the TAC in an experimental conservative manner, while addressing the goals of the ARMP by using the harvested stock to create new population centers in other locations. The experiment will yield valuable information to be used by the Department in rebuilding this and other abalone populations. At the same time, long-term monitoring will elucidate the sustainability of harvest rates under a TAC. San Miguel Island provides the last remaining mechanism for rebuilding stocks across the historic range in Southern California and we should seize such a timely opportunity. This last strong-hold of reproductive abalone and their gametes is too valuable to remove from the environment without

[5] Abalone Recovery and Management Plan, Section 6.4.2 Enhancement Activities

[6] Summary of Review Committee commentary on Draft Final "Scope of Work" for Red Abalone Risk Assessment Modeling dated June 10, 2009

first re-building stocks in other locations. Alternative C offers rigorous testing of a TAC with minimal risk to the resource while fulfilling the ARMP goal 6.1 of aiding recovery in historic habitat.

B. Recommendation for a Total Allowable Catch (TAC)

This proposal assumes that a TAC is warranted after the population modeling has concluded and undergone rigorous scientific review, and the Department's risk assessment has been conducted. Only then should this proposal go forward.

The harvestable TAC under this Alternative may be no different than that for other options. However, whatever the TAC, the most precautionary, conservative approach would be to harvest a percentage of the TAC (e.g. 25%, 50%) and/or harvest across a small spatial scale for a period of time (5-10 years) until monitoring data proves that level of harvest is sustainable. We will not assume that any rate of harvest will be sustainable until careful and thorough monitoring of the stocks has taken place over a period of 5 years or more, given that abalone recruitment is known to be both stochastic and unpredictable.

Allocation between recreational and commercial take

This allocation option will initially use 100 % of the abalone harvested under the TAC for rebuilding population centers via translocation, rather than for landings. A team of qualified divers will be required for the harvest and translocation work and could be comprised of commercial and recreational divers in addition to agency staff. This effort will be evaluated after a period of time 5-10 years to ensure that the TAC is sustainable and appropriate. This is our preferred scenario as we feel that the reproductive output of the resource is far too valuable to remove from the ecosystem at this time. However, it is conceivable that a consumptive fishery (both commercial and recreational) could take place at the same time solely as a mechanism to help fund this alternative (through sale of abalone tags, permits and landings). The TAC would remain the same and the harvest would be split between landings and transplanted broodstock.

C. Phasing of Approach Once TAC is scientifically shown to be appropriate

Phase 1. "Experimental Fishery"

During Phase 1, abalone will be harvested for enhancement of existing stocks at San Miguel and rebuilding depleted stocks in historic habitat at other islands. Abalone will not be landed, initially negating competition for allocations between commercial and recreational fishers. We call this an "experimental fishery" as removing abalone from the substrate accounts to "fishing" regardless of fate of the harvest. Fished, non-fished control and replanted areas will be closely monitored for signs of sustainability or population declines. The hypothesis to be tested is whether or not the TAC is sustainable. Abalone will not be harvested for consumption, which will negate the substantial financial concerns associated with re-opening the fishery (costs of increased enforcement, management of licenses and tags, changes in regulations, etc.). The outcome will be a rigorous test of the TAC while maximizing the potential reproductive output of existing broodstock. This Phase may last for 5 years or longer, until enough information has been collected to substantiate the appropriateness of the TAC. This may be the first such scientific test of a TAC ever conducted before a consumptive fishery opens.

Phase 2. "Consumptive Fishery"

Implementation of Phase 2 will depend upon the outcome of Phase 1. If the experiment shows that the TAC meets criteria allowing for 'continuing recovery', then a consumptive fishery may be authorized by the Commission. The Commission may also decide to retain a portion of the

harvest allocation for continued rebuilding of depleted stocks in other locations. Phase 2 will demand adequate financial and personnel resources for fishery management and enforcement at a level not needed in Phase 1.

Safeguard Mechanisms

Under this proposal, the appropriateness of the TAC will be scientifically tested during Phase 1. If any signs of recruitment failure or population decline becomes apparent, then the experimental harvest will cease immediately. If and when Phase 2 commences, the criteria will be the same. Additional cautions will be in place for El Nino events where declines in kelp and warm water may initiate Withering Syndrome and wide-scale mortality.

D. Summary of model information and other information used to support TAC

At the time of this writing (December 2009), the modeling work and the risk assessment have not been completed as proposed and therefore the AAG has incomplete information with which to establish a suitable TAC. The initial modeling report suggests that populations may be decreasing under the current no-harvest period: *"The low recruitment in recent years created a high probability that the population will keep decreasing even if there is no fishery*[7]". However, whether the TAC is 50 or 50,000 is somewhat immaterial, as the Alternative 3 proposal is focused on testing this number in such a manner that simultaneously furthers the goals of the ARMP. In this proposal, scientifically testing the TAC and rebuilding populations go hand in hand. The TAC should be set according to the best available science, and should be tested by closely monitoring population levels both at donor and translocation sites over several years. Only then will it be determined if the TAC was indeed appropriate.

E. Description of Management Considerations for Implementation

i. Management

Under Phase 1, no new management measure will be needed. Under Phase 2, the Department may wish to explore measures such as the cooperative approach outlined in Alternative 1.

ii. Enforcement

We recognize the fact that existing enforcement levels are not sufficient to adequately patrol the region, and that San Miguel receives much less attention than other islands closer to port. Under Phase 1 of this Proposal, there will not be an immediate need for additional enforcement effort as would accompany a consumptive fishery. However, we feel strongly that support for existing enforcement needs to be increased to where enforcement personnel can accomplish their job responsibilities.

Under Phase 2, the Consumptive Fishery, enforcement will need to be greatly ramped up both in the field and dock-side. There will need to be tracking of both recreational and commercial activity and landings to ensure that poaching and illegal sales do not occur. The existing level of enforcement will not be adequate to protect this valuable resource. The tag and tracking system outlined in Alternative 1 may be considered by the Department.

We have grave concerns that the publicity accompanying the re-opening of this fishery, regardless how limited the TAC, will open the doors to a dramatic increase in illegal take and trafficking. The public perception that a fishery has been opened may overshadow the 'fine print' of rules and regulations. For this reason, we feel that beginning with Phase 1 is the most precautionary and prudent step for testing a new fishery at San Miguel.

[7] Jiao, Yan 2009 "improving the stock assessment of California Red Abalone (Haliotis rufescens at San Miguel Island)

iii. Monitoring
We propose developing a careful monitoring plan for the harvested donor sites, control/reserve sites and at the transplant location(s). The aim of the monitoring will be to detect changes in populations resulting from harvest and to distinguish naturally occurring events such as El Nino. A review of monitoring data, perhaps at 5 year intervals, should allow the Department to decide whether or not to continue or not, or if to expand the harvest proportion of the TAC.

Funding: how to pay for it
The benefits of this Alternative should be considered along side of the costs. Rebuilding populations, a major goal of the ARMP, will be achieved while the Department gathers information important for re-opening this and other fisheries.
Under Phase 1, there will be no fishery-based revenue as landings will not exist. Still, funds will be needed to pay for the harvest and translocation of abalone under the experimental TAC, in addition to long-term monitoring costs. Our preferred option is to secure dedicated funds from a federal agency (CINMS, NPS) or NGO conservation organization that would cover 100% of the effort. Novel methods of raising funds could include an "Adopt-A-Abalone" fundraiser or even direct mail. For a rough estimate of costs, we examined a current experimental translocation of green and pink abalone undertaken by DFG. The estimated budget for that multi-year project is $100,000, which would transplant up to 500 abalone (based upon the number of pit tags requested). Using this DFG project as a guide, funds of $200,000 or more may be needed to undertake the envisioned experimental test of the San Miguel TAC. It is conceivable that with careful planning, multi-agency participation and public support, the costs for Phase 1 could be considerably less and the number of abalone transplant could be far greater.
Our second, less-preferred option is to allow some of the experimental harvest to be landed and the proceeds pay for the experimental effort. The trouble with this scenario is that once landings are permitted, the costs of the program will escalate due to an increase in enforcement and management related to handling permits and tags.
No landings simplifies the experimental test of the TAC as it eliminates the need for new enforcement, does not provide a venue for additional poaching & trafficking, does not initiate costs of new fishery management, etc. However, we are not opposed to consumptive harvest of part of the TAC if it were to provide a source of funding for the experiment. The revenue from commercial and recreational yields would also be needed to fund the monitoring, enforcement and management of a open fishery.
The bottom line is that everyone agrees that the red abalone resource at San Miguel is highly valuable, and as it may comprise most of the remaining stock in Southern California, the cost of this dual-purpose Alternative should not be considered prohibitive.

F. Key Regulations
New regulations would only be needed upon implementation of Phase 2, and could include those proposed by the other alternative proposals.

Note: All information required for this management option is contained in Parts I and II, above. This option does include an additional information section.

Abalone Advisory Group Option D: The Assurance Approach: High Density Requirement for Harvest.
Executive Summary

Lead: Daniel L. Geiger, AAG. Contributors: Jessie Altstatt, AAG; Dan Richards, AAG

a) Name and Overview Description of alternative

The Assurance Approach: High Density as requirement for Harvest

The current state of the red abalone population at San Miguel Island, and best available science does not support any sustainable harvest. Any demonstration fishery has the potential of disrupting recovery and to further imperil the largest population of red abalone in Central and Southern California. Best modeling efforts predict a declining population even with zero TAC. Hence, any TAC will accelerate the predicted population decline.

Accordingly, the population should be further monitored, and population models should be refined and tested, applying precautionary principles. Only at overall population densities >4000/ha should a fishery be opened. This number comes directly from the Abalone Recovery and Management Plan, which uses the density of 6,000/ha to deem an area "fully recovered." The high number will safeguard against sudden population fluctuations, i.e., due to mortality from El Niño events or large-scale poaching operations. The population at SMI is the last remaining stronghold for red abalone throughout Southern California, and is too valuable to risk.

b) Recommendation for TAC (and allocation)

Below overall population density (Additional information h) of 4000/ha, TAC = 0. The reason is the expected El Niño mortality of ~50% should leave the population above Minimum Viable Population (MVP) densities of 2000/ha (Additional Information g).

Above population densities of 4000/ha, TAC is a fraction of surplus production (Additional Information d). Surplus production is currently difficult to assess. Given the necessary time for populations to reach 4000/ha (decades?), surveys and modeling can be refined.

Definition of sustainability: model predicts with 90–95% confidence interval (18–19 out of 20 years) MVP densities do not fall below 2000/ha (Additional Information b).

Allocation (commercial/recreational): Any allocation/use from Options 1–3 are compatible with Option 4. No specific allocation is advocated in order not to detract from the high-density requirement.

c) Indicate if phased approach and triggers or timeframe for moving to different phase or change allocation

Phase 1. Wait for populations to reach >4000/ha. Estimated to take 10–20 years under favorable conditions, may never be reached again, hence, may make red abalone un-fishable.

Phase 2. At >4000/ha fishery starts at levels informed by 10–20 years of surveys and more modeling.

Safeguard mechanisms. Below 4000/ha as identified by surveys, fishery stops. In years where El Niño events are likely to occur, fishery is closed as a precaution (Additional Information i).

Change in allocation mechanism: No specific proposal, no objection to any of alternative options within the >4000/ha requirement.

d) Summary of model information and other data used to support TAC

- Population modeler's 1 year forecast model: declining population with no harvest.
- Bodega Bay lab El Niño simulation experiments on abalone mortality.
- Attempt of roughly estimating long-term population growth and necessary growth rates using simplistic and overly optimistic exponential growth calculations (i.e., power functions: see Additional Information d, e, g, for details and calculations).
- Abalone Recovery and Management Plan.

e) Description of Management Considerations for implementing the Alternative (including management, enforcement and monitoring approach)

Few specifics are provided in this option in order not to detract from the high-density requirement for harvest/use. Any management variable that helps to combat poaching is favored. As DFG has most experience in combating poaching, management variables are intentionally left to DFG to decide upon.

i) Management approach.

1) Area management: At discretion of DFG, should facilitate enforcement. DFG discretion encompasses both large-scale (e.g., SW zone only vs. all zones) as well as small-scale aspects (e.g., with/without microblocks).

2) Seasonality: At discretion of DFG, should facilitate enforcement.

ii) Enforcement (Additional Information h).

1) In no harvest years: As currently carried out, any additional enforcement should be beneficial to combat poaching.

2) In harvest years: As currently carried out by law enforcement for other fisheries. Tag system may be advantageous.

iii) Monitoring approach. Annual/biannual surveys similar to those carried out 2006–2008, according to Review Committee suggestion. Any suitable survey protocol (line transects, radial search, nearest neighbor) is acceptable. I should minimally have the detection power of the 2006–2008 surveys (30–50% population change), but ideally rather 10–20% power of detection.

iv). Funding. Once harvest/use starts, management costs should be covered by revenue from fishery (licenses, permits, tags, taxes, donations). With too many variables open, no specific proposal can be presented at this time.

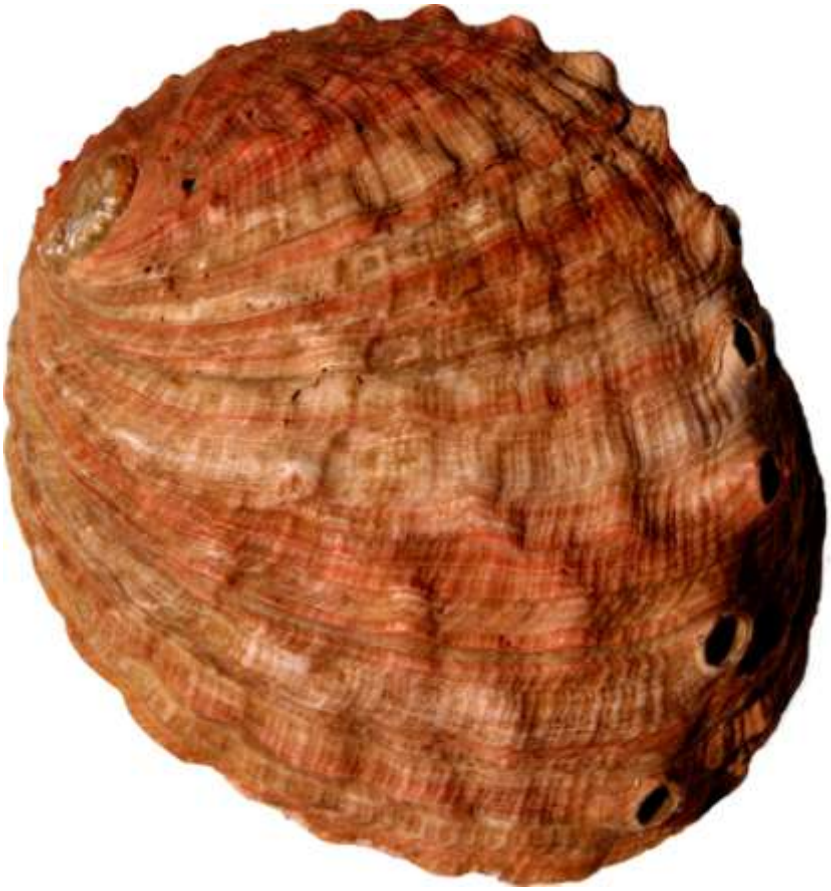
f) Key regulations needed

i) Legal size = 8 inches = 203 mm. Same for commercial and recreational.

ii) Season = limited season for ease of enforcement. At discretion of DFG, should facilitate enforcement.

iii) Automatic closure mechanisms at population density below 4000/ha, forecast of El Niño.

RED ABALONE MARKET FISHERY OPERATING GUIDELINES



California Abalone Association
December 2009

TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

TABLES

First Edition: October 24, 2009
Second Edition: December 4, 2009

APPENDICES

ACKNOWLEDGEMENTS

The California Abalone Association wishes to acknowledge the following groups and individuals who assisted us in this endeavor. We are grateful for the help we received and the opportunity to work with these bright, motivated, and visionary people.

California Center for Cooperative Development
Kim Coontz and Luis Sierra

California Department of Fish and Game
Tom Barnes, Kai Lampson, Sonke Mastrup, Derek Stein, Ian Taniguchi, Marija Vojkovich, John Ugoretz

California Fish and Game Commission – Marine Resources Committee
Richard Rogers, Michael Sutton, Craig Shuman

Ray Hilborn

Ken Manock

Patagonia

Jeremy Prince

SMI Abalone Advisory Group
Jessie Altstatt, Bill Bernard, John Butler, Daniel Geiger, Sean Hastings, Terry Maas, Chris Mobley, Greg Sanders

Steve Rebuck

Review Committee
Doug Butterworth, Harry Gorfine, Steve Schroeter, Ed Weber

Scientific Certification Systems
Sabine Daume, Stephen Mayfield, and Craig Mundy

Joseph Sullivan

Sustainable Fisheries Fund
Mike Eaton and Andy Reid

ACKNOWLEDGEMENTS

Sustainable Fisheries Group
Chuck Cook, Steve Gaines, Jocelyn Ondre, Michael Robinson

Robert Treanor

University of California at Santa Barbara
Bren School of Environmental Science & Management
Kristen Bor, Chris Costello, Heather Hodges, Ariel Jacobs, Hunter Lenihan, John Melack, Dan Ovando, Sarah Rathbone, Josh Uecker, Sarah Valencia

World Wildlife Foundation
Alison Cross and Meredith Lopuch

GUIDELINE AUTHORS

These guidelines were developed by members of the California Abalone Association. The authors listed below represent a cumulative total of more than 350 years of diving experience, much of it at San Miguel Island.

Chris Voss, President
Harry Liquornik, Vice President
John Woodcock, Secretary
Craig Brooker, Treasurer
Jim Marshall, Technical Advisor

Additional support and guidance was provided by: Jeff Baldwin, Mark Brubaker, Michael Candy, Pierre Charest, Bob Duncan, Michael Harrington, Mike Kitahara, Gaylord Parkinson, Richard Pogre, Mike Radon, and Don Thompson

Administrative support provided by Alicia Bonnette

Photos by Jody Helzer Pesapane of Liquid Blue Media

I. INTRODUCTION

Modern fishery management is not simply about science, it also requires fishermen to manage themselves and have a framework for doing so. By controlling their activities fishermen can avoid adding more strain on the valuable wild abalone populations of California. Fishermen need to be directly involved in resource management processes so they have a stake in resource stewardship and are encouraged to become guardians of that resource. Thus, their involvement completes an otherwise incomplete conservation equation.

The California market abalone fishery has been and continues to be a leader in innovative resource management. This fishery was the first in the State to set size limits and restrict access. Presently, the California market sector is striving to utilize tools that incorporate modern, successful, and cutting edge resource management principles which place fishery sustainability above all else.

II. GUIDING PRINCIPALS

The framework for the principles expressed in these Operating Guidelines is based on four (4) components:

First: The "California Marine Life Management Act" (MLMA), which became law on January 1, 1998, placed greater responsibility for marine fisheries on the California Fish and Game Commission (Commission) and the California Department of Fish and Game (CDFG). The MLMA places priority on long-term benefits and sustainability over short-term benefits and emphasizes an ecosystem perspective. It also places a strong emphasis on a science-based management plan that is developed by the combined efforts of knowledgeable fishermen, whose livelihood depends on a healthy resource, and marine biologists.

Second: "The Barefoot Ecologist's Toolbox", Jeremy Prince, Ph.D. (2003), acknowledges the spatial complexities of marine resource management and recognizes the invaluable knowledge of fishery participants about their fishery. These credentials include fishery history, culture, and environment; and are often discounted when assessing a resource. Both Dr. Prince and Dr. Ray Hilborn (Professor of Fisheries Management, University of Washington, and Member of President's Commission for Ocean Policy) have demonstrated great success in fishery management, recovery, and enhancement by developing studies that tap into, train, and utilize the fishermen. Implementing a Barefoot Ecology program for San Miguel Island (SMI) red abalone (Haliotis rufescens) will involve fishermen who have extensive knowledge of that resource. Their strong stake in the preservation of this resource will foster stewardship for the sustainability of the resource.

Third: The Commission policy on "*Restricted Access Commercial Fisheries*" (Appendix A) is a valuable reference. In general, the goals of the restricted access policy are to enhance the State's ability to manage its commercial fishery resources and contribute to sustainable fisheries management by:

1. Providing a means to match the level of effort in a fishery to the status of fishery resources
2. Promoting a sustainable fishery and giving fishery participants a greater responsibility for maintaining sustainability
3. Providing a mechanism for funding fishery management, research, monitoring, and law enforcement activities
4. Maintaining long-term economic viability in a fishery and providing long-term social and economic benefits to the State and fishery participants
5. Providing for an orderly fishery and expanding opportunities for the market sector to share management responsibility with CDFG

Fourth: The "Abalone Recovery Management Plan" (ARMP) adopted by the California Fish and Game Commission in December 2005 provides a framework for the recovery and management of California abalone populations. This recovery and management plan was developed to manage abalone fisheries and prevent further population declines throughout California, and to ensure that current and future populations will be sustainable. Section 7.38 (Alternative 8) of the ARMP allows for a limited abalone fishery at selected areas at a reduced density prior to full recovery in all areas (Appendix B).

III. Background

In 1997 legislation created a moratorium for the taking of abalone in the waters south of San Francisco. It also mandated the creation of the Abalone Recovery and Management Plan (ARMP) to provide a cohesive framework for the future management of abalone fisheries. In December 2005, the Abalone Recovery and Management Plan (ARMP) was adopted by the California Fish and Game Commission (Commission).

A. San Miguel Island Abalone Fishery Advisory Group (AAG)

In January 2006, the California Department of Fish and Game (CDFG) embarked on a "limited abalone fishery" management and monitoring process by forming the "San Miguel Island Limited Fishery Task Team". This group consisted of CDFG staff and representatives from the California Abalone Association (CAA). Their mission included:

1. The development of a scientifically sound survey program
2. Creating a framework for integrating CDFG and fishermen in survey and management efforts
3. Developing parameters for a fishery

In March 2006, the Commission directed CDFG to initiate a more formal process to consider the limited abalone fishery at SMI. This led to an extensive cooperative planning approach and constituents to an advisory group called the "San Miguel Island Abalone Fishery Advisory Group" (AAG) were selected. In September 2006, the AAG stakeholders from commercial fishing (CAA), recreational diving, fisheries science, and marine conservation groups, as well as the Channel Islands Marine Sanctuary, Channel Islands National Park, and CDFG began meeting. Their mission was "to provide a limited range of fully developed alternatives for managing a potential fishery at SMI to CDFG."

The AAG stakeholders are slated to complete their charge in November 2009 and finalize four (4) different management alternatives for a potential fishery at SMI. These alternatives will be prepared by the following AAG constituent groups:

1. Commercial fishing
2. Recreational diving
3. Conservation
4. Preservation

Each alternative will include recommendations on:

1. Total Allowable Catch (TAC),
2. Allocation between commercial and recreational take
3. Regulations to achieve TAC and allocation
4. Management, enforcement, and monitoring considerations

The CDFG will subsequently consider each of these proposed management alternatives in developing their recommendations to the Commission. The Commission will be asked to study these Alternatives in preparation for discussions in February 2010 on whether or not to reopen the SMI red abalone fishery.

B. California Abalone Association (CAA)

The California Abalone Association (CAA) was formed in 1971 and has been an active participant in abalone fisheries management for 38 years. The CAA has held a 501(c) (3) non-profit status since 1984 and is based in Santa Barbara California.

The CAA mission is "to restore and steward a market abalone fishery in California that utilizes modern management concepts, protects and enhances the resource, and guarantees a sustainable resource for the future."

In June 2006, the CAA presented CDFG with the "San Miguel Island Restricted Access Abalone Fishery Market Sector Plan" which captured the principals embraced by CAA members. Over the next several years these principals were further developed and expanded. In April 2009, the CAA presented the Fish and Game Marine Resources Committee with the "Red Abalone Market Fishery Operating Guidelines" (Guidelines) that embrace the four (4) guiding principles previously described.

The Guidelines expand upon traditional government approaches to public and stakeholder involvement to create an adaptive shared management framework that establishes a community based monitoring, harvesting, and marketing cooperative. This cooperative will be responsible to the State for management of the harvest and harvesters.

It is hoped that these Guidelines will be the framework for sustainably harvesting red abalone and merit a "certification of sustainability" from the Marine Stewardship Council (MSC). The MSC is an independent, non-profit organization with internationally recognized environmental standards for sustainable and well-managed fisheries. Their certification label identifies a product which originates from a responsibly managed fishery.

In October 2009, the CAA began the MSC pre-assessment process to identify strengths and weaknesses in the CAA's proposed fishery management Alternative. Scientific Certification Systems (SCS) has been retained to conduct the pre-assessment. Their report "San Miguel Island Red Abalone Fishery MSC Pre-Assessment" (Appendix C) will also be used to determine potential barriers to certification and whether a reopened red abalone fishery could progress to a full MSC assessment stage.

The MSC pre-assessment will complement a stock evaluation that is currently being conducted by the Bren School of Environmental Science and Management at the University of California at Santa Barbara. The Bren School evaluation will analyze potential fishery impacts and assess the effectiveness of the CAA's proposed management alternative. This evaluation will help determine whether the proposed management approach is precautionary enough to allow continued recovery of SMI red abalone populations.

In addition, the CAA is currently working with the Bren School on the "Optimal Design and Management of a Commercial Fishing Cooperative for the San Miguel Island Red Abalone Fishery" (Appendix D). Five (5) masters students and faculty sponsor Dr. Chris Costello will complete the group project. The project evaluates the viability of a self-funded commercial red abalone fishing cooperative, while providing recommendations to the CAA for managing the cooperative in a way that provides optimal environmental and economic benefits. If the fishery is reopened, the CAA will also work with the California Center for Cooperative Development (CCCD) and their partners to implement the cooperative's legal structure and help develop the educational and technical assistance essential to create a harvesting, monitoring, and marketing cooperative of abalone fishermen.

C. CAA Accomplishments

In 1991, the CAA initiated legislation that established the "Abalone Resource Restoration and Enhancement Dedicated Account". The purpose of this "Dedicated Account" is to fund abalone enhancement and research projects in California. Expenditures from the account are made by CDFG with guidance from the Commercial Abalone Advisory Committee (CAAC).

In 2006, 2007, and 2008 CAA members participated with other stakeholders (NOAA, National Parks, ReefCheck, CDFG, etc.) and contributed funding for surveys at SMI. In 2006, 400 transects were sampled at 202 random survey stations, and 5,695 abalone were counted. The results of this survey provided the first extensive data on SMI abalone densities, distribution, size, health, population estimates, and habitat characteristics since closure of the commercial abalone fishery in 1997. During the 2007 survey, 256 transects were sampled at 128 random survey stations, and 3,488 abalone were counted. The results for this survey data are still in draft form. In 2008, 350 transects were sampled at 175 random survey stations,

and 6,470 abalone were counted. The results for this survey are being compiled and all three years of data will be compared.

2008 Survey Transect Line

In 2009, the survey protocols were redesigned to gather data differently from the previous surveys. The redesign also addressed a lack of funding (both CDFG and CAA) so that efforts could be downsized and concentrated in areas of abalone habitat that could support a future fishery. Four areas of habitat were selected based on previous surveys and diver interviews. Two (2) of the areas were in the Southwest Zone (that is proposed for fishing) and two (2) were in areas that will not be fished. This will allow for Before-After-Control-Impact (BACI) comparisons to be made.

The CAA conducted these surveys from October 29 to 31 using four CAA boats each with a team of two divers. These teams completed 42 survey stations within the four (4) areas. Data entry is ongoing and a report will be prepared and distributed in January 2010.

Along with the public/private partnership developed with CDFG the CAA has successfully collaborated with University of California (UC) researchers, the CAAC, and the AAG on the following projects:

1. Testing materials and methods for "outplanting" larval stage red abalone (UC Santa Barbara)
2. Restocking of juvenile red abalone (UC Santa Cruz)
3. Investigation of micro-predators of larval red abalone (UC Santa Barbara)
4. Installation of a permanent National Park Service Kelp Forest Monitoring site at SMI through a grant to the CAA from the Santa Barbara Energy Division Fishery Enhancement Fund
5. Development of abalone monitoring protocols in collaboration with CDFG (2006, 2007, 2008, and 2009)
6. Initiation of a two day workshop on abalone data needs, population modeling, harvest strategies, and potential fishery controls (December 2006)
7. Hiring Dr. Yan Jiao, from Virginia Polytechnic Institute, to model Total Allowable Catch (TAC) options for red abalone at SMI (2008)
8. Completion of a two day scientific review to evaluate the red abalone stock assessment in support of AAG deliberations funded by the Sustainable Fisheries Fund (February 2009)
9. Collaborated with CDFG on the installation of study sites at SMI to detect movement and growth at Tyler Bight and Judith Rock Reserve (2009)

D. CAA Goals and Objectives

The primary goal of the CAA is to advocate rational management for the protection, preservation, enhancement, and promotion of abalone. The CAA is committed to:

1. Actively rebuilding abalone populations
2. Developing science based fishery management to prevent overfishing
3. Identifying and finding solutions for wasteful or damaging practices that negatively impact California abalone populations
4. Assisting local, regional, state and federal authorities in enacting approaches, guidelines, programs, and laws that ensure the sustainability of the resource

The primary objectives of the CAA are to:

1. Develop a market abalone fishery that uses a monitoring, harvesting, and marketing cooperative to avoid the "tragedy of commons"
2. Work with the California Department of Fish and Game in acquiring data needed to evaluate fishery impacts on the abalone resource and develop accurate annual stock assessments
3. Utilize timely adaptive management techniques that respond to changes in fishery conditions to maintain a viable red abalone population, and sustain the fishery

The introduction of the "Guide to California's Marine Life Management Act" (1998) states, "The effectiveness of management measures depends greatly upon public confidence in the way decisions are made and put into practice. Critical to building and maintaining this confidence is openness in decision making that goes beyond traditional, formal processes."

Therefore, the components outlined in these Guidelines are set forth to:

1. Expand upon traditional government approaches to public and stakeholder involvement to establish a framework for adaptive shared management
2. Outline the process to establish a community based monitoring, harvesting, and marketing cooperative that will be responsible to the State for management of the harvest and the harvesters
3. Meet the challenge of sustaining the abalone resource
4. Provide the basis for regulations and Memorandums of Understanding (MOUs) necessary to establish a "demonstration" commercial abalone fishery in the Southwest Zone of San Miguel Island

IV. EXECUTIVE SUMMARY

A. Red Abalone Demonstration Fishery at San Miguel Island (SMI)

The commercial sector, represented by the California Abalone Association (CAA), proposes a Restricted Access Fishery (RAF) for red abalone (Haliotis rufescens) at SMI. A community-based fishermen's harvesting cooperative will be developed to accept a harvest allocation. If an allocation is granted to this cooperative it will assist the California Department of Fish and Game (CDFG) with the management, enforcement, monitoring, and data collection of this fishery. This will be achieved by entering into a Memorandum of Understanding (MOU) and developing supporting regulations to ensure that the State retains oversight and that the abalone population continues to recover. The commercial option described here recognizes that responsible resource stewardship is inherently linked to the success of the cooperative which places the health and habitat of the abalone population above all other considerations.

San Miguel Island

B. Total Allowable Catch (TAC)

A TAC of 10,728 abalone over 8 inches (203mm) is recommended for the Southwest Zone of SMI. A bootstrap analysis (Appendix G) of the 2008 survey data was conducted to create a TAC Decision Table (Section VI) that illuminates the tradeoffs associated with different population probabilities and catch. Using this analysis, there is a 95% probability that 10% of abalone larger than 8 inches in the Southwest Zone is equal to or greater than 10,728.

The CAA proposes that 90% of the TAC be allocated to the commercial sector as the Total Allowable Market Catch (TAMC) and the remaining 10% allocated to the recreational sector as the Total Allowable Recreational Catch (TARC). A change in the TAC would not affect these allocation percentages. These percentages reflect historical allocations based on CDFG catch records. The commercial sector believes this is an equitable division because of the existing recreational-only fishery above San Francisco to the Oregon border. The commercial cooperative will divide its TAMC allocation among its members in an efficient, safe, and ecologically sustainable manner. The initial TAMC allocation will be divided equally among all participating cooperative members.

The TAC recommended in this option is based on a conservative estimate that preserves over 80% of the population's spawning potential, and is considered sustainable over both the short and long term. This options's recommended TAC represents 1% of the total abalone estimated at SMI. Populations in the Northwest, Northeast, and Southeast Zones, as well as in the Judith Rock Marine Reserve (in the Southwest) will remain untouched.

Precautions built into this option include:

1. An increased size limit
2. A conservative TAC
3. Eliminating incidental mortality of sub-legal abalone by only handling emergent abalone that can be easily measured
4. Harvesting 30% or less of abalone in a group to protect spawning aggregations and prevent potential "Allee effect"
5. Using a conservative population estimate based on data from non-invasive survey protocols that do not detect cryptic abalone.

Uncertainty is inherent in managing natural resources. This option reduces future uncertainty by collecting fishery independent data in both fished and unfished areas to closely monitor and adaptively manage abalone populations. These data will inform a "Decision Tree Process" which sets the annual TAC in order to maintain long term target abundance, and allows for a TAC of zero if certain triggers are met.

C. Information Used to Support the TAC

Three years of collaborative surveys were conducted to assess the population at SMI. Data from the 2006 and 2007 surveys, along with historical catch and fishery-independent data was used by the AAG Technical Panel (TP) to construct a suite of fishery models to assess the population at SMI.

In February 200, these modeling results and the associated TP reports along with data inputs were discussed and reviewed by an independent Review Committee (RC) composed of fishery scientists. The RC determined the modeling work and the related reports were incomplete and a second round of modeling work was recommended. This second round has not currently been commissioned due to a lack of funding. It is difficult to draw conclusions from the TP model and reports, especially since the model did not project forward more than one year in each fishing scenario or provide information on the long-term growth potential of the SMI population, as the RC recommends.

This commercial option focuses on the RC report "Evaluation of the Red Abalone Stock Assessment by the Review Committee In Support of Deliberations of the Abalone Advisory Group" (2009) which recommends "a program of experimental fishing should be considered for the Southwest Zone as an initial step in pursuing the option for removals." In pursuit of this experimental fishery, the RC also recommended that the size limit be raised to 8 inches, and that the initial TAC be set at 10% of the abalone over 8 inches in the Southwest Zone. The RC also stated, "given such a relatively high age at first capture, this 10% proportional take is well below standard fishing mortality reference points."

The CAA has developed this option pursuant to the recommendations of the RC, examples set by a number of foreign abalone fisheries, and the best available science. This option is further informed by the "A New Beginning for Abalone Management in California: Critique and Comment on the Abalone Advisory Group's Discussions" (2009) by Dr. Jeremy Prince and Bren School PhD candidate Sarah Valencia which describes how the SMI fishery can be opened and adaptively managed using a TAC "Decision Table" phased to a "Decision Tree Assessment Process".

D. Allocation Mechanisms

As described above, the initial TAC proposed in this option is based on the TAC "Decision Table". In the years to follow fishery dependent and independent data will continue to inform the "Decision Tree Assessment Process" (VI) to set the annual TAC. The "Decision Tree Assessment Process" will adjust the TAC up or down each year in response to Biological Reference Points (BRPs). These BRPs include ecological triggers such as; sea surface temperature, kelp availability, and long-term abundance targets.

The "Decision Tree" framework will:

1. Use harvest data collected by fishermen
2. Use unfished populations data as a reference
3. Detect and respond to changes in population levels and environmental conditions
4. Accommodate advances in knowledge regarding abalone management to maximize spawning biomass and recruitment

If certain triggers are detected, the "Decision Tree" recommends a zero TAC until data collected provides evidence of population sustaining ability. For example, if a disease outbreak occurs, fishing can be curtailed or terminated to ensure that all surviving spawning abalone are preserved to rebuild the stock following the outbreak.

Annual allocation of a TAMC to the cooperative will be based on the cooperative meeting stated obligations each year. The state will determine if fishing should continue based on the health of the population.

E. Management Approach

Community-Based Harvest Cooperative: Development of a community based cooperative management structure is currently underway by the CAA. This cooperative will meet all the guidelines and requirements set forth by the State of California and the Federal Fishermen's Collective Marketing Act (FCMA) of 1934. The cooperative's legal structure will be based on Articles of Incorporation, bylaws, membership applications, and marketing agreements provided by California attorney Kendall L. Manock of Baker Manock & Jensen in consultation with attorney Joseph M. Sullivan of Mundt MacGregor L.L.P. The cooperative will also take the necessary steps to qualify for the FCMA's limited antitrust exemption.

CDFG Code 5522 (e) states "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." Therefore, all individuals who held an abalone diving permit in the 1996/97 fishing year will be invited to participate in this cooperative.

Shared Management Framework: A shared management framework will be developed with CDFG through a combination of regulation and MOUs. This approach uses the harvesting cooperative to fulfill the necessary shared management activities and makes it possible to achieve comprehensive sustainable fishery management at a lower cost to the state. The harvesting cooperative will:

1. Take responsibility for directing specific harvest and data collection activities
2. Ease the burden to the state associated with enforcement duties

3. Assist with data management
4. Educate the fishing community on responsible marine resource stewardship
5. Create a cohesive and motivated community of market abalone divers that will respond wisely to the challenges of sustainable fisheries management

Under this shared management framework the state will be responsible for:

1. Setting the TAC
2. Providing licenses and permits
3. Evaluating the fishery and cooperative performance through an annual review process

Restricted Access Fishery (RAF): In general, the goal of the Fish & Game Commission Policy on "Restricted Access Commercial Fisheries" (Appendix A) is to enhance the state's ability to manage its commercial fishery resources and contribute to sustainable fisheries management. The RAF proposed for red abalone at SMI meets this goal by:

1. Providing a means to match the level of effort in a fishery to the health of the fishery resources,
2. Promoting sustainable fisheries and giving fishery participants a greater stake in maintaining sustainability,
3. Providing a mechanism for funding fishery management, research, monitoring, and enforcement activities,
4. Maintaining long-term economic viability in a fishery
5. Providing long-term social and economic benefits to the state and fishery participants
6. Providing for an orderly fishery while expanding opportunities for the commercial fishing industry to share management responsibility with CDFG

Harvest: An annual "fine scale" harvest plan will be developed to effectively and accurately manage and assess the abalone resource. The cooperative will implement a regional management approach and direct specific harvest by assigning fishermen to individual micro blocks. This micro block system will foster "community stewardship" by instilling a sense of direct responsibility in fishermen for the blocks they harvest. This approach will link allocation to specific harvest blocks and each member will harvest their allocation according to this annual harvest plan developed by the cooperative in conjunction with CDFG. To achieve fine scale management that is information driven, harvest areas will be divided into $1/10^{th}$ mile blocks. Harvest and population data collected at this scale will provide spatially explicit information for refining management approaches.

"Decision Tree Assessment Process": The "Decision Tree Assessment Process" will remove much of the annual burden of management from CDFG by providing a prescriptive approach to setting the TAC based on scientific data. The CAA will

work with fishery scientists to finalize a Decision Tree specific to red abalone at SMI. The Decision Tree will be in a user-friendly format and will be provided to both the cooperative management and CDFG so that each party can independently verify the TAC recommended by the Decision Tree each year. A secure web-based data management system that can be accessed by the CAA, cooperative, and CDFG will be set up to inform the stock assessment process.

Annual Evaluation and Report: An annual evaluation process will be established to determine success of the cooperative in fulfilling management objectives. The cooperative will be required to complete an annual report documenting its compliance with the terms and conditions stated by the MOU(s) in place and under which its annual allocation was issued. Another purpose of the report will be to determine how well the cooperative met its goals for the year. Some evaluation and report areas include:

1. Population trends over time
2. Data collection and research
3. Fishery dependent data
4. Enhancement
5. Revenue generated from the fishery
6. Management costs

F. Enforcement Approach

This option recognizes two levels of enforcement: government law enforcement agencies and the fishing community. Government enforcement can be seen as a joint effort between CDFG, Channel Islands National Parks Service, Channel Islands National Marine Sanctuary, and the Coast Guard. By vertically integrating the harvest activity and wholesale marketing of abalone with a cooperative, many enforcement concerns can be addressed by the fishing community. A comprehensive state and community enforcement approach also includes:

1. Tag tracking system
2. Single port of landing
3. Season restrictions
4. Harsh penalties
5. Vessel identification/monitoring systems
6. Trace Register (www.traceregister.com) as the independent/third party "registry"

The cooperative will enforce its community bylaws on its members and also aide and assist in enforcement of state regulations. The cooperative will implement an "Island Watch Program" within the existing commercial fisheries to look for suspicious behavior by commercial and recreational vessels. A cooperative funded reward program for information on poaching could also be considered.

Tags and Tracking System: Tags (ARMP Section 7.1.3.) are the cornerstone in connecting biological monitoring, management and enforcement. A system will be developed using a database supported by the tag and logbook system which will identify individual abalone and connect them to a specific diver and area. The cooperative will set up a digital chain-of-custody system to help prevent illegal abalone from entering the marketplace and identifying them if they do. A simple web-based, automated database will be used to track abalone through the entire supply chain (fishery to consumer). It is proposed that the cooperative and all abalone handlers use Trace Register (Section IX) as the independent/third party "registry" into which product, source, and tracking information are entered, secured, and shared throughout the supply chain.

G. Monitoring Approach

Fishery Dependent Data: Each fisherman in the cooperative will be required to complete a "Red Abalone Harvest Log" page for every harvest dive. Each Harvest Log will have sequentially numbered two-part carbon sheets. The "Log" format will provide fishery dependent data that will be used to track the TAMC, determine catch-per-unit-of-effort (CPUE), and enhance understanding of spatial distribution to assist in managing the resource.

Fishery Independent Data: The CAA and the cooperative will work with CDFG to collaboratively train fishermen and design surveys to monitor:

1. Biological Reference Points
2. Spatial distribution
3. Size frequency
4. Densities in both fished and unfished areas

These data will provide detailed information on the fisheries impact on population growth and inform the yearly "Decision Tree Assessment Process" to set the TAC. The 2009 survey protocols used a Before-After-Control-Impact (BACI) design to monitor population trends at specified areas of SMI. This design will reduce costs. The resulting density information can be used for setting future fishery parameters.

H. Funding Mechanisms

The cooperative will enter into an MOU with the state which describes the economic responsibilities and obligations of the cooperative. One goal of the cooperative will be to reduce CDFG costs and create its own revenue stream to pay for education and fishery related monitoring and enforcement.

I. Key Regulations Needed

Specific regulations needed to manage the TAMC are described in Appendix E of the "Red Abalone Market Fishery Operating Guidelines". These regulations include:

1. Season
2. Eight inch minimum size limit
3. Harvest zones
4. Restricted access
5. Gear
6. Landing receipts
7. Taxes and licensing
8. Tamper proof tags

Additional regulations regarding the cooperative's ability to receive an allocation and the content of the necessary MOU(s) that outline the cooperative's responsibilities will also need to be developed.

V. REGULATIONS AND MOU'S

A shared management framework will be developed with CDFG through a combination of regulations and MOUs. This framework will use the cooperative to fulfill a portion of the shared management activities and make it possible to achieve comprehensive sustainable fishery management at a lower cost to the state. The cooperative will:

1. Take responsibility for directing specific harvest and data collection activities
2. Reduce the need for state associated enforcement duties
3. Assist with data management
4. Educate the fishing community on responsible marine resource stewardship
5. Create a cohesive and motivated community of market abalone divers that will respond wisely to the challenges of sustainable fisheries management

Under this shared management framework, the state will be responsible for:

1. Setting the TAC
2. Providing licenses and permits
3. Evaluating the fishery and cooperative performance through an annual review process

It is anticipated that CDFG will develop regulations when the fishery is reopened. The cooperative would like to work jointly with CDFG to develop those regulations. Appendix E contains suggested regulations based on:

1. Commercial Fishing Provisions 95-01 for Abalone Diving (as of January 1, 1995)
2. Excerpts from the Fish and Game Code
3. Excerpts from the California Code of Regulations (Title 14)
4. Fishermen proposed regulatory modifications regarding the cooperative

VI: TOTAL ALLOWABLE CATCH (TAC)

An initial Total Allowable Catch (TAC) of 10,728 abalone 8 inches (203mm) or over is currently recommended for the Southwest Zone of SMI. This initial TAC based on the TAC Decision Table (Table 1), is conservative and includes the following precautions:

1. TAC represents 1% of the total abalone estimated to be at SMI
2. Populations in the Northwest and Southeast Zones, as well as in the Judith Rock and Harris Point Marine Reserves will remain unharvested (Map A)
3. TAC is based on a conservative population estimate based on data from non-invasive survey protocols that do not detect up to 30% of the abalone over 150 mm which remain cryptic
4. Increased size limit (from 7 ¾ to 8 inches)
5. Eliminate incidental mortality of sub-legal individuals by only handling emergent abalone that can be easily measured and clearly meet the 8 inch size limit
6. Harvest no more than 30% of legal-sized abalone in a given aggregation to protect spawning potential and preserve nearest-neighbor distances
7. TAC preserves over 80% of the Spawning Potential Ratio (SPR) in the area to be fished. A common target SP of 50 - 60% is considered precautionary.

A. TAC Development

Three years of collaborative surveys were conducted to assess the population at SMI. Data from the 2006 and 2007 surveys, along with historical catch and other fishery-independent data were used by the AAG Technical Panel (TP) to construct a suite of fishery models to assess the population at SMI.

These modeling results and the associated TP reports along with data inputs were discussed and reviewed by an independent Review Committee (RC) composed of fishery scientists in February 2009. The RC determined that the TP modeling work and the related reports were incomplete and a second round of modeling work was recommended but not commissioned to date due to a lack of funding. Therefore, it is difficult to draw conclusions from the TP model and reports, especially since the model did not project forward more than one year in each fishing scenario or provide information on the long-term growth potential of the SMI population, as the RC recommended.

This initial TAC for the Southwest Zone was determined based on the RC recommendations, examples set by a number of foreign abalone fisheries, and the best available science. In particular the RC indicated that "a program of experimental fishing should be considered for the Southwest Zone as an initial step in pursuing the option for removals." The complete RC Report "Evaluation of the

Red Abalone Stock Assessment by the Review Committee in Support of Deliberations of the Abalone Advisory Group" can be referenced in Appendix F.

In pursuit of this experimental fishery, the RC also recommended that the size limit be raised to 8 inches, and that the initial TAC be set at 10% of the abalone over 8 inches in the Southwest Zone. The RC also stated, "given such a relatively high age at first capture, this 10% proportional take is well below standard fishing mortality reference points." This TAC is further justified and informed by the "A New Beginning for Abalone Management in California" (Appendix G) by Dr. Jeremy Prince and Bren School PhD candidate Sarah Valencia, which describes how the SMI fishery can be opened and adaptively managed using a TAC Decision Table phased to a Decision Tree.

B. Decision Table Designed to Develop Initial TAC

A bootstrap analysis of the 2008 survey data was conducted to create the initial TAC Decision Table (Table 1) that illuminates the tradeoffs associated with different population probabilities and catch. Using this analysis, there is a 95% probability that 10% of abalone larger than 8 inches in the SW zone is equal to or greater than 10,728. This analysis is described in detail in "A New Beginning for Abalone Management in California".

Table 1: Harvest Decision Table using 2008 San Miguel Survey Data

Total Population In SW Zone	320,220	335,562	345,560	353,252	359,640	365,186
Population> 203mm	107,278	112,418	115,767	118,344	120,484	122,342
Harvest Fraction	**95%**	**90%**	**85%**	**80%**	**75%**	**70%**
0.05	5,364	5,621	5,788	5,917	6,024	6,117
0.1	**10,728**	11,242	11,577	11,834	12,048	12,234
0.15	16,092	16,863	17,365	17,752	18,073	18,351
0.2	21,456	22,484	23,153	23,669	24,097	24,468
0.25	26,819	28,104	28,942	29,586	30,121	30,586
0.3	32,183	33,725	34,730	35,503	36,145	36,703
0.35	37,547	39,346	40,518	41,420	42,169	42,820
0.4	42,911	44,967	46,307	47,338	48,194	48,937

C. Decision Tree Assessment Process

The strength of the Decision Tree process lies in its simplicity. It makes few assumptions and requires minimal inputs, but prescribes catch levels based on continuous monitoring to achieve long range target stock levels. By incorporating MPAs as a reference stock, it integrates an ecosystem based approach into fisheries management, and facilitates monitoring of California's MPAs. In addition, involving fishermen in the stock assessment process, promotes greater industry involvement and accountability in management. This will support the implementation of various harvest strategies.

Uncertainty is inherent in managing natural resources. Future uncertainty can be reduced by collecting fishery independent data in both fished and unfished areas (Figure 1) to closely monitor and adaptively manage abalone populations. These data will inform a Decision Tree Assessment Process which:

1. Sets the annual TAC to achieve long term target abundances
2. Allows for a TAC of zero if certain triggers are met

The Decision Tree Process will adjust the TAC up or down each year in response to Biological Reference Points (BRPs). These BRPs include ecological triggers such as sea surface temperature, kelp cover, kelp abundance, long term abundance targets, population size structure and spawning potential.

The SMI Decision Tree Assessment Process (Figure 2) will embrace a conservative management approach for protecting more than 80% of Spawning Potential Ratio (SPR). This SPR is the proportion of spawning conserved in the fished population relative to the level of spawning expected if the population was left unfished. Since fisheries biologists and managers worldwide recommend SPR targets of 50% to 60% to conserve fish stocks, a target of over 80% provides a precautionary margin for environmental variability, poaching, and other events that might increase rates of mortality. Using this target the SMI abalone population is expected to continue re-building during the projected harvest. The Decision Tree will be used to assess stock relative to the target level of SPR and revise the annual TAC according to relative trends.

The Decision Tree framework will:

1. Use harvest data collected by fishermen
2. Use unfished (MPAs) populations as a reference
3. Detect and respond to changes in population levels and environmental conditions
4. Accommodate advances in knowledge regarding abalone management to maximize spawning biomass and recruitment

If certain triggers are met, the Decision Tree can recommend a zero TAC until data provides evidence the population is capable of sustaining itself again. For example, if a disease outbreak occurs, fishing can be curtailed or terminated to ensure all surviving spawning abalone are preserved to rebuild the stock following the outbreak.

Figure 1: San Miguel Island with Kelp Coverage and Marine Protected Areas

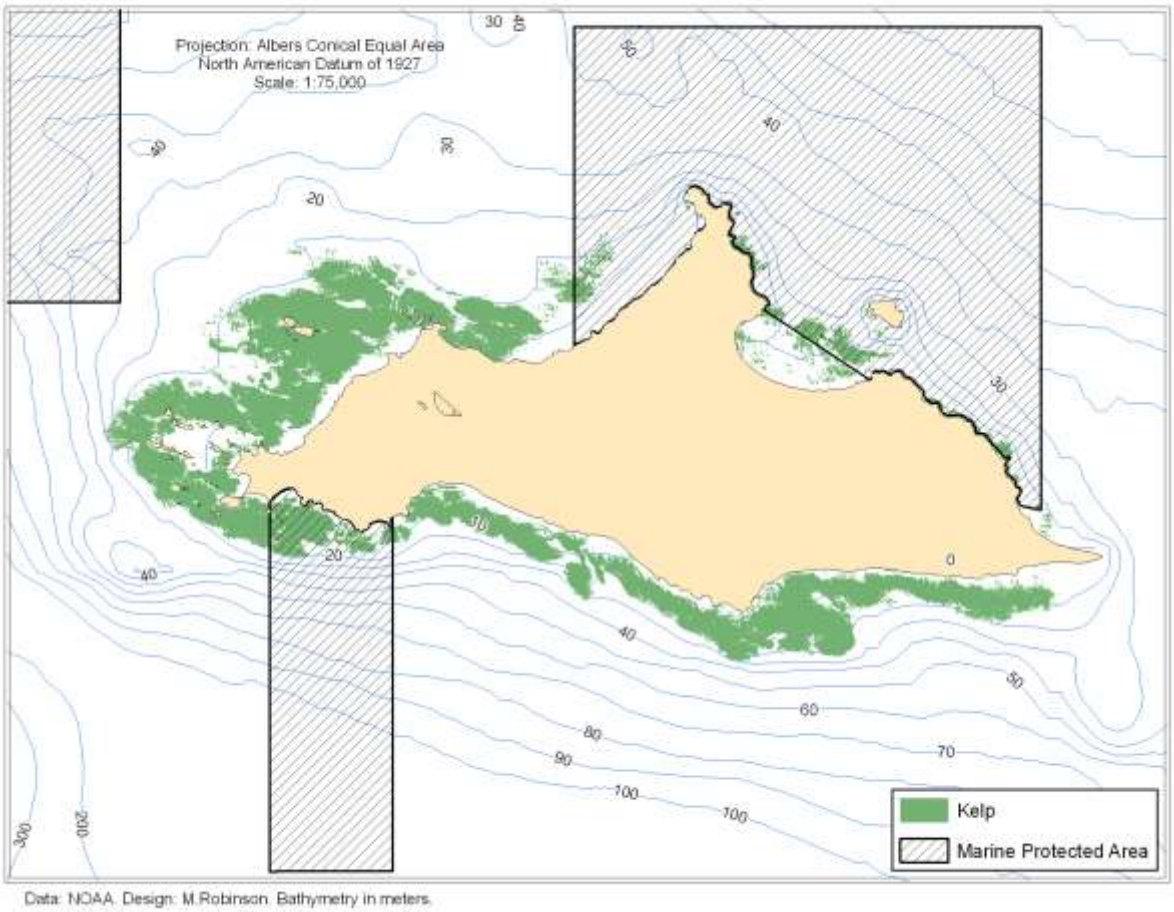
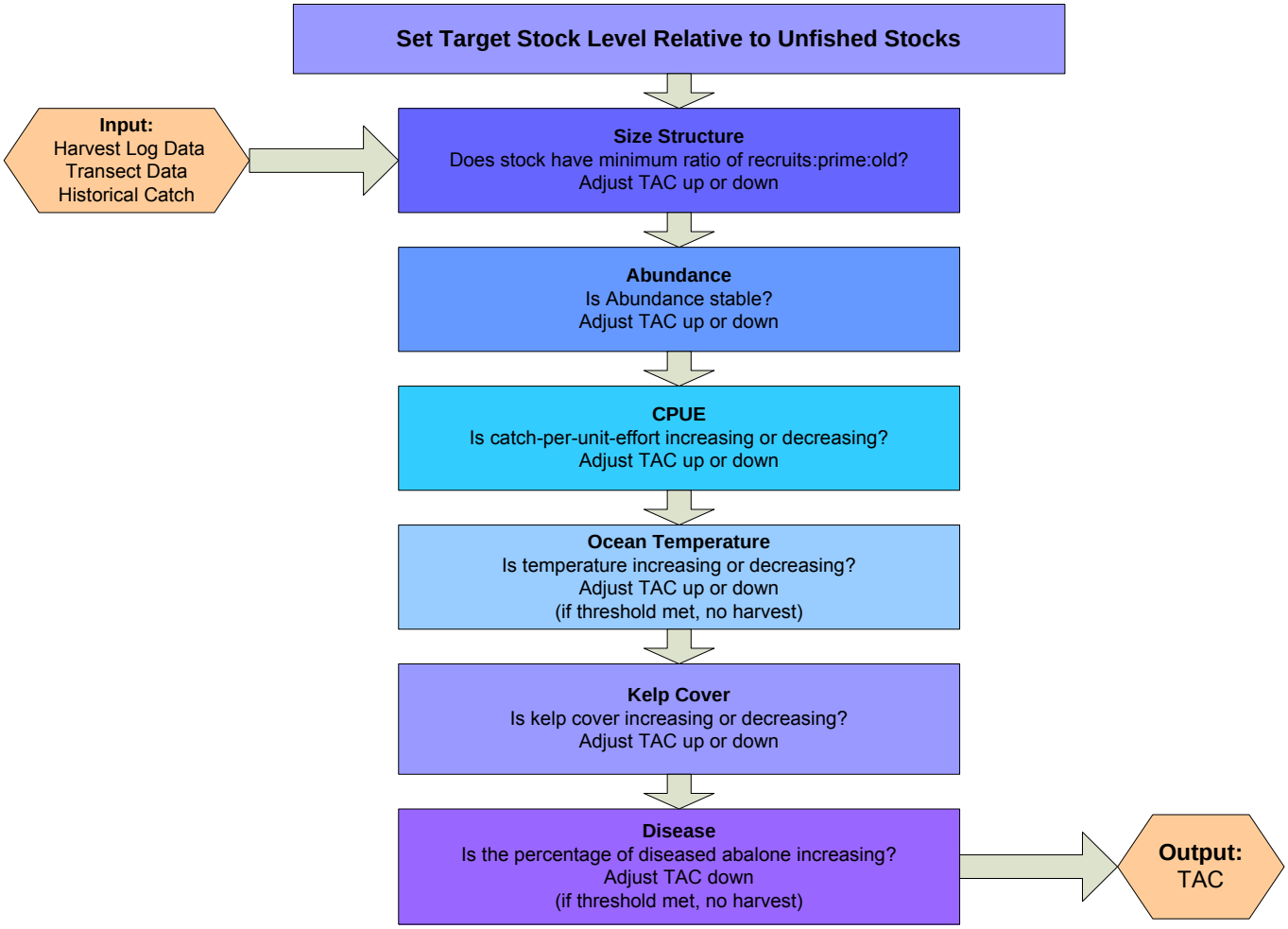


Figure 2: Conceptual representation of a Decision Tree Assessment Process for Red Abalone



VII: Resource Assessment and Data Collection

"The core of the MLMA is the principle of basing decisions on sound science and other useful information. With this in mind, the MLMA includes, as a general objective, promotion of research on marine ecosystems that will enable better management decisions." The MLMA also calls for basing decisions on the best available scientific information along with other information that CDFG and Commission possess.

While the MLMA emphasizes scientific information, it also recognizes the value and importance of other sources of information, such as local knowledge, in making decisions regarding the conservation and sustainable use of California's marine life resources.

The SMI data collection program should be thought of as an evolving process. A large set of abalone population density and size frequency data has been collected through collaborative surveys conducted in 2006, 2007, and 2008. Those surveys termed "Snapshots", gave a good impression of the overall population status at SMI. In 2009, a BACI designed survey was executed to more closely monitor population trends within specified areas at SMI. The survey data will be used to inform analysis of the population status at the island and provide data for the Decision Tree.

When fishing begins, Harvest Logs will be used to gather fishery dependant data. These data will be reviewed annually in conjunction with ongoing fishery independent data to identify population changes. Data gap analysis will be also conducted annually for both fishery dependent and independent data. Improving data collection methods and techniques, identifying data gaps, and informing changes in management will all be components of the data collection and analysis process.

Fishery Dependent Data: Fisherman in the cooperative will be required to complete the "Red Abalone Harvest Log" for every dive during harvest. Each Harvest Log will have sequentially numbered two-part carbon sheets and the format will provide fishery dependent data that will be used to track the TAMC, determine catch-per-unit-of-effort (CPUE) at a fine scale to enhance understanding of spatial distribution and assist in managing the resource.

Fishery Independent Data: The CAA and/or the cooperative will work with CDFG to collaboratively design and conduct surveys to monitor:

1. BRPs
2. Spatial distribution
3. Size frequency
4. Densities in both fished and unfished areas

These data will provide information on the impacts of the fishery on population growth, and feed the yearly Decision Tree Assessment Process to set the TAC.

A. Data Coordinator

In the short term the CAA and/or cooperative will take the lead role in developing data systems, survey designs, and stock assessments.

In the long term a Data Coordinator will be recruited to work with the cooperative and CDFG managers. This important role is expected to evolve and expand over time. The recruit will also be someone who can work closely with the industry, its associated researchers, experts and agencies. The person should have training in fisheries ecology and quantitative stock assessment, but might not need to have a great body of work experience in the early stages. Most importantly he/she should have a personality that will relate well to industry members, as this will be absolutely essential if his/her role is to succeed.

Broadly speaking the Coordinator's role will include, but not be limited to:

1. Become familiar with the industry including, core CAA and/or cooperative members and key agency staff, the port, and the fishing techniques being used
2. Participate in the design and implementation of the survey system
3. Participate in the development of stock assessment
4. Work with the relevant agencies and scientists to collate and organize the data required to formalize a stock assessment for the resource
5. Act as the interface between industry and CDFG in formal stock assessment, research and management process
6. Document formalized stock assessment
7. Update the stock assessment as new data becomes available
8. Participate in the design of the Harvest Log and other required electronic log books
9. Collect, error check, organize, and archive survey data being entered onto the Harvest Log (with assistance from the divers)
10. Take responsibility for ensuring that any additional electronically collected data are error checked and transferred into the central database
11. Maintain the central database and any associated web sites
12. Coordinate harvest activities and work closely with CDFG enforcement in those activities
13. Act as liaison with Trace Register
14. Work with the divers to ensure that they and other volunteer surveyors have the required training and equipment to conduct surveys and work as an effective data collection team

15. Act as liaison to divers and volunteer surveyors to keep them informed about their research role
16. Report activities to the CAA and/or cooperative Board of Directors
17. Prepare required annual reports
18. Attend CAA, cooperative, CDFG, Commission, and other related meetings

B. Survey Training

All data collectors will be trained by the cooperative and/or CDFG in the current survey protocol. The cooperative will continue to work closely with CDFG in data collection training.

C. Annual Surveys

The long term plan is to move towards greater reliance on fishery dependent data, which is more cost effective to collect than fishery independent data. Initially fishery dependent data will continue to be collected and calibrated to fishery independent data. In time, more extensive fishery independent data collections will be triggered by harvest data. If, for instance, the size frequency of harvested abalone were to drop, this might indicate the need for increased fishery independent sampling to help determine possible causes.

1. Fishery Dependent Monitoring

    a. Harvest log
        i. Spatially explicit
        ii. Size/weight catch
        iii. Estimate of remaining
        iv. Area searched/time CPUE
        v. Habitat information
        vi. Ability to map all data 10x10 meter

2. Fishery Independent Monitoring (in and out of reserves)

    a. Band transects
        i. Spatially explicit
        ii. Size frequency
        iii. Density

    b. Timed swim
        i. Spatially explicit
        ii. Size frequency
        iii. Rough density estimate

3. Research

    a. Movement and growth studies are ongoing at Miracle Mile and Crook Point at SMI
    b. Artificial Recruitment Modules (ARMs) have been placed at the "Miracle Mile"
    c. Permanent transect/reference sites at Castle Rock, Judith Rock Reserve, Tyler Bight, Miracle Mile, Wycoff Ledge, Crook Point and Harris Point

Tagged Abalone at Miracle Mile

D. SMI Red Abalone Survey Protocols

The 2009 survey protocols were designed to standardize observations, increase statistical power, and reduce costs (see Appendix H). The 2006, 2007, and 2008 protocols are available at http://ftp.dfg.ca.gov/Public/R7_MR/AAG/.

E. Annual Stock Assessment To Set TAC or Other Fishery Parameters

1. Data Used to Inform Decision Tree Assessment Process

    a. Fishery dependent data
        i. Size structure of catch
        ii. Catch effort trends
    b. Fishery independent data
        i. Size structure of population in/out of reserves
    c. Biological Reference Points
        i. Size structure
        ii. Abundance
        iii. CPUE
        iv. Ocean temperature
        v. Kelp cover
        vi. Disease

VIII: ECONOMIC VIABILITY

California Fish and Game Code, Section 711(2) states that "the costs of commercial fishing programs shall be provided out of revenues from commercial fishing taxes, license fees, and other revenues, from reimbursements and federal funds received for commercial fishing programs, and other funds appropriated by the Legislature for this purpose".

The cooperative will enter into an MOU with the state that describes its required economic responsibilities and obligations. One goal of the cooperative will be to reduce CDFG costs and create its own revenue stream to pay for education and fishery related monitoring and enforcement obligations. It is anticipated that the State's revenue will be generated through the collection of permit and permit transfer fees.

A. Bren School Group Project

This section will also be further developed by completion of the Bren School Group Project entitled "Optimal Design and Management of Commercial Fishing Cooperative for the San Miguel Red Abalone Fishery" (Appendix D). This study will assess the economic and environmental viability of the proposed commercial harvesting cooperative. It will also make recommendations for revising and enhancing the cooperative design in order to maximize profits, while ensuring the long term sustainability of the fished abalone population at SMI.

To accomplish these goals, objectives of the Bren study are to:

1. Utilize environmental and economic data to perform a cost-benefit analysis of a cooperative management structure provided by the CAA, in order to evaluate the long-term financial viability of the proposed fishery
2. Determine alternative management structures for the cooperative, developed from discussions with the CAA and recommendations drawn from collected case studies of similar fishing cooperatives across the globe
3. Conduct cost-benefit analyses of these alternative plans, and synthesize economic viability reports in order to provide the CAA with concrete data on the financial impacts of potential management scenarios and ecological states
4. Develop a comprehensive report assessing the economic viability of a self-funded SMI commercial abalone fishing cooperative along with providing recommendations for optimizing profits while ensuring the sustainability of the resource

This project is significant because abalone is a valuable resource to the State and people of California. As such, if the fishery is to be opened, it must be managed and cared for so as to ensure its economic and ecological sustainability.

The Bren study will help properly design and implement a commercial harvesting cooperative that will:

1. Present a state-of -the-art example of fine scale fishery management with catch shares, a harvest cooperative, and shared management
2. Help shape future policies on the implementation of catch shares and/or fishing cooperatives and/or shared management
3. Demonstrate the viability of fisheries management strategies designed to function in a environmentally sustainable fashion
4. Support local fishermen, restaurant owners, and the local food movement

The data collection phase of this study should be completed by mid January 2010 and a final report on the economic viability analysis with recommendations for the cooperative management structure is expected in February 2010.

IX: COOPERATIVE OPERATING STRUCTURE

The California Abalone Cooperative (CALAB) is a member owned community-based fishermen's cooperative. This monitoring, harvesting, and marketing association will return profit earned to its members. This cooperative will be organized under the guidelines set forth by the Fishermen's Collective Marketing Act (FCMA). It will meet all the guidelines and requirements set forth by the State of California.

The economy of scale for this small fishery strengthens the need to develop a cooperative structure that will include those who held abalone diving permits in the 1996/97 fishing year. A single cooperative will efficiently facilitate, maintain, and fund internal management controls as well as provide consistent shared-management with the state.

This small fishery will be best served with a small cooperative membership, as it will be difficult to manage a large number of members. Therefore, it will be necessary to have a plan to reduce the number of participants over time, and to maintain the cooperative's efficiency and ability to function responsibly. Divers that are considering membership in this cooperative will be expected to accept all the explicit responsibilities for the shared management of this fishery.

A. Mission Statement

The California Abalone Cooperative places the health and habitat of the abalone resource above all other considerations and will co-manage an abalone fishery while recognizing the link between stewardship of the resource and a successful cooperative.

B. CALAB Goals

1. Meet the members' needs for affordable and high-quality marketing and management services
2. Invite all individuals who held an abalone diving permit in the 1996/97 fishing year to participate in this cooperative
3. Ease enforcement duties for the State
4. Co-direct monitoring and assist the State in data management
5. Educate fishing and public communities
6. Enhance the abalone resource
7. Develop constructive community relationships

C. Allocation to Harvesting Associations

Total Annual Market Catch (TAMC) will be allocated annually to the abalone harvesting association(s) that files an application which satisfies regulatory criteria. Such criteria will include:

1. All members hold a current restricted access permit
2. An abalone harvesting plan that conforms to the fishery management measures in effect (such as minimum size requirements, harvest location documentation, prohibitions on high-grading, tagging requirements, etc.)
3. A monitoring and enforcement system sufficient to enforce harvesting plan requirements and prevent over-harvest of the association's allocation
4. Data gathering and reporting practices that satisfy stock assessment requirements
5. An annual report and compliance audit that demonstrates the association has complied with the terms and condition of its prior allocation

Allocation criteria will be reviewed and modified on a periodic basis to insure such criteria are aligned with abalone stock management goals.

1. Allocation to CALAB

   CALAB will receive its share of the Total Allowable Market Catch (TAMC), provide access to that allocation for its members, and determine how that allocation is divided among its members. The cooperative will divide its allocation of TAMC among its members in the most efficient, safe, and ecologically sustainable manner. The initial TAMC allocation will be divided equally among all the participating cooperative members.

   Annual allocation of the TAMC to the cooperative will also be reviewed based on the cooperative's ability to meet stated obligations each year, and the State will determine if fishing should continue based on the health of the population.

D. Member Participation

In order to provide the framework for its members to share in the management of the resource with the State, members participating in this cooperative will be required to:

1. Possess a commercial abalone diving permit issued by CDFG
2. Sign this cooperative's "Marketing Agreement "
3. Sign and agree to act under this cooperative's "Code of Conduct"
4. Agree and abide to cooperative bylaws
5. Be fully trained in data collection protocols

6. Collect data as required (Section IX)
7. Dive only their share of the total allocation
8. Pay initial membership assessment to the cooperative
9. Participate in capitalizing the cooperative

"Moe: A Hypothetical Day in the Life of a Cooperative Abalone Diver" can be found in Appendix J.

E. Shared Management Framework

During each season the cooperative will assume primary responsibility for ensuring the market catch fishery is conducted in a manner consistent with CDFG's management plan, as reflected in harvest allocation application criteria. By using fishery participants within this cooperative's framework to complete the shared management activities (listed below) it will be possible to achieve comprehensive sustainable fishery management at a lower cost. This harvesting cooperative will:

1. Supply the formal and legal structure to guide harvest activity in a way that least impacts the resource and most informs the stock assessment model
2. Provide the fishermen who will work as co-managers with State managers
3. Create a cohesive and motivated community of market abalone divers that will respond wisely to the challenges of sustainable fisheries management
4. Supply harvest data in addition to fishery independent data
5. Maintain a data management system, provide data to CDFG, and assist in analyzing the data
6. Provide diving schedules and harvesting plans to CDFG mangers and enforcement personnel

Some of the state's responsibilities in this shared management framework will be to:

1. Set the TAMC
2. Provide licenses and permits
3. Evaluate this cooperative's performance through an annual review process

F. Information to Support Resource Assessment

The cooperative in coordination with CDFG will provide fishery independent data that will inform design making process described in an approved Decision Tree. Specific descriptions of fishery monitoring and resource assessment research can be found in Section VII.

G. Micro Block Harvest

An annual fine scale harvest plan will be developed to effectively and accurately manage and assess the abalone resource. This cooperative will implement a regional management approach and direct specific harvest by assigning fisherman to individual micro blocks. This micro block system will foster "community stewardship" by instilling in fishermen a sense of direct responsibility for the blocks they harvest. This approach will link allocation to specific harvest blocks and each member will harvest their allocation according to this annual harvest plan developed by the membership in conjunction with CDFG.

In order to achieve fine scale management that is information driven, harvest areas will be divided into $1/10^{th}$ mile blocks. The $1/10^{th}$ mile block approximates the scale on which harvest occurs, which is typically a dive hose length. Data collected at this scale will provide spatially explicit information for refining management approaches.

Cooperative members will pool catches and profits, and use a directed micro block harvest that will eliminate the "race to fish" and conserve the resource by:

1. Allocating a percentage of the overall TAMC to each member
2. Developing evolving catches for each micro block
3. Assigning each member to several micro blocks for harvesting and data collection
4. Adopting a strategy that conserves aggregations
5. Providing information to adjust the TAMC

H. Harvest Log

Each fisherman will be required to complete the "Red Abalone Harvest Log" (Figure 3) for every micro block in which they harvest. Each Harvest Log will have sequentially numbered two-part carbon sheets and the format will provide fishery dependent data that will be used to:

1. Track the TAMC
2. Determine catch-per-unit-of-effort (CPUE)
3. Track stock structure
4. Enhance the understanding of spatial distribution to assist in managing the resource

The Harvest Log will supply the following information:

1. Diver and boat information
2. Micro block fished
3. Latitude and longitude
4. Time spent harvesting
5. Estimate of area searched during harvest
6. Size and weight of all harvested abalone
7. Estimate of unharvested abalone, both solitary individuals and the number and size of aggregations
8. Observations of bottom type and relief

Figure 3: Red Abalone Harvest Log (completed)

Log #	001
Date	02/15/09
Diver	M. Harrington
L #	02910
Vessel	Uno Mas
F&G Boat #	41291

Signature			
Latitude	34 01.416	F&G Block	690
Longitude	120 23.693	Micro Block	86-53

Depth Range	15-25	1
Harvest Time	1:05	2
Abalone Harvested	15	3

Substrate Relief Harvest Area			
<1M	1-3	>3	4
80%	20%	0%	

Substrate Type in Harvest Area				
Reef	Boulder	Cobble	Sand	5
75%	20%	0%	5%	

Solitary Abalone	18	6

Number of Aggregations	5	7

Size of Aggregations	10/20/8/3/9/3/2	8

Tag Numbers	00001-00015	9

Tag #/Size/Weight of Each Abalone 10		
1/212/1850	2/209/1357	3/210/1290
4/222/1780	5/208/1230	6/250/2400
7/225/1900	8/231/1925	9/208/1300
10/254/3510	11/240/2150	12/204/1100
13/206/1200	14/218/1440	15/205/1260

Comments	11

I. Harvest Log Instructions

Divers harvesting red abalone are required to complete the Harvest Log. A separate page must be used for each location. If the boat is moved and another dive made at a different location, another page must be used to record data for the new location.

A small writing slate will be carried by the diver while harvesting to record; substrate relief, substrate type, and a count of abalone and aggregations remaining in harvest area. Information from this slate will be entered on the harvest log page.

Divers must record data in every field of the log and sign each page. Upon landing, log page numbers and tag numbers of harvested abalone must be entered on a CDFG Fish Landing Receipt.

The data from this log will be used to inform the understanding of catch size structure and population structure for the abalone remaining and relate that information to specific locations. It will also be used to help create fine scale charts of the reefs in harvest areas. The data will be managed on the cooperative's data management system (currently under development) and data will be available to CDFG biologists.

Original pages containing completed harvest data must be returned to cooperative Data Coordinator upon landing.

<u>Instructions for Completing the Harvest Log</u>

The top of the form contains:

1. Latitude and longitude entered to the 1,000th of a minute
2. CDFG block number
3. 1/10th mile micro block

The harvest area searched diagram will have a mark in every 10 x 10 meter grid square where a diver searched for and/or harvested abalone. These marks are oriented to compass heading and not boat heading.

Additional information on the form includes:

1. Depth Range: Enter range of depth during search and/or harvest, in feet. **15-25**

2. Harvest Time: Enter time spent underwater searching for and/or harvesting abalone, in hours and minutes. **1:05**

3. Abalone Harvested: Enter number of harvested abalone at this location. **15**

4. Substrate Relief Harvest Area: Enter estimated percentages of the substrate relief in the harvested area. Percentages in three categories; relief < 1 meter (less than one meter), relief 1-3 meters, and relief > 3 meters (greater than three meters), Entries must total 100%. **80% 20% 0%**

5. Substrate Type in Harvest Area: Enter estimated percentages of four categories of substrate type in the harvested area. Reef any rock substrate that can't be moved, Boulder – rock > 0.5 m that can be moved, Cobble - all rock < 0.5 m, Sand (substrate fine enough to be able to insert your finger). Entries must total 100%. **75% 20% 0% 5%**

6. Solitary Abalone: Enter number of visible abalone not occurring within 1 meter of nearest neighbor remaining in harvested area. **18**

7. Number of Aggregations: An abalone within 1 meter of its nearest neighbor is considered an aggregation. If another abalone is less than a meter away from either it is also in that aggregation. Enter the total number of aggregations remaining in harvested area. **5**

8. Size of Aggregations: Enter number of abalone found in each aggregation remaining in harvested area. **10/20/8/3/9/3/2**

9. Tag Numbers: Enter tag number series used to mark harvested abalone. **00001-00015**

10. Tag#/Size/Weight of Each Abalone: Enter tag number followed by size in millimeters and weight in grams. **12/212/1850**

11. Comments: Enter information on swell, visibility, kelp canopy, red algae cover, water temperature at 20 feet, etc.

J. Decision Tree Assessment Process

The cooperative will provide a self-funded mechanism for collecting fishery independent data in both fished and unfished areas to closely monitor abalone populations. A SMI specific Decision Table, as described in Section VI, similar to that currently being used in South Australian abalone fisheries will be used to set the initial TAC.

Then a transparent prescribed decision making procedure, referred to as the Decision Tree Assessment Process, will be used to assess future management performance. It will also guide management changes in the harvest area. The Decision Tree compares stock structures in "no-take" areas with those in the fished areas, and size structure of the catch. These comparisons trigger simple robust management changes that will maintain desired abalone stock structure and spawning biomass levels in the fished areas. The abalone specific Decision Tree will also be used to adjust the TAC up or down each year in response to Biological Reference Points (BRP) such as:

1. Size structure
2. Long term abundance,
3. CPUE
4. Ocean temperature
5. Kelp cover
6. Disease

Additional ecological triggers include:

1. Sea surface temperature
2. Kelp availability
3. Oceanic conditions
4. Spawning potential

The cooperative will be responsible for assisting the state in monitoring stocks that help determine the annual TAC for this fishery. The Decision Tree will remove much of the annual burden of management from CDFG by providing a prescriptive approach to set the TAC and make other management changes.

Cooperative members will collect fishery independent data for use in the decision making process in an efficient, scientifically rigorous, and cost-effective manner. The cooperative will:

1. Work with scientists to track population fluctuations in response to fishing
2. Examine the effect of various harvest strategies in a spatial context on spawning biomass
3. Project recruitment and yield
4. Use the results to determine the optimal harvest strategy for the cooperative

Transparency is of paramount importance, so all fishery-independent collection methods and analyses will be independently vetted to ensure objectivity. The cooperative will work with CDFG to design and build a password-protected web-based data storage system to facilitate communication and data sharing between the two agencies.

K. Market Catch Tags

Tags (ARMP Section 7.1.3.) are the cornerstone in connecting biological monitoring, management and enforcement. A system will be developed using a database supported by the tag and logbook system which will identify individual abalone and connect them to a specific diver and area.

Each cooperative member will be issued Market Catch Tags, one per abalone, equal to their individual allocation. The cooperative will coordinate with CDFG regarding certification and distribution of the tags. These tags will be fixed to each abalone upon harvest. Each tag will identify the permit holder, be sequentially numbered, tamper proof, and use a bar code system. The tag will remain on the abalone all the way to its final destination (i.e., restaurant, etc.) to identify legally harvested abalone in the marketplace. Tags are only valid in the season which they are issued.

L. Market Catch Tag Tracking System and Security Procedures

Illegal, unreported, and unregulated (IUU) fishing is a serious problem that will not be tolerated by the cooperative. This practice not only devastates fisheries and marine ecosystems, but it also deprives honest fishermen of an opportunity to harvest valuable resources. The cooperative will use new technology and set up a digital chain-of-custody system to help prevent IUU abalone.

The cooperative will set up a digital chain-of-custody system to help prevent illegal abalone from being obtained. A simple web-based, automated database will be used to track abalone through the entire supply chain (fishery to consumer). At this time it is proposed that the cooperative and all handlers use Trace Register (www.traceregister.com) as the independent/third party "registry" into which

product, source, and tracking information are entered, secured, and shared throughout the supply chain.

This digital chain traceability provides powerful tools for government regulators and for the industry because it delivers the facts necessary to identify and prevent illegal products from entering the supply chain. It also provides an important common platform on which government and market forces can work together to initiate and drive the coordinated and consistent actions necessary to eliminate illegal harvest. This system will not only help the cooperative meet its legal requirements but also protect their brand integrity and the abalone population from damage that is associated with illegal, unreported and unregulated harvest.

Sharing of information is vital to the shared management of this resource. Entering data into a central secure repository allows all parties to share the same up-to-date and accurate information. This dramatically reducing ambiguity and misunderstanding while increasing cooperation and coordinated action, even when working across many roles, and responsibilities. Having a central database holding key fishery related data, which builds over time, offers information that can be analyzed and reported on to drive decision making, risk management, and planning.

The current vision is for the tracking to begin with the cooperative when divers are assigned to specific harvest blocks. Harvest will take place and abalone will be immediately tagged as they are brought on board. The required "Harvest Log Book" information will be recorded at each harvest site and when divers arrive at the landing port, pertinent data will be entered into the web site's database. CDFG personnel could easily access this password protected information via the internet, at any time. CDFG enforcement wardens could also use the site to identify who, where, and when abalone were harvested as well as where abalone were landed and where each abalone is.

At the cooperative handling facility, all abalone will be referenced in the database by their tag number. As abalone handling is completed, tag numbers will be recorded on the packing box and this information will also be entered into the database. As abalone is sold, all shipping information will be entered into the database. Whole abalone and shells will always retain tags and, as they are sold, all shipping information will be entered. In the case of processed abalone, a secondary numbered tag will be inserted through the meat. The movement of abalone from the processing facility to the end users will also be recorded into the database and be available for audit by those with the appropriate password.

California Fish and Game Codes 8043 (1.12.1) and 8050 (1.12.2) mandate that written records of landings and sales after landing are available for audit by enforcement wardens. Additionally, Fish and Game Code 8050 addresses end user accounting records requirements.

1. *Fish and Game Code 8043*

(a) Every commercial fisherman who sells or delivers fish that he or she has taken to any person who is not licensed under Article 7 (commencing with Section 8030), and every person who is required to be licensed under Article 7 (commencing with Section 8030) to conduct the activities of a fish receiver, as described in Section 8033, shall make a legible landing receipt record on a form to be furnished by the department. The landing receipt shall be completed at the time of the receipt, purchase, or transfer of fish, whichever occurs first.
(b) The landing receipt shall show all of the following:
(1) The accurate weight of the species of fish received, as designated pursuant to Section 8045. Sablefish may be reported in dressed weight, and if so reported, shall have the round weights computed, for purposes of management quotas, by multiplying 1.6 times the reported dressed weight.
(2) The name of the fisherman and the fisherman's identification number.
(3) The department registration number of the boat.
(4) The recipient's name and identification number, if applicable.
(5) The date of receipt.
(6) The price paid.
(7) The department origin block number where the fish were caught.
(8) The type of gear used.
(9) Any other information the department may prescribe.
(c) The numbered landing receipt forms in each individual landing receipt book shall be completed sequentially. A voided fish landing receipt shall have the word "VOID" plainly and noticeably written on the face of the receipt. A voided fish landing receipt shall be submitted to the department in the same manner as a completed fish landing receipt is submitted to the department. A fish receiver who is no longer conducting business as a licensed receiver shall forward all unused landing receipts and landing receipt books to the department immediately upon terminating his or her business activity.

2. *Fish and Game Code 8050*

(a) In addition to the receipt required in Section 8043, every person licensed under Article 7 (commencing with Section 8030), and any commercial fisherman who sells fish to persons who are not licensed under Article 7 (commencing with Section 8030), and any person who deals in fresh or frozen fish for profit, shall keep accounting records in which all of the following shall be recorded:
(1) The names of the different species.
(2) The number of pounds sold, distributed, or taken of each different species.
(3) The name of the person to whom the fish were sold or distributed.
(4) The name, address, and phone number of the seller or distributor.
(5) The date of sale.

(6) The price paid.
(7) The intended use.
(b) Accounting record information required by this section that is transmitted from any person identified in subdivision (a) to any business that deals in fish for profit shall be in the English language.
(c) The accounting records shall be maintained by both buyer and seller for a period of three years and upon request, shall be open for inspection during normal business hours by the department. The accounting records shall be maintained within the State of California.
(d) The names used for designating the species of fish shall be those in common usage unless otherwise designated by the department.

M. Market Coordinator

It will be necessary for the cooperative to retain an independent individual who can act as the Market Coordinator. This person will be required to have extensive knowledge of wholesale local and foreign abalone markets. This individual will be paid on a percentage basis and will report directly to the cooperative Board of Directors. The Market Coordinator would be required to negotiate and conduct bonded and insured transactions in a fully transparent process that can be audited if necessary.

The Market Coordinator will comply with all Trace Register tracking requirements and will be responsible for entering information into the web based tracking system at the time of a sale and/or transport of abalone.

Recommendations regarding the nature of this position will be informed by the Bren School Group Project regarding the design for the cooperative.

N. Enforcement

There are two levels of enforcement, state and community. By vertically integrating the harvest activity and wholesale marketing of abalone with a cooperative, many state enforcement concerns can be addressed. This cooperative will enforce its Bylaws on its members and also aide and assist in enforcement of state regulations.

O. Code of Conduct

This cooperative's "Code of Conduct" (Figure 4) will also be enforced on its members. Adherence to this "Code" will be a prerequisite for continued membership in the cooperative.

Figure 4: CALAB Code of Conduct

This cooperative prides itself on the high standards of excellence embodied by our operating principles. We expect our members to personify these ideals in their dealing with persons both inside and outside the cooperative. Your signature below indicates that you have read, understand, and agree to abide by the Cooperative's code of conduct on this ___day of _____, 2010.

1. I will be trained and participate in accurate data collection using protocols approved by the cooperative and the California Department of Fish and Game
2. I will conduct myself in accordance with cooperative bylaws
3. I will conduct myself in a legal fashion. It is my responsibility to know and obey all state laws and regulations in effect while I am fishing.
4. I will report violations of those state laws.
5. I will record all required information into the cooperative Harvest Log accurately and in the required timeframe
6. I will practice good harvesting methods that include but are not limited to:

    a. Measuring before handling and harvesting
    b. Record harvest aggregations according to harvest guidelines set forth by the cooperative
    c. Harvest only legal abalones taken off a rock (no high-grading)
    d. Tag all abalones immediately after leaving the water and being placed on a vessel (no untagged abalones in your fish hold or vessels receiver)
    e. Only harvest abalone on a single species fishing trip
    f. Do not turn over rocks

7. I will conduct myself with integrity, honesty, and respect for others
8. I will conduct myself in a professional manner that casts a positive light on the cooperative

Failure to adhere to Fish & Game Code or the cooperative's Code of Conduct and bylaws will be grounds for losing membership in the cooperative

P. Violations/Sanctions

1. Violations

   It is unlawful for any person to purchase, receive, possess, or sell any abalone, or parts thereof, which were illegally taken in California waters.

   Any violations of abalone fishing regulations should be prosecuted by CDFG to the full extent of the law. It is recommended that infractions of a serious nature (over limits, under sized, out of season, out of area, possession of shucked abalone, buying or selling any fish illegally taken in California waters, or harvesting restricted abalone species) shall result in expulsion from the fishery and/or permanent revocation of all abalone-harvesting privileges.

   All cooperative members will assist CDFG in enforcement efforts. Communication between CDFG enforcement personnel and cooperative members should be promoted with ways and means of enhancing compliance sought.

   Violations of state regulations that lead to permit revocation by the state are grounds for expulsion from this cooperative.

2. Sanctions

   The consequences of lesser infractions which the state allows the cooperative to enforce will be developed in conjunction with CDFG. A complete list of sanctions related to these infractions (i.e. incomplete Harvest Log) will be developed once the cooperative is formed.

Q. Member Capacity Adjustment/Transfer

Initially the cooperative will accept all qualified applicants for membership consideration. Over time the number of members may need to be adjusted as conditions change. Adjusting the fishery's participant capacity would be a function of both the cooperative and CDFG with all decisions reached in consultation between the two. The CDFG will issue transferable permits and the cooperative will allow change by increasing, decreasing, or transferring membership.

The goal is to create a plan that is flexible and easily adaptable, which recognizes that over time a target capacity goal needs to be set. The following background and assumptions were used to develop the capacity scenarios:

1. There were 102 permitted divers when the fishery moratorium was imposed
2. As of January 1, 2009 there are 84 potential cooperative members
   a) 8 divers have passed away
   b) 10 divers have not been located
3. It could be difficult to manage 84 individuals under a cooperative structure
4. State issues transferable permits to all former 96/97 permit holders
5. Cooperative allows membership to persons who have a State permit
6. Cooperative membership requires "capitalization" from member
7. Cooperative membership allows access to allocation controlled by the cooperative
8. The harvest area and the allocation will be small
9. A Memorandum of Understanding (MOU) between CDFG and the cooperative will be negotiated
   a) The recommended initial carrying capacity for SMI is approximately 35 participants because 35 divers landed 90% of the abalone at SMI when the fishery was closed
   b) All changes in capacity will be addressed in consultation with the cooperative, CDFG, and divers entering or leaving the fishery

The following scenarios have been developed as potential methods for decreasing, maintaining, and increasing capacity.

1. How to Decrease Capacity

   Goal: To task the cooperative's Board to develop a formula to set a value for members leaving the cooperative and develop procedures for decreasing state issued transferable permits.

   It is generally agreed that catch share and cooperative share values are fluid and should be determined at the time of its sale or transfer. This value should be determined by the cooperative, a fee based on the TAC, and the investment value of the departing member.

   Assumptions, goals, and objectives:

   a) Keep catch shares equal
   b) Decrease the number of permits so the cooperative is successful
   c) CDFG will agree to shelve permits of divers leaving the fishery to allow the number of permits to decrease
   d) Value of catch shares will be dependent on the market value and size of TAC

e) Permits have an arbitrary value that is outside the control of the cooperative
f) Cooperative investment share value will be determined by cooperative

Under each of the four (4) scenarios listed below it is also assumed that:

a) Transfers in permits/cooperative membership occur in consultation with all parties (state, cooperative, departing diver, and new diver)
b) New diver (seeking transferred permit) meets state criteria and buys permit from departing diver/member
c) New diver contributes capital to cooperative based on recalculated asset value that is a function of the number of members and value of cooperative investment at that time
d) Funding the increased value and capitalization costs is the responsibility of all cooperative members and will be divided equally
e) New diver and cooperative buy back departing members cooperative shares
f) New diver becomes cooperative member with full privileges and access to allocation

Scenario 1: Two for one – until desired number of permits is reached (35)
Scenario 2: Three for one - until desired number of permits is reached (35)
Scenario 3: Four for one - until desired number of permits is reached (35)
Scenario 4: Four for zero - until desired number of permits is reached (35)

2. How to Maintain Capacity

Goal: To task the cooperative's Board to develop a formula to set a value for members leaving the cooperative and develop procedures for maintaining state issued transferable permits.

It is generally agreed that catch share and cooperative share values are fluid and should be determined at the time of its sale or transfer. This value should be determined by the cooperative and fee based on the TAC the investment value of the departing member.

Assumptions, Goals and Objectives:

a) Keep catch shares equal
b) Transfers in permits/cooperative membership occur in consultation with all parties (state, cooperative, departing, and new diver)
c) New diver (seeking transferred permit) meets state criteria and buys permit from departing diver/member

d) New diver contributes capital to cooperative based on recalculated asset value that is a function of the number of members and value of cooperative investment at that time
e) New diver buys out departing member's cooperative shares
f) New diver becomes cooperative member with full privileges and access to allocation

3. How to Increase Capacity

Goal: If a need arises to increase the capacity of the fishery the cooperative will consult with CDFG to determine under what conditions that increase might be considered and what methods would be used for implementation.

R. Enhancement

In the future the cooperative may be interested in economically viable and environmentally sound enhancement programs.

X: COOPERATIVE LEGAL STRUCTURE

The cooperative will meet all the guidelines and requirements set forth by the State of California and the Federal Fishermen's Collective Marketing Act (FCMA). The cooperative's legal structure will be based on articles of incorporation, bylaws, membership applications, and marketing agreements provided by California attorney Kendall L. Manock of Baker Manock & Jensen in consultation with attorney Joseph M. Sullivan of Mundt MacGregor L.L.P.

The cooperative will also take the necessary steps to qualify for the FCMA's limited antitrust exemption. In order to do so it will meet the following four (4) requirements:

1. Association membership must be limited to "fishermen"
2. Association may deal in product of members and nonmembers, but the value of members' product must be greater than or equal to the value of nonmembers' product
3. Association must be operated for the mutual benefit of its members
4. Association members are limited to one vote or dividends limited to 8% per annum

Details regarding federal antitrust issues related to fishermen's cooperative marketing associations can be found in Joseph Sullivan's memo dated March 2, 2009 (Appendix I).

XI: COOPERATIVE ANNUAL EVALUATION AND REPORT

An annual evaluation process will be defined in an MOU and then established to determine the success of the cooperative in fulfilling management objectives.

The Data Coordinator will review comprehensive fishery dependent and independent data along with fishermen's observations to evaluate the health of the resource so the process can:

1. Respond to changing environmental and socio-economic conditions
2. Review the fishery management systems effectiveness in achieving sustainability
3. Involve people in a fair and reasonable manner
4. Provide an opportunity to design methods for direct input from the fishery participants that help prevent or reduce excess efforts
5. Design management measures to provide information needed to evaluate success or failure
6. Rationalize harvest each year based on data from the previous fishing year

A. Annual Fishery Evaluation and Report

According to the MLMA, the purpose of a fishery management program "is to pursue sustainability by achieving a number of objectives, two of which give more detail about sustainability. First, the long-term health of the resource should not be sacrificed for short-term benefits. Second, depressed fisheries are to be rebuilt to the highest sustainable yields allowed by environmental and habitat conditions."

The cooperative will be required to complete an annual report documenting its compliance with the terms and conditions stated by the MOU(s) in place and under which its annual allocation was issued. Another purpose of the report will be to determine how well the cooperative met its goals for the year.

The Data Coordinator in conjunction with cooperative board members will submit a report at the end of each permit year to cooperative members, CDFG, and the Commission. This report will include fishery results from the past year and recommendations for management in the coming year. The report will also evaluate the following areas:

1. Sustainability and Harvest Activity
   a) Recording the number of animals landed
   b) Recording the activity of participants in the fishery
   c) Stock assessment surveys
   d) Effects of management measures on abalone populations and habitats

2. Data collection and research
   a) Data collected (fishery dependent and independent)
   b) Identify steps CDFG and cooperative should take to monitor the fishery and to obtain essential fishery information
3. Fishery dependent data
   a) Market fishery logbooks
   b) Recreational fishery reports (if available)
4. Enhancement
5. Revenue and Expenditures
   a) Market value of the harvest
   b) Breakdown of taxes and fees (collected by CDFG)
   c) Distribution of funds from the taxes and fees (CDFG expenditures)
   d) Data collection costs
   e) Management Costs
      (1.) Expenditures by CDFG
      (2.) Expenditures by cooperative
   f) Cooperative Administrative Costs
      (1.) Trace Register©
      (2.) Data Coordinator
      (3.) Marketing
      (4.) Administrative support
      (5.) Legal
      (6.) Accounting
6. Non-compliance events

Evaluation tools for the annual report would include:

1. Spreadsheets created from fishery data prepared by the Data Coordinator using logbook data
2. Reports by biologists, technicians, and analysts who utilize Geographic Information System (GIS) to show surveyed and fished areas and present the data visually
3. Data analysis and assessment to refine the fishery process and procedures
4. A report from the fishermen containing their evaluation of the harvest strategy, oceanic conditions and the abalone population.
5. Financial reports prepared by a management/accounting firm

Upon evaluation of the above components, the performance of the fishery will be measured by how well the following standards have been met:

1. Providing evidence that population goals at SMI are being met
2. Monitoring biological reference points to detect changes to the population and oceanic conditions
3. Promoting community-based management to sustain spatially intricate, renewable fishery resources
4. Addressing research needs and information gaps as they arise

It may be required to have a compliance audit conducted by a third party that would report the results of the audit directly to CDFG.

REFERENCES

Abalone fishery history and status. (2001). California Department of Fish and Game from http://ftp.dfg.ca.gov/Public/R7_MR/AAG/regulatory_history/

Abalone Recovery Management Plan (adopted by California Fish and Game Commission, December 9, 2005)

Adler, J.H. (2003). Legal Obstacles to Private Ordering in Marine Fisheries. Roger Williams University Law Review, Vol. 8:9

Anderson, L.G. & Holliday, M.C. (2007). The Design and Use of Limited Access Privilege Programs. National Marine Fisheries Service Technical Memorandum, NMFS-F/SPO-86, November 2007

Ault, J. S. & DeMartini, J. D. (1987). Movement and dispersion of red abalone Haliotis rufescens, in northern California. California Fish and Game Bulletin. 73. 196-213.

Butterworth, D., Gorfine, H., Schroeter, S. & Weber, E. (2009). Evaluation of the Red Abalone Stock Assessment by the Review Committee In Support of Deliberations of the Abalone Advisory Group.

California Department of Fish and Game. Commercial Fishing Provisions 95-01 Relative to Abalone Diving (January 1, 1995).

California Department of Fish and Game Memorandum. Milton, J. (2002). Legal opinion regarding recreational preference that governs marine fishery management decisions (in preparation of the Nearshore Fishery Management Plan).

California Department of Fish and Game (2007). The San Miguel Island Red Abalone Resource: Results of a Survey Conducted in Late August 2006.

California Department of Fish and Game Memorandum. Ugoretz, J. (April 2, 2007). Department Policy Regarding Individual Transferable Quota Fisheries.

California Department of Fish and Game Memorandum. (2007). Management of SMI Red Abalone as a Distinct Population.

California Department of Fish and Game Memorandum. (2007). Clarifying the Derivation of Minimum Viable Population (2,000 abalone per hectare) in the Abalone Recovery and Management Plan.

California Fish and Game Commission. (June 18, 1999). Policy on Restricted Access Commercial Fisheries.

Castilla, J.C., et al. (1998). Artisanal ‘‘caletas’’ as units of production and co managers of benthic invertebrates in Chile. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management. Jamieson, G.S. & Campbell, A. (Eds.). Canadian Special Publication of Fisheries and Aquatic Sciences 125, Guelph, Ontario, Canada, pp. 407-413.

Cope, J.M. & Punt, A.E. In press. Length-Based Reference Points for Data-Limited Situations: Applications and Restrictions. Marine and Coastal Fisheries: Dynamics, Management & Ecosystem Science, from http://www.fisheries.org/mcf/index.html

Deacon, R.T. & Costello, C. (2008). Strategies for Enhancing Rent Capture in ITQ Fisheries, from www.econ.ucsb.edu/~deacon/DeaconCostelloChapter.pdf

Deacon, R.T., Parker, D.P. & Costello, C. (2008). Improving Efficiency by Assigning Harvest Rights to Fishery Cooperatives: Evidence from the Chignik Salmon Cooperative. Arizona Law Review 50(2): 479–510, from www.law.arizona.edu/journals/ALR/ALR2008/vol502.htm

Deacon, R. (2009). Creating Marine Assets: A Greater Role for Property Rights in Marine Resource Management. PERC Policy Series, 43, from http://www.perc.org/articles/article1137.php

Fishermen’s Collective Marketing Act of 1934.

Froese, R. (2004). Keep it simple: three indicators to deal with overfishing. Fish and Fisheries *5: 86-91.*

Froese, R., Stern-Pirlot, A., Winker, H. & Gascuel, D. (2008). Size matters: How single species management can contribute to ecosystem-based fisheries management. Fisheries Research 92: 231-241.

Gordon, H. R. & Cook, P.A. (2001). World abalone supply, markets and pricing: Historical, current and future, Journal of Shellfish Research 20-2, pp. 567-570.

Gordon, H.R. & Cook, P.A. (2004). World abalone fisheries and aquaculture update: supply and market dynamics, Journal of Shellfish Research 23-4 pp. 935.

Gorfine, H.K. & Dixon C.D. (2001). Diver behaviour and its influence on assessments of a quota-managed abalone fishery. Journal of Shellfish Research 20-2, pp. 787-794.

Gorfine, H. K. et al. (2001). Triggers and targets: What are we aiming for with abalone fisheries models in Australia? Journal of Shellfish Research 20-2, pp. 803-811.

Guzman del Proo, S.A. (1992). A review of the biology of abalone and its fishery in Mexico. In: Abalone of the World: Biology, Fisheries and Culture (Proceedings of the 1st International Symposium on Abalone. La Paz, November 21-25, 1989) (Eds. Shepherd, S.A., Tegner, M.J. & Guzman del Proo, S.A.), pp. 341-350. Fishing News Books, Cambridge.

Haaker, P.L. et al. (1998). Growth of red abalone, Haliotis rufescens (Swainson), at Johnsons Lee, Santa Rosa Island, California, Journal of Shellfish Research 17-3 pp. 747-753.

Hardin, G. (1968). The tragedy of the commons. Science, 162, 1243–1248.

Hart, A.M. et al. (2008). Digital video surveys of abalone (Haliotis sp.) stocks by commercial fishers in Western Australia. Fisheries Research 93, pp. 305-314.

Hilborn, R. & Walters, C.J. (1992). Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty. Chapman and Hall, New York, 570.

Hilborn, R., Punt, A.E. & Orensanz, J.M. (2004). Beyond band-aids in fisheries management: fixing world fisheries. Bull. Mar. Sci. 74, 493–507.

Hilborn, R., Orensanz, J.M., Parma, A.M. (2005). Institutions, Incentives and the Future of Fisheries. Phil. Trans. R. Soc. B, 360, 47–57.

Hilborn, R. (2007). Moving to Sustainability by Learning from Successful Fisheries, Royal Swedish Academy of Sciences, Ambio Vol. 36, No. 4.

Hines, A.H. & Pearse, J.S. (1982). Abalones, shells, and sea otters: dynamics of prey populations in central California. Ecology, 63, 1547–1560.

Historical Regulations. (2001). California Department of Fish and Game from http://ftp.dfg.ca.gov/Public/R7_MR/AAG/regulatory_history/

Huchette, S.M.H. & Clavier, J. (2004). Status of the ormer (Haliotis tuberculata L.) industry in Europe, Journal of Shellfish Research 23-4 pp. 951.

Jiao, Y., Leaf, R. (In preparation 2009). Improving the Stock Assessment of California Red Abalone at SMI.

Jiao, Y., Rogers-Bennett, L., Crone, P., & Butler, J. (April 2009) Developing a TAC Framework for Red Abalone at SMI. Final Technical Panel Report to Abalone Advisory Group.

Johannes, R.E. (2002). The Renaissance of Community-based Marine Resource Management in Oceania. Ann. Rev. Ecol. System. 33, 317–340.

Johannes, R.E. (1992). 6th FFA Technical subcommittee workshop focus: Decentralized Nearshore Fisheries Management in Oceania. 6th Forum Fisheries Agency Committee.

Johannes, R.E. (1992). Co-operative fisheries management: Major Changes in Training Required for Government Fisheries Personnel. Traditional Marine Resource Management and Knowledge Information Bulletin.

Karpov, K.A., et al. (1998). The red abalone, Haliotis rufescens, in California: importance of a depth refuge to abalone management. Journal of Shellfish Research 17:863–870.

Karpov, K.A., et al. (2001). Interactions among red abalones and sea urchins in fished and reserve sites of northern California: Implications of competition to management. Journal of Shellfish Research 20: pp. 743-753.

Kashiwada, J.V. & Taniguchi, I.K. (2007). Application of recent red abalone Haliotis rufescens surveys to management decisions outlined in the California Abalone Recovery and Management Plan. Journal of Shellfish Research, 26-3, pp. 713-717

Keesing, J.K. & Baker, J.L. (1998). The benefits of catch and effort data at a fine spatial scale in the South Australian abalone (Haliotis laevigata and H. rubra). In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management (Eds. Jamieson, G.S. & Campbell, A.), pp. 179-186. Can. Spec. Publ. Fish. Aquat. Sci., 125.

Leaf R., Rogers-Bennett, L., & Jiao, Y. (2008). Exploring the Use of a Size-Based Egg-per-Recruit Model for the Red Abalone Fishery in California. North American Journal of Fisheries Management 28:1638–1647.

Leal, D.R. (2008). A Fisherman's Agreement and Co-op in Yaquina Bay Roe Herring. In Case Studies in Fisheries Self-Governance, Eds. Townsend, R., Shotton, R. & Uchida, H. FAO Technical Paper 504. Rome, Italy, 415–23, from www.fao.org/docrep/010/a1497e/a1497e00.htm.

Marine Stewardship Council. Sustainable Fisheries Goals, from www.msc.org.

Mayfield S., McGarvey R., Carlson, I.J. & Dixon, C.D. (2008). Integrating commercial and research surveys to estimate the harvestable biomass, and establish a quota, for an unexploited abalone population. ICES Journal of Marine Science 65, 1122-1130.

Mayfield, S. et al. (In preparation 2009). Survey estimates of fishable biomass following a mass mortality in an Australian molluscan fishery**.** South Australian Research and Development Institute.

McGarvey, R., et al. (2008). A diver survey design to estimate absolute density, biomass and spatial distribution of abalone. Canadian Journal of Fisheries and Aquatic Sciences, 65:1931-1944.

McLeod, Lubchenco, Palumbi, & Rosenberg. (2005). Scientific Consensus Statement on Marine Ecosystem-Based Management, from www.compassonline.org/pdf/EBM_Consensus_Statement_v12.pdf

McShane, P.E. & Naylor, J.R. (1995). Small-scale spatial variation in growth, size at maturity, and yield and egg-per-recruit relations in the New Zealand abalone Haliotis iris. N. Z. J. Mar. Freshwater Res., 29, 603–612.

McShane, P.E. (1992). Early life history of abalone: a review. In: Abalone of the World: Biology, Fisheries and Culture (Proceedings of the 1st International Symposium on Abalone. La Paz, November 21-25, 1989) (Eds. Shepherd, S.A., Tegner, M.J. & Guzman del Proo, S.A.), pp. 120-138. Fishing News Books, Cambridge.

McShane, P.E. & Smith, M.G. (1988). Measuring abundance of juvenile abalone Haliotis rubra Leach (Gastropoda: Haliotidae); Comparison of a novel method with two other methods. Aust. J. Mar. Freshwater Res. 39, pp. 331–336.

McShane, P.E., Black, K.P. & Smith, M.G. (1988). Recruitment processes in Haliotis rubra Leach (Mollusca: Gastropoda) and regional hydrodynamics in southeastern Australia imply localized dispersal of larvae. J. Exp. Mar. Biol. Ecol., 124, 175–203.

National Research Council. (1999). Sharing the Fish: Toward a National Policy on Individual Fishing Quotas. National Academy of Sciences.

Officer, R.A. et al. (2005). Movement and re-aggregation of the blacklip abalone, Haliotis rubra Leach, after fishing. Journal of Shellfish Research 20-2, pp. 771-779

Officer, R.A., Haddon, M. & Gorfine, H. K. (2005). Distance-based abundance estimation for abalone. Journal of Shellfish Research 20-2, pp. 781-786.

Orensanz, J.M. (Lobo) & Jamieson, G.S. (1998). The assessment and management of spatially structured stocks: an overview of the North Pacific Symposium on Invertebrate Stock Assessment and Management. . In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management. (Eds. Jamieson, G.S. & Campbell, A.), pp. 441-459. Can. Spec. Publ. Fish. Aquat. Sci., 125.

Parker, D.O., Haaker, P.L. & Togstead, H.A. (1992). Case histories for three species of California abalone, Haliotis corrugata, H. fulgens and H. cracherodii. In: Abalone of the World: Biology, Fisheries and Culture (Proceedings of the 1st International Symposium on Abalone. La Paz, November 21-25, 1989) (Eds. Shepherd, S.A., Tegner, M.J. & Guzman del Proo, S.A.), pp. 384-394. Fishing News Books, Scientific Cambridge.

Parma, A.M. et al (2003). Diving for shellfish and data: incentives for the participation of fishers in the monitoring and management of artisanal fisheries around southern South America. Towards Sustainability of Data-Limited Multi-Sector Fisheries. Australian Society for Fish Biology Workshop Proceedings, Bunbury, Western Australia 23-24 September 2001. Fisheries Occasional Publications No. 5, June 2003, Department of Fisheries, Perth, Western Australia, pp. 8-29.

Ponce-Diaz, G. et al. (1998). Socioeconomic characteristics of the abalone fishery along the west coast of the Baja California Peninsula, Mexico. Journal of Shellfish Research 17-3, pp. 853-857.

Prince, J.D., et al (1987). Experimental evidence for limited dispersal of haliotid larvae (genus Haliotis: Mollusca: Gastropoda). J. Exp. Mar. Biol. Ecol., 106, 243–263.

Prince, J.D., et al. (1988). Confirmation of a relationship between the localized abundance of breeding stock and recruitment for Haliotis rubra leach (Mollusca: Gastropoda). J. Exp. Mar. Biol. Ecol., 122, 91–104.

Prince, J.D. (1989). The fisheries biology of the Tasmanian stocks of Haliotis rubra. PhD Thesis, University of Tasmania, Hobart

Prince, J.D. & Shepherd, S.A. (1992). Australian abalone fisheries and their management. In: Abalone of the World: Biology, Fisheries and Culture (Proceedings of the 1st International Symposium on Abalone. La Paz, November 21-25,1989) (Eds. Shepherd, S.A., Tegner, M.J. & Guzman del Proo, S.A.), pp. 407-426. Fishing News Books, Cambridge.

Prince, J.D. & Hilborn, R. (1998a). Concentration profiles and invertebrate fisheries management. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management. (Eds. Jamieson, G.S. & Campbell, A.), pp. 187-196. Can. Spec. Publ. Fish. Aquat. Sci., 125.

Prince, J.D., Walters, C., Ruiz-Avila, R.J. & Sluczanowski, P. (1998b). Territorial user's rights in the Australian abalone fishery. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management (Eds. Jamieson, G.S. & Campbell, A.), pp. 367-375. Can. Spec. Publ. Fish. Aquat. Sci., 125.

Prince, J.D. (2003). The barefoot ecologist goes fishing. Fish and Fisheries, 4, 359-371.

Prince, J.D. (2005). Combating the tyranny of scale for haliotids: Micro-management for microstocks. Bulletin of Marine Science, 76(2): 557–577.

Prince, J.D. (2008). Re-scaling fisheries assessment and management: access privileges, responsibilities and toolboxes. Presentation at Mote Marine Laboratory Fisheries Conference, Summer 2008.

Ramade-Villanueva, M.R. et al. (1998). An evaluation of the annual quota mechanism as a management tool in the Mexican abalone fishery. Journal of Shellfish Research 17-3, pp. 847-851.

Restrepo, V.R., et al. (1998). Technical Guidance on the Use of Precautionary approaches to Implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act Prepared for the National Marine Fisheries Service.

Rogers-Bennett, L. & Pearse, J.S. (1998). Experimental seeding of hatchery-reared juvenile red abalone in northern California, Journal of Shellfish Research 17-3, pp. 877-880.

Rogers-Bennett, L. et al. (2007). Modeling growth and mortality of red abalone (Haliotis rufescens) in Northern California. Journal of Shellfish Research 26-3, pp. 719-727.

Ruddle, K. & Johannes, R.E. (Ed.) (1983) Traditional marine resource management in the Pacific Basin: an anthology. 410p. UNESCO/ROSTSEA Jln. M.H. Thamrin No. 14, Jakarta

Roberts, R. (2005). Trends in world abalone production. PowerPoint presentation. Paua Industry Conference, New Zealand.

Roberts, R. et al. (2007). Viability of abalone (Haliotis iris) stock enhancement by release of hatchery-reared seed in Marlborough, New Zealand. Journal of Shellfish Research 26-3, pp. 697-703.

Shepherd, S.A. & Baker, J.L. (1998). Biological reference points in an abalone (Haliotis laevigata) fishery. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management (Eds. Jamieson, G.S. & Campbell, A.), pp. 235-245. Can. Spec. Publ. Fish. Aquat. Sci., 125.

Shepherd, S.A. & Brown, L.D. (1993). What is an abalone stock: implications for the role of refugia in conservation. Can. J. Fish. Aquat. Sci., 50, 2001–2009.

Shepherd, S.A. & Breen, P.A. (1992). Mortality in abalone: its estimation, variability and causes. In: Abalone of the World: Biology, Fisheries and Culture (Proceedings of the 1st International Symposium on Abalone. La Paz, November 21-25, 1989) (Eds. Shepherd, S.A., Tegner, M.J. & Guzman del Proo, S.A.), pp. 276-304. Fishing News Books, Cambridge.

Shepherd, S.A. & Rodda, K.R. (2001). Sustainability demands vigilance: evidence for serial decline of the greenlip abalone fishery and a review of management. J. Shellfish Res., 20, 829–841.

Shepherd, S.A., Rodda, K.R. & Vargas, K.M. (2001). A chronicle of collapse in two abalone stocks with proposals for precautionary management. J. Shellfish Res., 20, 843–856.

Shepherd, S.A. (1986). Studies on Southern Australian abalone (genus haliotis) VII. Aggregative behavior of H. laevigata in relation to spawning. Marine Biology 90, pp. 231, 236.

Sullivan, J. M. (2000). Harvesting Cooperatives and U.S. Antitrust Law Recent Developments and Implications. Proceedings of the Tenth Biennial Conference of the International Institute of Fisheries Economics and Trade. July 10-14, 2001, Corvallis, Oregon.

Taniguchi, I., Stein, D., Lampson, K. & Kalvass, P. (2007). The San Miguel Island Red Abalone Resource: Results of a Survey Conducted from July-October 2007.

Technical Panel-Abalone Advisory Group. (February 2009). Draft Overview of Red Abalone Stock Assessment and TAC Considerations for San Miguel Island.

Tegner, M.J. (1989). Population biology of red abalones, Haliotis rufescens, in southern California and management of the red and pink, H. corrugata, abalone fisheries. Fishery Bulletin, U.S. 87:313-339.

Tegner M. J. (2001). Climate variability, kelp forests, and the Southern California red abalone fishery. Journal of Shellfish Research 20-2: pp. 755-763.

Townsend, R., Shotton, R. & Uchida, H. (Eds.) (2008). Case studies in fisheries self-governance. FAO Fisheries Technical Paper. No. 504. Rome, FAO. 451p.

Trace Register (2009). Using Digital Supply Chain Traceability to Halt Illegal, Unreported, and Unregulated (IUU) Fishing, from www.traceregister.com.

Troynikov, V.S. & Gorfine, H.K. (1998). Alternative approach for establishing legal minimum lengths for abalone based on stochastic growth models for length increment data. Journal of Shellfish Research 17-3, pp. 827-83.

Vilchis, L. Ignacio. (2005). Ocean warming effects on growth, reproduction, and survivorship of southern California abalone. Ecological Applications, 15(2), 2005, pp. 469-480

Weber, M. & Heneman, B. (1998). Guide to California's Marine Life Management Act. Common Knowledge Press.

Walters, C. (1986). Adaptive Management of Renewable Resources. The Blackburn Press.

Walters, C. et al. (1998). Management options for the South Australian rock lobster (Jasus edwardsii) fishery: a case study of co-operative assessment and policy design by fishers and biologists. In: Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management. (Eds. Jamieson, G.S. & Campbell, A.), pp. 377-384. Can. Spec. Publ. Fish. Aquat. Sci., 125.

Wilen. (2002). Property Rights and the Texture of Rents in Fisheries. Paper presented at PERC's 13th Political Economy Forum.

Worm, B. et al. (2009). Rebuilding Global Fisheries. Science 325, 578.

APPENDIX A: FISH AND GAME COMMISSION POLICIES REGARDING RESTRICTED ACCESS TO COMMERCIAL FISHERIES

From the California Marine Life Management Act - Appendix D - 1999

The policies in this document provide a source of information for the public and a guide for the Commission and Department in preparing and reviewing legislation, regulations, or policies that propose to restrict access to commercial fisheries. The development and adoption of these policies do not represent an initiative to apply restricted access approaches to all California fisheries. The objective is primarily to guide the Commission and Department in responding to requested for restricted access programs.

1. RESTRICTED ACCESS AS A MANAGEMENT TOOL

The Global Context. Virtually every modern fishery faces-or has faced-similar intractable management problems. Because these problems recur in so many dissimilar fisheries, it is clear that they are not caused by the biology of the species harvested, nor do they depend on the type of gear or size of vessel employed by harvesters.

The one factor common to all of these fisheries is that the fishery resources are available to anyone who wants to pursue them. Once a fisheries management authority specifies the total catch, the season length, and the allowable gear, every fisherman competes with every other fisherman to catch as much as possible in the shortest time possible. In some fisheries, bigger and faster boats, more electronics, more gear, longer hours each day and fewer days each season are the result as each fisherman rushes to catch more than the other - the "race for fish" so often described in the fishery management and economics literature. In other fisheries, the problem may just be that the number of participants has increased to a level that jeopardizes the economic viability of the fishery. What makes sense for the individual makes no sense in the aggregate because it results in too many vessels, too much gear, too much waste, and too little income for fishermen. Moreover, excess fishing capacity usually leads to overfished populations of fish, which eventually leads to confrontations between fishermen and fishery managers over the status of the resource and the need for more restrictive regulations. Debate then follows over the need for better data.

The race for fish does not result from inadequate biological information. Population surveys, stock assessments and biological samples are important components of sound fishery management, and improving the science on which management decisions are based is always a desirable objective. But management plans based on better biology alone will not solve problems caused by the economics of the harvest system. Economic problems must be addressed directly.

The most effective solutions to these fishery management problems restrict fishing effort in some way so that the "race for fish" is ended. New entry to a fishery is most often restricted by issuing only a certain number of licenses to participate in the fishery. Existing effort in a fishery is usually restricted by limiting the size of the vessel, limiting the size or amount of gear, or directly limiting the quantity of fish that can be landed. Theoretically, the "right" number of licenses fished by the "right" size of vessels using the "right" amount of gear can harvest fish more sustainably and efficiently than the unrestricted fleet.

The problems restricted access programs are meant to address can actually become worse if the programs are poorly designed. Because many restricted access programs have been seriously flawed, some fishermen and others lack confidence that they can work. For example, in setting up restricted access programs, fishery managers have sometimes issued licenses to many more participants than are possible for the fishery to be both sustainable and economically viable for its participants. Clearly, expanding the fleet can have no effect on slowing the race for fish. Just as important, effort restrictions, such as those on the size of vessels or amount of gear, have sometimes been insufficient to restrain fishing power. Finally, managers sometimes address only one dimension of the race for fish by restricting access without also restricting capacity expansion by existing fishermen.

Because these mistakes have been frequent, it is sometimes said that restricted access doesn't work. What does not work is a management system that lacks the clear policies, the will, and the compassion to design and implement restricted access systems that reconcile the need of fishermen to make a living with the need to restrict total harvest. The set of policies in this document are intended to provide guidance on restricted access programs for the Commission, the Department, the fishing industry, and other interested members of the public.

The California Context. Because California historically did not restrict the number or amount of fishing effort allowed to harvest fish, the state's commercial fisheries generally are overcapitalized: they have the physical capacity to exert more fishing pressure than the resources are able to sustain. Loss and degradation of marine and anadromous habitats and other ecological changes have aggravated this condition of excess fishing capacity. The build-up in harvest capacity began with the advent of ocean commercial fishing in the mid-1800's and accelerated following World War II. Vessels became larger and faster, have greatly increased fishing power and hold capacity, and use a wide variety of electronic innovations to find and catch fish. At the same time, increasing knowledge of the behavior of target species have made fishermen increasingly skilled at their trade.

Since the early 1980s, various programs have been implemented, through statute or regulation, to limit the number of commercial vessels or fishermen allowed to use specific types of fishing gear or to harvest specific species or species groups of fishes. These programs have seldom resulted in adequate reduction in the overall

fishing capacity for those species. They sometimes have been effective in capping the number of fishery participants; however, an unintended consequence has been a shift in effort from restricted fisheries to open access fisheries that were already fully developed. The lack of consistent policies for guiding the development of restricted access fisheries¤ has resulted in a myriad of laws and regulations that are confusing to the industry, difficult for the Department to interpret and administer, and, in some cases, of questionable benefit to the fishery or the resource they were intended to protect.

Potential Benefits. Properly designed, restricted access programs can enhance the State's ability to manage its commercial fishery resources. Restricted access programs should:

- Contribute to sustainable fisheries management by providing a means to match the level of effort in a fishery to the health of the fishery resource and by giving fishery participants a greater stake in maintaining sustainability;
- Provide a mechanism for funding fishery management, research, monitoring, and law enforcement activities;
- Provide long-term social and economic benefits to the State and fishery participants; and
- Broaden opportunities for the commercial fishing industry to share management responsibility with the Department.

Need for other Fishery Management Tools -- Restricted access programs are an important tool for fishery managers, but they do not eliminate the need for other fishery management measures, such as gear restrictions, time and area closures, size limits, landing quotas, total allowable catches, and related measures. In all fisheries, a minority of vessels or divers catch most of the fish. Statistics show that a major fleet size reduction would be required to significantly reduce the fleet's fishing capacity. A severe restriction in the number of fishery participants, while perhaps contributing to fishery sustainability, can have other consequences that are undesirable: processors may have difficulty acquiring fishery product, for example, and the control of harvest might shift to a few individuals. Laws or regulations that limit the amount of gear that vessels may use or that restrict the amount or size of fish that may be taken are usually important in ensuring that restricted access initiatives achieve the desired benefits.

POLICY 1.1: The Commission and the Department may use restricted access programs as one of a number of tools to conserve and manage fisheries as a public trust resource.

2. GENERAL RESTRICTED ACCESS POLICY/GOALS AND OBJECTIVES OF RESTRICTED ACCESS PROGRAMS

California's fisheries are a public trust resource. As such they are to be protected, conserved and managed for the public benefit, which may include food production, commerce and trade, subsistence, cultural values, recreational opportunities, maintenance of viable ecosystems, and scientific research. None of these purposes need be mutually exclusive and, ideally, as many of these purposes should be encouraged as possible, consistent with resource conservation.

Fisheries are also a finite and renewable resource. If harvest and other human-caused factors affecting their health are not managed, fishery resources may be less than optimally productive or, in the worst case, may suffer serious declines. Therefore, as part of a program of controlling harvest, it is appropriate to control the amount of fishing effort applied in a fishery, including restrictions on the number of individuals or numbers of vessels participating. Restricting access to a fishery has become one of many standard fishery management tools that have been used by public agencies in carrying out their conservation and management responsibilities for publicly held, finite fishery resources.

In general, the goals of restricting access to commercial fisheries are to contribute to the effective conservation and management of the State's marine living resources, provide long-term social and economic benefits to the commercial fishing industry and the State, and retain the public ownership status of those resources. More specifically, the Commission's purposes for restricting access or entry to a fishery are described as being to: 1) promote sustainable fisheries; 2) provide for an orderly fishery; 3) promote conservation among fishery participants; and 4) maintain the long-term economic viability of fisheries. Restricted access programs may be instituted in order to carry out one or more of these purposes in a given fishery.

Promote Sustainable Fisheries. Depending on the fishery, limiting the fishing capacity of the fishery by limiting the number of individual fishermen or vessels may be one means of reducing take in order to protect the fishery resource. In most instances, reducing the number of individuals or vessels alone will not in itself reduce take unless it is accompanied by complementary measures such as trip limits, quotas, seasons, or gear limitations. Together restrictions on access coupled with other measures can be an effective way of controlling effort to protect fishery resources and contribute to sustainability.

Provide for an Orderly Fishery. Extreme overcapitalization can lead to unsafe conditions as part of the competition among fishery participants, as in the case of "derby" fisheries. Properly designed restricted access programs can promote safety in those circumstances. Where fishing grounds are limited due either to geographical factors or fish congregating in small areas where harvest occurs, it may

be necessary to limit the number of individuals or vessels involved in the fishery. The herring roe fishery is one example of where restricted access was established primarily for the purpose of maintaining an orderly fishery.

Promote Conservation Among Fishery Participants. Limiting the number of individuals or vessels in a fishery can give those in the fishery a greater stake in the resource, a sense of ownership, and confidence that a long-term opportunity exists in the fishery that usually does not exist in open access fisheries. A well-designed restricted access program can give fishery participants greater incentive to be stewards of that resource and even to invest in rebuilding the fishery (the commercial salmon stamp program, for example). Limiting access can also increase compliance with fishery regulations since an individual with a restricted access permit is much less likely to risk losing the opportunity to participate in that fishery because of a fishery violation.

Maintain the Long-term Economic Viability of Fisheries. To assure the greatest economic benefit to society from the harvest of a public fishery resource, it may be necessary to limit the number of individuals or vessels to assure economically viable fishing operations. When open access contributes to the impoverishment of fishery participants or illegal or unsavory behavior by participants competing for the limited resource, some form of restricted access based on economic viability may be necessary. Any restricted access program established, entirely or in part, for the purpose of economic viability must be crafted to avoid restricting access more than is necessary.

POLICY 2.1: The Commission may develop restricted access programs for fisheries that retain the public ownership status of the resource for one or more of the following purposes:

1) to promote sustainability;
2) to create an orderly fishery;
3) to promote conservation among fishery participants;
4) to maintain the long-term economic viability of fisheries.

3. DEVELOPMENT AND REVIEW OF RESTRICTED ACCESS PROGRAMS

Participation of Stakeholders in Program Development. Restricted access programs should be developed with substantial support and involvement from stakeholders. Indeed, many of California's current restricted access programs were drafted by, or with considerable input from, the affected fishermen (the salmon, herring, Dungeness crab, and sea urchin fisheries, for example). Programs in which fishery participants and others have a substantial role in the design benefit from their knowledge of both the resource and the business aspects of the fishery. Such programs are also more likely to enjoy the support of fishery participants during

implementation. Furthermore, any restricted access program must be developed consistent with the stakeholder participation requirements of Section 7059 of the Fish and Game Code.

Programs Specific to the Needs of the Fishery. Standardization in the elements of restricted access programs is a laudable goal and could help reduce some of the complexity fishermen and the Department are faced with when dealing with different requirements for different fisheries. However, the overriding concern is that each restricted access program meets the needs of its particular fishery.

Each of the existing restricted access programs in California fisheries was designed to meet the needs of a particular fishery. As a result of periodic reviews of those programs, it may be possible to reduce some of the complexity that has resulted. However, a program should not be revised solely for the purpose of uniformity or consistency if there is a sound basis for the unique features of the program.

Program Review. Restricted access programs need periodic review for possible revision. Restricted access programs should be reviewed periodically by the Department and fishery participants in the particular fishery to determine whether the program still meets the objectives of the State and the needs of the fishery participants. For the statutorily created restricted access programs, this review should take place preceding the expiration ("sunset") dates when the law is under consideration for extension. In addition, this restricted access policy should be reviewed at a regularly scheduled Commission meeting at least once every four years following its adoption.

POLICY 3.1: Restricted access programs shall be developed with the substantial involvement of participants in the affected fishery and others, consistent with the stakeholder participation requirements of Section 7059 of the Fish and Game Code, and shall balance the specific needs of the fishery with the desirability of increasing uniformity among restricted access programs in order to reduce administrative complexity.

3.2: Each restricted access program shall be reviewed at least every four years and, if appropriate, revised to ensure that it continues to meet the objectives of the State and the fishery participants. Review of each restricted access program shall occur at least as often as the particular fishery is reviewed in the annual fishery status report required by Section 7065 of the Fish and Game Code. The general restricted access policy should be reviewed at a regularly scheduled Commission meeting at least once every four years following its adoption.

4. ELEMENTS OF RESTRICTED ACCESS PROGRAMS

Categories of Restricted Access Fisheries. Existing restricted access programs in California generally are based on target species or species groups of the fishery. The Commission expects that most new restricted access programs will follow that pattern.

Another option that may be appropriate for some fisheries, or groups of fisheries, is basing the restricted access system on gear type. Sixteen species or species groups of fishes comprise 90 percent of the State's commercial fish landings, although only a relatively few basic gear types produce the entire catch. As a means to minimize the number of programs and provide greater flexibility for fishery participants, the Commission and Department could base each restricted access program, first, on the gear type and then, if necessary, on endorsements for the species or species groups that are the target of that gear type. Where possible, the entire range of species (i.e., multi-species, ecosystem approach) contacted by a particular gear type would be included in the same program.

Additional flexibility would be provided in instances in which a fishery participant converted a restricted access permit from one gear type to another. Whether such conversions are allowed would be decided on a fishery-by-fishery basis depending on whether the conversion is consistent with the State's sustainable fisheries policies and the objectives of the two restricted access programs involved.

Each restricted access program should take into account possible impacts on open access fisheries and on other restricted access fisheries.

Fishery Capacity Goals and Means to Achieve Capacity Goals. Because a primary purpose of restricted access programs is to match the level of effort in a fishery to the health of the fishery resource, each restricted access program that is not based on harvest rights (see section on harvest rights) shall identify a fishery capacity goal intended to promote resource sustainability and economic viability of the fishery. Fishery capacity goals can be expressed as some factor or combination of factors that fairly represents the fishing capacity of the fleet. These factors may include the number of permitted fishery participants, number of permitted boats, net tonnage of the permitted fleet, amount of gear used in the fishery, and cumulative hold capacity. Fishery capacity goals should be based on such biological and economic factors as what is known about the size and distribution of the target species, historic fleet size or harvest capacity, and distribution of harvest within the current fleet. Conflicts with other fisheries or ocean interest groups and economic conditions (current and future) within the fishery may also be factored in to such determinations. Depending on the fishery, the fishery capacity goal may be expressed as a single number or as a range.

The preferred approach to determining the capacity goal is to conduct a biological and economic analysis of the fishery. The analysis should consider the probable level of resource sustainability and the impact of various fleet capacities on the fishery and local communities. When such an analysis is not feasible, the Commission, Department, and stakeholders should work together in reviewing available information to arrive at a reasonable capacity goal for the fishery.

Capacity goals should be included in each restricted access program review. A fishery capacity goal will not be useful in managing effort in a fishery unless the restricted access program includes mechanisms for achieving the goal. If the fishery is overcapitalized and above its fishery capacity goal, there must be a system to reduce capacity as a basic requirement of the restricted access program. If the fishery is below its capacity goal, there must be a method to increase participation. In fisheries that are above their fishery capacity goals, transfers of permits should be allowed only if they are consistent with the system for achieving the fishery capacity goal (see Permit Transfers section).

In restricted access fisheries in which the permit is vessel based, the system for achieving fishery capacity goals must include a means of comparing and controlling the fishing power of individual vessels. Without that ability, the system controls only one aspect of fishery capacity-the number of vessels-without providing a means to manage the fishing power of those vessels (see policies on Permit Transfers and Replacement Vessels). The system may be based on factors such as vessel length, displacement, horsepower, hold capacity, or allowable amount of gear.

There are several options available to reduce the number of permits to meet fishery capacity goals. A few examples include:

- Attrition - permit reduction when permit holders fail to renew their permits - has contributed to reducing effort in some fisheries. That process is slow, however, and only occurs when the outlook for the fishery is so poor that the permit has little value.
- "Two-for-one" or similar requirements in transfer of permits have been used in several fisheries to reduce capacity and is effective if there is an active market for permits.
- Annual "performance" standards can be required of each permit holder. For example, a minimum number of landings could be required to qualify for permit renewal. This approach may be appropriated in some fisheries, although it can artificially increase effort.
- Permit or vessel buybacks have been used in a few fisheries and being explored for others in the United States. California's experience with this system is limited to nearshore set gill nets in Southern California. Buyback programs have been funded by both industry (through permit transfer fees, landing fees, special permit fees, etc.) and the public.

POLICY 4.1: Each new restricted access program shall be based either on one or more species or species groups targeted by the fishery or on a type of gear. In programs based on a type of gear, an endorsement may be required for one or more species or species groups targeted by the gear type. Each restricted access program should take into account possible impacts of the program on other fisheries.

4.2: Each restricted access program that is not based on harvest rights shall have a capacity goal. The Commission, Department, and stakeholders will use the best available biological and economic information in determining each capacity goal.

4.3: Each restricted access fishery system shall have an equitable, practicable, and enforceable system for reducing fishing capacity when the fishery is exceeding its participation goal and for increasing fishing capacity when the fishery is below its fishery capacity goal.

4.4: In fisheries that exceed their fishery capacity goals, permit transfers will be allowed only if they are consistent with the means for achieving the fishery capacity goal.

5. PERMITS

Issuance of Initial Permits. The public will be given reasonable notice of intent to limit access to the fishery. A legislative bill may serve as an initial notice of intent, or the Commission may take an action that serves as a notice of intent.

The Commission may set a Control Date for determining qualification for a restricted access program. Some level of fishery participation may be required to qualify for an initial permit. Fishery qualification can be based upon fishery participation during a period of time preceding notification of intent. In determining criteria for qualifying for the program, the Commission may consider the balance of gear types currently or historically relying on the fishery or the specialty markets or niches that the fishery was intended to serve. Fish landing data maintained by the Department shall be the basis for documenting fishery participation. Affidavits of fishery participation, or medical statements of inability to meet qualification standards shall not be accepted unless a system for considering exceptions, consistent with Policy 5.1, is included in the design of the restricted access program. Vessels under construction or inoperable during the qualification period shall not be considered for a permit.

California has had a practice-shared with other states, the Federal government, and other nations-of giving preference for issuing permits into a restricted access fishery to fishermen or vessels with past participation in that fishery. The practice has meant, as well, that permits generally have been issued to licensed California

commercial fishermen rather than to nonfishermen or persons not licensed in the State. The practice is a fair means to assure that those who rely on that fishery or who have invested in that fishery can remain in the fishery. In determining priorities for the issuance of permits in a restricted access fishery, first priority for permits shall be given to licensed commercial fishermen/vessels with past participation in that fishery. Among fishermen or vessels with past participation in the affected fishery, preference for permits may be based on factors such as years of participation in the fishery or level of participation (landings). Second priority for permits may be based on such factors as crew experience, number of years in California fisheries, or participation in fisheries similar to that for which a program is being developed. (An example of a similar fishery being considered for eligibility for a permit was when displaced abalone divers were added to those eligible for any new sea urchin permits.) Drawings or lotteries for permits should only be used when two or more applicants have identical qualifications (for example, the same number of points for eligibility for a herring permit).

When initiating a restricted access program with vessel-based permits, designing a formula for deciding which vessels qualify that is equitable but does not increase the number of permits or the amount of effort already in the fishery is difficult but necessary; without such a formula, the program can easily exacerbate the fishery's problems. The Commission's policy on this issue has three elements. First, the policy for all restricted access fisheries begins with the premise that initiating a restricted access program must not increase the recent level of fishing effort. Second, the default approach in designing a new program will be to issue initial permits only to the current owners of qualifying vessels. Third, in order to meet the needs of a particular fishery, it may be desirable to modify the approach of giving permits only to current owners of qualifying vessels.

Such exceptions would be decided fishery by fishery, but in no case would the formula allow increasing the recent level of effort.

A permit issued for dive, gill net, and some trap fisheries shall be issued to qualifying fishermen. A permit issued for a boat-based fishery may be issued to, 1) an individual who owned a qualifying vessel during the period in which the vessel qualified, and 2) 20-year commercial fishermen (as provided in Section 8101 of the Fish & Game Code).

Issuance of New Permits. In the case of restricted access fisheries that are below their fishery capacity goals, new permits may be issued. The factors used to determine priority for issuance of new permits may be the same as for the issuance of initial permits.

Permit Renewal and Duration. Permits are renewable annually upon application and payment of the permit fee if the permit holder meets the requirements of the restricted access program. Permits may be renewed annually for the life of the

restricted access program. Limiting participation to a period less than the actual life of the limited access program has several drawbacks. First, it could eliminate incentive for conservation among permit holders if they know that their participation in the fishery will be limited. Second, a limitation on permit life would tend to discourage investment and diminish the value of existing investment (vessels, for example) in the fishery. New investment in many fisheries is needed for safer, more fuel efficient vessels, for equipment to maintain quality of the catch, and for changing gear. That will be discouraged if the duration of the permits is limited.

Substitutes. Each restricted access program with fishermen-based permits should determine whether substitutes for the permit holder will be allowed and, if so, in what circumstances and for what length of time. One option is that the permit holder must be present. Some programs have allowed temporary use of the permit by another in the case of death or disability of the permit holder.

POLICY 5.1: The Commission will give adequate public notice of intent to establish a restricted access program. The Commission may set a Control Date for determining qualification for a restricted access program. A new restricted access program shall not allow fishing effort to increase beyond recent levels. Some level of fishery participation may be required to qualify for an initial permit. Fishery qualification can be based upon fishery participation during a period of time preceding notification of intent, or on other factors relevant to the particular fishery. Affidavits of fishery participation, or medical statements of inability to meet qualification standards shall not be accepted. Vessels under construction or inoperable during the qualification period shall not be considered for a permit.

5.2: New permits in a restricted access fishery shall only be issued when the fishery is below its fishery capacity goal.

5.3: Restricted access fishery permits shall be of one year duration and are renewed upon annual application and payment of the permit fee and shall be valid, provided they are annually renewed and the permit holder meets the requirements of the restricted access program, for the life of the program.

5.4: Each fisherman-based program shall determine in what circumstances, if any, a substitute may fish the permit.

6. PERMIT TRANSFERS

Permits within a restricted access program may be transferable or not, depending on the fishery. California currently manages some restricted access fisheries in which the permits are not transferable. Although non-transferable permits may be appropriate for some fisheries, the Commission expects that the trend will be toward transferability. First, permit transferability can and should be used as part of

the mechanism for reducing capacity in a fishery that is above its capacity goal. Second, permit transferability allows for new entry into a restricted access fishery, particularly for younger fishermen or crew. Third, permit transferability protects part of an individual's investment in a fishery.

In California, as in nearly all states and federally managed fisheries, most limited access permits are transferable. Although a number of limited access fishery programs in California initially did not allow for permit transfers, these systems were found unworkable. Permit holders, even the aged, the sick, or those seeking to leave the fishery, held on to their permits, attempting in many instances to have the permit fished by another, non-permitted, individual. Non-transferability encouraged some fishery participants to work around the program rather than within it. Moreover, fishing vessels, particularly the larger ones or those built for a specific fishery, were rendered useless if there was no permit to go with them at the time of sale. For fishermen, as is the case with small business owners or farmers, their retirement funds are derived from the sale of their business, which in the case of a fisherman may be his/her vessel.

Fully transferable permits in restricted access programs have been criticized for the following reasons: 1) sales of permits on the open market can make the cost of entry into a fishery for young fishermen or crew extremely expensive and does not assure that the most deserving individuals obtain permits; 2) sales of permits on the open market can result in windfall profits for those individuals who were initially issued a permit by the State and whose investment in the permit has only been the payment to the State of the permit fee; and 3) sales of permits on the open market can result in permits going to more active participants or to larger vessels deploying more fishing effort thereby increasing the fishing effort or capacity of the fleet. To the extent that these criticisms are valid, they can, and currently are in California, being addressed through conditions placed on permit transfers.

In order to prevent an increase in fishing power, in California's salmon limited entry program, permits are transferable with the fishing vessel at the time of sale or to another vessel of equal or less fishing capacity, under specified conditions. In the herring fishery, where the permit is to the individual rather than the vessel, permit transfers may only be made to a fishing partner or an individual holding a maximum number of points in that fishery, with points based on years of crew experience and years in California fisheries. This limitation on transfers is intended to give an advantage to those who have spent time in the fishery. Thus, those deserving of a permit are given a preference. By limiting the market for permit sales, the cost of entry is lower than it would be if the permits were available on a wide open market.

It is also possible to prevent increases in fishery capacity and reduce speculation in permits by setting fishery participation criteria in selected qualifying years for a permit to be transferable, or by requiring that the permit be held for some minimum number of years before it can be sold.

It is possible, as well, for the State and other participants in the fishery to benefit from the sale of permits through transfer fees or two-for-one permit transfer requirements. In California, there are transfer fees in some restricted access fisheries where the fees exceed the cost of administering a change in the permit. A transfer fee addresses the concern that permit holders may be making windfall profits from the sale of permits and can allow the State to share in the economic benefits of good conservation and management measures. Other participants in the fishery can benefit if the permit transfer fees are re-invested in the fishery, such as through a permit buyback program. Both the State and participants in the fishery can benefit through two-for-one permit transfer requirements if they are used to help reach a fishery capacity goal.

POLICY 6.1: Restricted access permits may be transferable. In fisheries in which the permit is transferable, transfer may be subject to conditions that contribute to the objectives of the restricted access program. In new restricted access programs, permit transfers will not be allowed unless a fishery capacity goal and a system for achieving that goal is part of the restricted access program. In existing restricted access programs, the objective is to review and revise those programs to include fishery capacity goals and systems to achieve those goals. A restricted access program may include a fee on the transfer of permits, in excess of actual administrative costs for the permit change, to offset other costs involved in the conservation and management of that fishery.

7. VESSEL ISSUES

Vessel Retirement. All vessel-based restricted access programs should provide for the voluntary retirement of commercial fishing vessels so that these vessels are no longer eligible to compete with permitted vessels in future years. Any vessels requested by the owner to be retired will be permanently identified on Department commercial fishing vessel registration documents. Permits from retired vessels may be allowed to transfer to replacement vessels within one year of retirement provided the replacement vessel is of equal or lower fishing capacity or to a larger vessel if the restricted access program provides for vessel upgrades (see section on vessel upgrades).

Replacement Vessels. Replacement vessels of the same or lower fishing capacity as the permitted vessel will be allowed only if the permitted vessel is lost, stolen, or no longer able to participate as a commercial fishing vessel, as shown on State or government documents, or other sources of information that the Department might consider. This requirement is necessary to preclude effort shift to open-access and other restricted access fisheries. Replacement vessel determinations will be made by the Department. The ownership of the replacement vessel, as shown on government documents, shall be same as the permitted vessel.

Vessel Permit Upgrades. Fishermen who hold vessel permits may want the option of acquiring a larger or more efficient vessel and transferring their existing permits or acquiring and adding new permits to the new vessel. The concern with allowing fishermen to upgrade their vessels is that by doing so the overall capacity of the fleet to catch fish increases, which should be allowed only to the extent that it is consistent with the fishery capacity goal. To offset this increase in fleet harvest capacity in fisheries that are above their fishery capacity goal, a permit consolidation process is needed whereby two or more permits can be combined to allow for the permitting of a single larger vessel. This is not a new concept in restricted access programs elsewhere. The Pacific Fishery Management Council, for example, uses a formula based on vessel length and capacity that allows for combining permits to allow for larger vessels in the groundfish fishery. In the California salmon fishery, vessel length is used by the Salmon Review Board in approving or denying vessel transfer requests for vessels in the 20- to 40-foot range.

Support Vessels. In some fisheries, the use of support vessels can substantially increase the available fishing power of the fleet. In such restricted access fisheries with vessel-based permits, only vessels with a permit for that fishery should be allowed to support fishing operations of other permitted vessels. Non-permitted vessels shall not be allowed to attract fish for permitted vessels or to receive fish from permitted vessels for landing. In programs in which the permit is fisherman based, the use of support vessels may be allowed if they do not create significant enforcement problems or significantly add to the capacity of the fishery, but a registration fee may be required that is the same as the annual permit fee paid by a fishery participant.

POLICY 7.1: Vessels requested to be retired by the vessel owner will no longer be eligible to participate in commercial fisheries in California.

7.2: Replacement vessels of the same or lower fishing capacity as the permitted vessel will be allowed only if the permitted vessel is lost, stolen, retired, or no longer able to participate as a commercial fishing vessel.

7.3: Each restricted access program that allows for vessel permit transfers may allow for vessel upgrades, provided a permit consolidation/vessel retirement process consistent with the fishery capacity goal is made part of the program.

7.4: A restricted access program may prohibit the use of support vessels or require that they be permitted in the fishery or that they pay a fee comparable to the permit fee.

8. HARVEST RIGHTS

Background. Harvest rights, often called individual transferable quotas (ITQs), involve the assignment of the exclusive rights to harvest a share of the annual total allowable catch (TAC) in a fishery. Harvest rights systems are a form of restricted access programs in that participation in the fishery is restricted to those who own quota shares. Setting TACs has been a key element in determining quota shares. The State or nation retains ownership of the fisheries resource. In most cases, individual quota systems have been implemented in fisheries with previously established limited entry programs. These individual quotas can be allocated for specific time periods, but most often are allocated in perpetuity. Individual quotas are often allocated for specific geographic areas such as the International Pacific Halibut Commission's zones. Usually, individual quotas are fully transferable (buy, sell, lease) to allow quota owners to optimize their business activities. Transferability of quota shares allows fishermen to move between fisheries. In exchange for this exclusive harvest right, quota owners usually are required to pay the costs of management, enforcement, and research. This cost recovery often leads to increased involvement of industry in research and management.

Harvest rights have usually been allocated to vessel owners. In some fisheries around the world quotas have also been allocated to communities, processors, and fishermen's organizations. Limits on the amount of quota harvest rights each entity can hold are set to prevent excessive aggregation. Aggregation limits currently range from 0.5 percent in Alaska's halibut fishery to 35 percent in some New Zealand offshore fisheries.

Similar management systems have been used to allocate fishing gear units instead of shares of a TAC. A tradeable lobster trap certificate program developed by fishermen in the southeastern United States is an example.

When these restricted access policies were adopted (1999) industry comment was negative in regard to harvest rights systems. Nonetheless, these programs have become a tool for managing fisheries in various parts of the world, with the herring-roe-on-kelp fishery in California being one example. This policy acknowledges the existence of this tool as well as the complex issues that must be dealt with in developing any harvest rights program. The Commission may consider recommending development of a harvest rights program after careful consideration of stakeholder input.

The first 15 years of experience with individual quota management has shown that they end the race for fish and provide incentives to fishermen to change their business to maximize revenues and minimize costs. However, individual and community transferable quota systems have been controversial in the United States. In the Sustainable Fisheries Act of 1996, Congress placed a four-year moratorium of implementation of new ITQs and instructed the National Academy of Sciences to

conduct a thorough study. In December 1998, the NAS study recommended that Congress end the moratorium.

Numerous issues have arisen when individual quotas are implemented and need to be considered:

1. **Allocation of Initial Quotas.** This usually, but not always, has been based on historical catches and/or vessel fishing power. The NAS study recommends that alternative methods of initial allocation be considered in addition to catch histories. Who receives the allocations (fishermen, processors, communities, tribes, etc.) must be determined and other issues resolved. Will initial allocation be free? Will the harvest right be for a certain time or perpetuity? Who is and is not eligible to obtain quota?
2. **Catch Histories.** If initial harvest rights are based to some degree on catch histories, accurate individual vessel or fisherman landings data are needed.
3. **Transferability**. The degree to which quotas are transferable (buy, sell, lease, "fishing on behalf of") must be determined.
4. **Total Allowable Catches.** Assuming individual quotas are a percentage of the TAC, in order to determine how much actual quota each quota owner may harvest, a TAC will have to be set. Setting TACs requires high quality resource assessment information and scientifically sound estimates of sustainable yields.
5. **Aggregation Limits.** Limits on the amount of quota an individual, company, community or other entity may hold needs to be considered, perhaps on a fishery by fishery basis.
6. **Enforcement and Monitoring.** Emphasis would likely shift towards enforcement methods to prevent quota holders from under-reporting their catches. Methods used elsewhere include increased record keeping/tracking of catches, limiting number of landing ports, and increased use of industry-funded monitors at landing ports.
7. **Cost Recovery.** Most individual quota systems include, at a minimum, methods for having quota owners pay the cost of managing the system.
8. **Processor-Fishery Participant Relationships.** Depending on who winds up owning the harvest right, this relationship might change. Past experience shows that the quota owner will have increased influence on fishing decisions.
9. **Quality Considerations.** Early experience with individual quotas shows a consistent trend towards maximizing quality to maximize prices received. This could affect the timing and location of fishing and the other types of regulations needed.

POLICY 8.1: It is the policy of the Commission that harvest rights systems such as individual transferable quotas may be considered only after careful consideration of stakeholder input. In establishing such management systems the State should consider:

(1) fair and equitable initial allocation of quota shares which considers past participation in the fishery,
(2) resource assessment for establishing total allowable catch estimates,
(3) fishery participation goals and aggregation limits,
(4) cost recovery from quota owners,
(5) quota transferability and,
(6) recreational fisheries issues.

9. ADMINISTRATION OF RESTRICTED ACCESS PROGRAMS

Administration. Administrative costs should be minimized by requiring easily understood regulatory or statutory language including a minimum of exceptions to the main provisions. The use of review or advisory boards may be considered on a program-by-program basis. Board members should be reimbursed for travel and per diem expenses. The total cost for administration of each a program should be borne by that program.

The Department will determine what unit is responsible for program administration and made all determinations relating to vessel fishing capacity.

Cost Accounting. Fees collected from restricted access initiatives should, for cost accounting and reporting purposes, be deposited in a single, dedicated Restricted Access Fishery Account within the Fish and Game Preservation Fund. Charges would be made against the account for direct restricted access program support. A fund condition and activity report should be published annually and include the amount of funds received from each restricted access fishery and the distribution and expenditure of those funds.

Enforcement. Restricted access programs should provide specific disincentives for violations of pertinent laws and regulations. Provision for a Civil Damages schedule, pursuant to regulations of the Commission, can serve in this regard. Because restricted access programs confer benefits to permit holders that are denied to those not in the fishery, penalties should be high for violations of the provisions of restricted access programs.

Restricted access programs should minimize enforcement costs. New technologies such as satellite-based vessel tracking are available and can be required of commercial fisheries that operate under Federal fishery management plans. Commission authority to require such technology, if deemed desirable, should be a part of any legislation or regulation creating a restricted access fishery. Wildlife protection staff will be responsible for monitoring the vessels and enforcing the pertinent laws and regulations. Enforcement costs for restricted access fisheries should be borne by the restricted access programs.

POLICY 9.1: Administrative costs shall be minimized, and those costs shall be borne by the respective programs. Review or advisory boards may be considered on a program-by- program basis. The programs shall be administered in their entirety within an existing department unit.

9.2: Fees collected from restricted access initiatives may, for cost accounting and reporting purposes, be deposited in a single, dedicated Restricted Access Fishery Account within the Fish and Game Preservation Fund. A fund condition and activity report should be published annually.

9.3: Restricted access programs should provide specific disincentives for violations of pertinent laws and regulations. Enforcement costs of restricted access programs should be minimized through the use of new technologies or other means.

APPENDIX B: ALTERNATIVE 8

From the Abalone Recovery Management Plan – Section 7.3.8 - December 2005

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 the Minimum Viable Population (MVP) level exists 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 alternative allows fishing prior to achieving the 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 reevaluated.

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 efforts 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 insure 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 the potential fishery participants once this option was adopted. 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, subsection 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 on-going 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 plan, the Department would need to divert staff and funding from other priorities. Existing State law requires the Department to expend dollars to manage the commercial portion of this plan commensurate with the commercial related income we receive from the fishery.

APPENDIX C: SAN MIGUEL ISLAND RED ABALONE FISHERY MARINE STEWARDSHIP COUNCIL PRE-ASSESSMENT

From Scientific Certification Systems (SCS)
2200 Powell Street, Suite 725 Emeryville, CA 94608, USA

Assessors: Sabine Daume, Craig Mundy, and Stephen Mayfield – December 2009

Introduction

This report sets out the results of a pre-assessment of the San Miguel Island Red Abalone Fishery. This assessment refers to the Marine Stewardship Council's (MSC) Principles and Criteria for Sustainable Fishing (the 'MSC standard'). The report can provide guidance only, and the outcome of a main assessment will be the subject of deliberation by an assessment team and would not be influenced by the results of this pre-assessment.

Scope of Pre-Assessment

The principal aim of the pre-assessment is to determine, on the basis of information made available by the client, the position of the fishery in relation to the Marine Stewardship Council (MSC) Principles and Criteria. In particular, the pre-assessment will:

- Outline the key components of the fishery and determine the scope of the main certification
- Identify any obstacles or problems for certification

No verification of information, or contacting of stakeholders, however, takes place at this stage. This will be part of the main assessment, which is open to public scrutiny and comment.

This report sets out:

- The background of the fishery
- The location and scale of the fishery
- Other relevant fisheries
- Key stakeholders in the fishery
- Preliminary evaluation of the fishery against the MSC Principles and Criteria.
- Obstacles or problems to certification for the fishery
- A recommendation as to whether or not the fishery should move to main assessment

Due to time and budget constrains no on-site visits were scheduled for the whole assessment team. The team met in Australia on 29 October and 6 November 2009. Dr. Daume met with the client representatives (Chris Voss, Alicia and John Woodcock), a representative from WWF (Alison Cross) and abalone researchers from the Californian Department of Fish and Game (Dr. Ian Taniguchi, Kai Lampson

and Derek Stein) calling in by phone. In addition, a draft final report was discussed between the client (both CAA and WWF representatives) and the assessment team by phone conference on the 10 December 2009. No other stakeholders were interviewed.

Pre-assessment Team

Principle 1: Dr. Craig Mundy, Abalone Program Leader, Tasmanian Aquaculture and Fisheries Institute (TAFI)
Principle 2: Dr. Sabine Daume, Team Leader, Scientific Certification System (SCS)
Principle 3: Dr. Stephen Mayfield Sub-Program Leader: Molluscan Fisheries, South Australian Research and Development Institute (SARDI)

Dr. Mundy has been the Abalone Research Group Leader at the Tasmanian Aquaculture and Fisheries Institute, University of Tasmania for the last 8 years and is primarily responsible for abalone wild fisheries research and assessment within Tasmania (historically and currently the world's largest wild abalone fishery). He has had 24 years experience with sub-tidal biology and ecology ranging from tropical to temperate waters. Dr. Mundy worked and studied at the Australian Institute of Marine Science for 10 years focusing on community and population dynamics of corals, fertilization and reproductive ecology of echinoderms, and experimental design of large-scale, long-term monitoring programs. Dr. Mundy's current research interests are focused in two distinct areas 1) the ecology of exploited abalone populations, specifically the importance of early life history and reproductive ecology in managing exploitation of blacklip and greenlip abalone; and 2) the application of spatial techniques for assessment of small-scale "s-fisheries".

Dr. Daume is a marine biologist with special expertise in the biology and ecology of exploited marine resources. She is leading the MSC program at SCS and has been involved in the surveillance and assessments of several fisheries. Dr. Daume has over 10 years experience working closely with the abalone fishing and aquaculture industry in Australia. She obtained a PhD in marine biology in 1998 and worked as a Research Fellow at Deakin University in Australia specialising on the early life history of abalone. Prior to joining SCS, D. Daume worked as a Senior Research Scientist at the Research Division of the Department of Fisheries in Western Australia. Dr. Daume has experience working with diverse cultural groups, often in remote marine environments. She has worked with industry personnel at all levels (divers, technicians, managers, executive officers) as well as policy makers and managers in Government departments.

Dr. Mayfield has been the Wild Fisheries abalone sub-program leader at SARDI Aquatic Sciences since 2001, a position he took up following employment on rock lobsters at Marine and Coastal Management in Cape Town, South Africa. Dr. Mayfield's primary responsibilities are to ensure ongoing management of the abalone sub-program, provide advice to PIRSA Fisheries on the exploitation of greenlip and blacklip abalone in South Australia by commercial and recreational

fishers; ensure the continuation of long-term data collections. His research interests are varied and include the biology and ecologically sustainable management of nearshore living marine resources; development and evaluation of Biological Performance Indicators; survey design; numerical modeling; spatial scale of fishery management; management of recreational fisheries; optimizing the efficiency of the commercial industry; role and efficacy of marine protected areas; movement and migration patterns. Dr. Mayfield has been the fisheries expert for an abalone MSC pre-assessment in Australia.

Proposed Fishery

The fishery proposed for certification is as described below (Table1).
The MSC Guidelines to Certifiers specifies that the unit of certification is "*The fishery or fish stock (=biologically distinct unit) combined with the fishing method/gear and practice (=vessel(s) pursuing the fish of that stock) and management framework.*"

Table 1: Description of the fishery proposed for certification

Target Species	Red Abalone (*Haliotis rufescens*)
Location	The area proposed for a commercial fishery is the Southwest Zone of San Miguel Island (SMI) California Channel Islands
Fishing Methods	Hookah diving
Management System	The California Department of Fish and Game (CDFG) is the state body responsible for management of fisheries in California, and the California Fish and Game Commission has regulatory authority for the abalone fishery. It is the intention of the California Abalone Association (CAA) to form a community-based fishermen's harvesting and marketing cooperative organized under the Fishermen's Collective Marketing Act (FCMA) guidelines. Through this organizational structure, the CAA will share management of the resource with the state.
Client	The CAA and World Wildlife Fund are co-clients for this pre-assessment. The CAA is a non-profit group that was formed in 1971. The CAA currently represents the former commercial abalone diving community in their pursuit to reopen the fishery. WWF helps guide fisheries through the MSC certification process.

Introduction to the Scoring Methodology

The MSC Principles and Criteria set out the requirements for a certified fishery. The certification methodology adopted by the MSC has recently been updated (FAM version 2, July 2009). Default performance indicators and scoring guideposts have been determined and updated which should make the pre-assessment more efficient and transparent. In order for the fishery to achieve certification, an overall score of 80 is considered necessary for each of the three Principles, 100 represents surpassing of the performance necessary and 60 a measurable shortfall. During the pre-assessment, a fishery does not get scored but the performance indicators and guideposts are used to determine the readiness of the fishery for full-assessment (see below).

Within each Principle, Scoring Performance Indicators are grouped in a hierarchy (Fig.1):

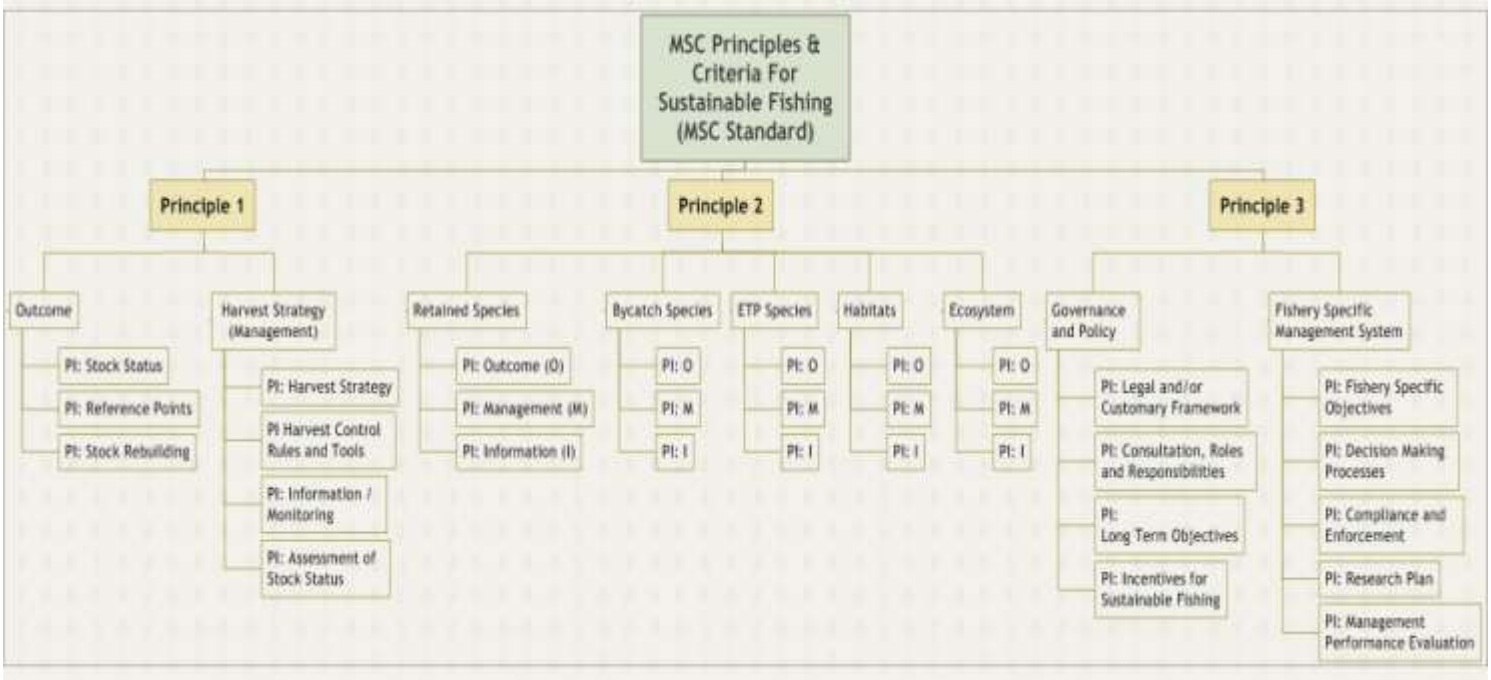


Figure 1. Assessment Tree Structure with Performance Indicators for each Principle (FAM v.2, MSC 2009)

Principle 1: A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

Seven performance indicators (PIs) are used, that are grouped into two key aspects of a fishery's performance: 1) The current status of the target stock resource with three PIs; and 2) Harvest Strategy (Management) with four PIs. The PIs under 1) consider the impact of the fishery on the target species, and particularly whether the stock is at sustainable levels. In contrast, the PIs under 2) consider the tools, measures or strategies that are being used specifically to manage the impact of the fishery on the target species.

Principle 2: Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

There are five components that need to be assessed under this principle, with each consisting of three performance indicators (PIs). The five components are 1) Retained Catch; 2) Bycatch; 3) Endangered, Threatened or Protected Species; 4) Impacts on the Habitats; and 5) Impacts on the Ecosystem.

Principle 3: The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

The intent of Principle 3 is to ensure that there is an institutional and operational framework, appropriate to the size and scale of the fishery, that is capable of delivering sustainable fisheries in accordance with the outcomes articulated by Principles 1 and 2. The Assessment Tree structure divides the performance indicators into two categories: 1) Governance and Policy, with four PI`s, captures the broad, high-level context of the management system within which the fishery under assessment is found and 2) Fishery-Specific Management System, with five PIs, focuses on the management system directly applied to the fishery.

Documents provided by the client for the pre-assessment

- Abalone Recovery Management Plan (ARMP): www.dfg.ca.gov/marine/armp/pdfs/entire_armp.pdf
- Marine Life Management Act (MLMA): www.dfg.ca.gov/marine/mlma/
- Red Abalone Market Fishery Operating Guidelines or "Guidelines", CAA October 2009
- Stock assessment Reports (2006, 2007 and 2008 preliminary summary)
- Survey Protocols (2006-2009)
- San Miguel Island red abalone catch data 1960-1996, diver surveys, snapshots and maps
- CDFG 2008 Sea urchin report
- CDFG survey cruise reports
- CDFG Sea urchin landings 2003-2008. February 2009
- Butterworth, D, Gorfine, H., Schroeter, S, Weber, E (2009): Evaluation of the Red Abalone Stock Assessment by the Review Committee in Support of Deliberations of the Abalone Advisory Group. La Jolla, California (17-18 February 2009)
- Jiao, Y and Leaf, R (2009): Report- Improving the Stock Assessment of California Red Abalone (*Haliotis rufescens*) at San Miguel Island. Abalone Advisory Group (January 2009)
- Jiao, Y, Rogers-Bennett, L, Crone, P and Butler, J (2009): Developing a Total Allowable Catch Framework for Red Abalone at San Miguel Island. Final Report of the Technical Panel (February and April 2009)
- Kushner, DJ, Rich, P and Sprague, J (2004): Kelp Forest Monitoring annual report. National Park Service Channel Islands National Park, Technical Report CHIS-07-03
- Prince, J and Valencia, S (2009): A New Beginning for Abalone Management in California: Critique and Comment on the Abalone Advisory Group's Discussions
- Haaker, PL, Parker, D, Barsky, K C and Chun, C.S. Y (1998) Growth of red abalone *Haliotis rufescens* (Swainson), at Johnson Lee, Santa Rosa Island, California: Journal of Shellfish Research 17: 747-753
- Leaf, RT, Rogers-Bennett, L and Haaker, P L (2007) Spatial, temporal, and size-specific variation in mortality estimates of red abalone, *Haliotis rufescens*, from mark-recapture data in California: Fisheries Research 83: 341-350
- Rogers-Bennett, L, Allen, B L and Davis, GE (2004): Measuring abalone (*Haliotis* spp.) recruitment in California to examine recruitment overfishing and recovery criteria: Journal of Shellfish Research 23: 1201-1207
- Rogers-Bennett, L, Rogers, DW and Schultz, SA (2007): Modeling growth and mortality of red abalone (*Haliotis rufescens*) in Northern California: Journal of Shellfish Research 26: 719-727

- Tegner, M, Breen, PA and Lennert, J L (1989) Population biology of red abalone, *Haliotis rufescens*, in southern California and management of the red and pink, *H. corrugata*, abalone fisheries. Fishery Bulletin 87: 313-339
- Weber, M and Hennemann, B: Guide to California's Marine Life Management Act. www.fgc.ca.gov/mlma/general_policies.html

Background to the Fishery

Species and History of the Fishery

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*; and flat abalone, *H. walallensis*. Threaded abalone, *H. kamtschatkana assimilis*, was once thought to be a separate species, but is now considered to be synonymous with the pinto abalone. *H. rufescens* is the largest species and was historically the most important commercial species in California (Tegner et al. 1989).

Fishing for abalone along the Californian coast begun in the early 1900s, when Japanese-American divers began fishing virgin stocks of subtidal abalone. Total landings peaked at about 3.9 million lb in 1935 and then declined to under 200,000 lb by 1942. Landings rapidly increased between 1942 and 1951 and appeared relatively stable from 1952 to 1968, averaging about 4.5 million lb per year, but began declining rapidly in 1969. By 1996, the last full year the commercial fishery was open, landings had fallen to about 229,500 lb.

In California, serial depletion occurred in the abalone fishery as declines in red abalone (*H. rufescens*) and later pink abalone (*H. corrugata*) landings were masked by increased landings of rarer species and from distant fishing grounds (Karpov et al. 2000, Hobday et al. 2001). From 1952 to 1968, combined landings appeared stable. In 1971, pink abalone landings declined abruptly when pink abalone size limits were raised to protect stocks. The total landing of red abalone started to decline in 1968, but the drop was masked by increased commercial fishing for green, black, and white abalones. Landings for these three species rapidly peaked and then declined in the 1970s. In the early 1970s, substantial increases in black abalone landings helped to maintain the appearance of stability.

From 1952 to 1968, most red abalone were caught in central California. Catches declined on the central coast due to fishing pressure from humans and most likely also by the expanding sea otter population. This decline caused the fishery to shift to the southern California mainland and to Santa Rosa, Santa Cruz, San Nicolas, and San Miguel Islands.

One other major contributor to the population decline along the Californian coast was a disease called “withering syndrome” that mainly affected black and red abalone in southern and central California (Moore et al. 2002). Withering syndrome is a chronic wasting disease caused by a bacterium and was first observed in the

Channel Islands in the mid-1980s. The intensity of the infection and the bacterial transmission is directly temperature-dependent, particularly at temperatures exceeding 15°C (Moore et al. 2000). Hence it has been suggested that red abalone populations were less effected by the disease in colder, upwelling areas like some parts of San Miguel Island.

The commercial black abalone fishery was closed in 1993, and the commercial fisheries for green, pink, and white abalones were closed in 1996. In 1997, fishing for all species of abalone was prohibited from San Francisco to the U.S.-Mexico border, effectively ending commercial fishing in California. Commercial fishing was prohibited north of Point Lobos in San Francisco County in 1949. Since then, the northern California red abalone populations have supported a viable recreational fishery.

Location and Scale of the Fishery

The area proposed for a commercial fishery is the Southwest Zone of San Miguel Island (SMI) California Channel Islands (Figure 2). The proposed annual TAC to be taken from the SW Zone is 8,300 abalone (Butterworth et al. 2009: Review Committee), 6,700 (Jiao et al. 2009: Technical Panel), or 10,278 (Prince and Valencia, 2009, "Guidelines" CAA October 2009) respectively. According to the California Abalone Association (CAA) 10 vessels and 35 divers will likely be operating through a proposed fishing 'co-operative', should the proposed SMI red abalone fishery be re-opened.

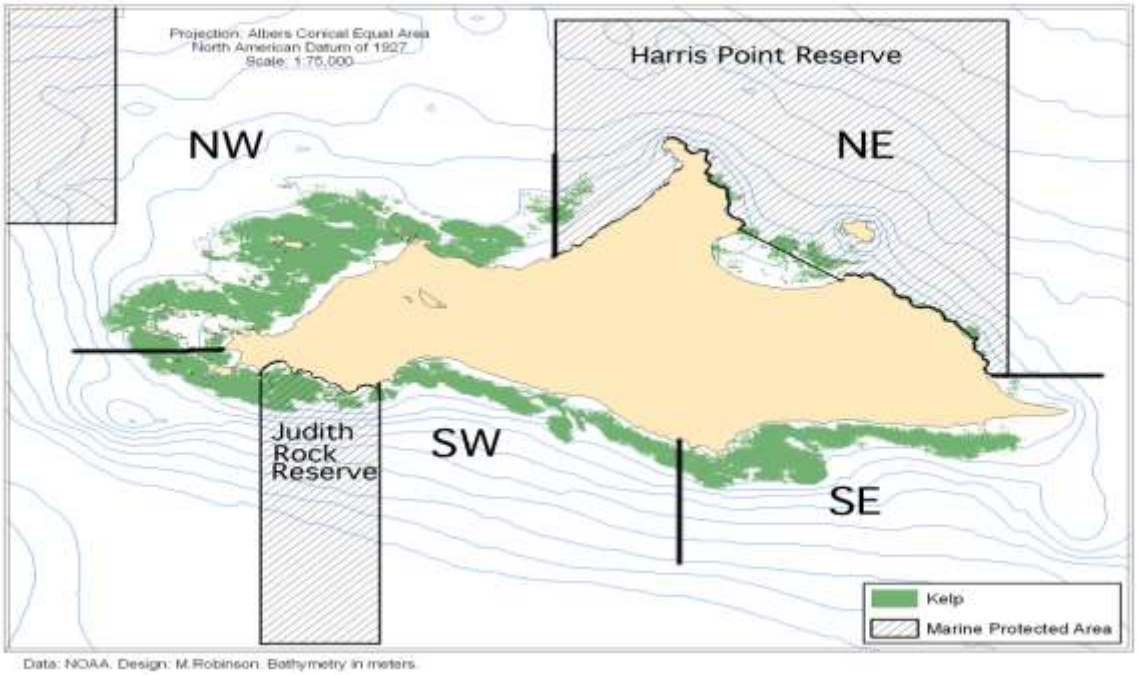


Figure 2: San Miguel Island with marine protected areas and proposed commercial fishery area in the SW of the island.

Other Relevant Fisheries

There is a significant commercial sea urchin (*Strongylocentrotus franciscanus)* fishery at San Miguel Island (SMI). Approximately 40 boats (7-15 meters) and 80 licensed divers access the fishery from Channel Islands, Ventura and Santa Barbara Harbors. Hookah or mixed gas SCUBA, hand-held rakes and harvest bags/baskets with attached air-lift bags are used for collecting. Divers operate for ~4 hours per day. Total catch of sea urchins from SMI was estimated between at 600,000 and 800,000 pounds a year from 2006-2008. Processing of the gonads takes place at plants in Ventura, Los Angeles and San Diego. Processors transport the live sea urchins to their shops where the gonad is removed, cleaned and packed.

Key Stakeholders

Given the state of this fishery, conservation and academic oriented groups that focus on the rational use of the ocean's living resources are likely to have an interest in the re-opening and potential certification of this fishery. Though we cannot confirm or eliminate any specific stakeholder groups, we suggest it is necessary to include the larger, well-known groups with conservation and fishery interests in the list of stakeholders for this fishery. Below is a short list of a few well-known conservation groups as examples of the types of organizations that will need to be considered in full stakeholder consultation. This list is neither exhaustive nor exclusive and will need to be revisited during any potential full certification.

1. Greenpeace
2. World Wildlife Fund
3. Oceana
4. Ocean Conservancy
5. Natural Resource Defense Fund
6. Nature Conservancy
7. The Center for Marine Conservation
8. Environmental Defense
9. Pacific Fisheries Resource Conservation Council
10. Sea urchin fishery
11. Recreational abalone fishery
12. Californian Department of Fish and Game (CDFG)
13. Californian Fish and Game Commission

MSC Principle 1

Indicator 1.1.1 - Stock status

From the documents provided, it is difficult to ascertain the current status of red abalone stocks at SMI relative to the status during the period of active fishing (e.g. late 1980's), and a judgment is not made here. The key problem is that detailed, robust, fishery-independent research data were not collected in the final years prior to closure to match the current data series (2006 to 2008), and there is currently not an active fishery to compare against the performance of the fishery prior to closure. Using the 2006 to 2008 survey data, a range of methodological approaches

have been used to consider stock status in the context of supporting a commercial fishery, including Yield per Recruit (YPR) and Statistical Catch at Age (SCA) modeling, Replacement Density Analysis (RDA), and Minimum Viable Population (MVP) size. Relative abundance is used in the SCA model, but TAC's estimated as a fraction of absolute abundance. RDA and MVP methods appear to use absolute abalone abundance per Hectare as the basis for calculations.

Obtaining an independent assessment of absolute abalone abundance is a difficult task, and arguably unreliable for most abalone fisheries. The use of abundance data estimates (abalone/m^2) to calculate absolute abundance (abalone/Ha) based on assumed habitable area is problematic, not well accepted amongst abalone biologists, and with few exceptions (e.g. *Haliotis laevigata* fishery in South Australia), is rarely used in the management of abalone fisheries elsewhere. Two key reasons for this are 1) abundance of abalone is highly spatially variable from scales of meters, to 10's of meters, and is often not linked to apparently suitable habitat; and 2) calculation of absolute abundance should include some knowledge of the proportion of the total abalone at a site that are available to be seen by divers. Circumstances where absolute abundance calculations might be permitted are reef systems where spatial variability in abalone abundance and reef complexity are low.

The results from Replacement Density Analysis suggests that there is insufficient recruitment to the fishery to maintain densities of exploitable biomass in the presence of natural mortality alone, despite using conservative estimates of natural mortality of around 0.15. There is also reference to the current density of abalone populations in abalone/hectare falling short of the mythical minimum viable population size of 2000 abalone/hectare. A Minimum Viable Population (MVP) size has never been rigorously established for any abalone population and, regardless, differences among sites in abalone biology, habitat structure, kelp community and hydrodynamics would lead to wide ranging values of MVP. Frequent references to an MVP of 2000/hectare also neglect to identify whether that is total population size or just those animals that are reproductively mature. Concern over Allee effects and sperm limitation is raised in the ARMP and in Technical Panel considerations. However, the Allee effect concept is not limited to sperm limitation issues, and relates to a range of density threshold issues, some of which may be more important than sperm limitation. Calculations of absolute density per Hectare in the context of Minimum Viable Population size ignore the spatial clustering typically evident in abalone populations. For example even at low overall densities, the majority of abalone in a defined 1Ha block may occur as one or several distinct aggregations, within which abalone density is high and distances between reproductive abalone are small. This clustering of abalone at scales smaller than the scale of Hectares negates concerns of sperm limitation.

Because the RDA and MVP approaches rely on absolute abundance data, results from these methods should be used with caution. In fact, the outcome of these methods and the SCA modeling suggest the abalone populations at San Miguel Island are in decline, which directly conflicts with the time series data of population structure, that clearly shows a pattern indicative of stock rebuilding.

Data on total catch from SMI appears in the Jiao and Leaf (2009) assessment, but there is no information on how that catch was distributed spatially around San Miguel. Does the current spatial pattern of abalone abundance reflect the historic distribution of abalone, or have there been marked changes, or loss of productive populations? While anecdotal information on catch distribution may be available, this does not allow a rigorous examination of change in stock status. Changes made by DFG in the spatial reporting system for the commercial abalone fishery in the 1990's also contributes to the difficulty of determining whether San Miguel Island abalone populations actually followed the same pattern as other abalone populations in Southern California.

The current fishery-independent surveys (2006 – 2008) provide a relatively rich data set to assess abundance and population structure. However, there are little historic data with which to compare i.e. are current densities similar to densities that would have been observed when the fishery was in a depleted phase or a sustainable phase within the historic fishery? With respect to the historic fishery-independent data, concerns were expressed by the Review Committee over the quality of the early abundance data, with recommendations to cease use of that data.

The proposed annual TAC of 8,300 abalone (Butterworth et al. 2009: Review Committee) or 6,700 (Jiao et al. 2009: Technical Panel), to be taken from the SW Zone represents approximately half of the estimated sustainable TAC at SMI based on modeling and absolute abundance estimates. In the context of the history of the fishery, the average annual San Miguel abalone catch was approximately 25,000 abalone in the late 1980's, although the fishery appeared to increase to around 75,000 abalone for a short period prior to the eventual closure of the fishery in 1997. Modeling from Jiao and Leaf (2009) also suggest that an annual total SMI TAC of ~ 22,000 Red abalone would be unsustainable based on the data presently available. However the pre-assessment team has significant reservations about the reliability of the model estimates.

Results from the Abalone Recruitment Module (ARM) surveys suggest there has been a drop in recruitment over the last 3 years of monitoring. However, if this apparent decline of recruitment to the ARMs is the case and broadly representative, this will affect future abundance estimates, rather than those obtained from 2006 to 2008. The logic behind use of recruitment modules to provide an early warning of major change in cohort size (e.g. recruitment pulses/failures) is sound. The practicality of building modules that are neutral to juvenile abalone behavior is a challenge that has not yet been overcome (i.e. modules that neither attract nor deter

juvenile abalone). A description of the ARM methodology and appropriate validation of the assumptions made in the use of data derived from the ARMs is not available.

Given the weaknesses in the tools and performance measures for determining the stock status, the most robust approach may be to open the fishery at a highly precautionary TAC (and size limit), and monitor the progress in detail with a program designed explicitly for the San Miguel Island fishery. The Review Committee (Butterworth et al Feb 2009) also suggests a program of experimental fishing be considered for the South-West zone as an initial step ((page 4 Section V.). Section 7.1.4.2 of the ARMP suggests, "*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 estimated TAC's have varied from 6700 abalone to 10,728 abalone. Rather than commence the fishery at this intensity, the initial TAC would be much lower, and gradually increase in line with 7.1.4.2 of the ARMP. This should also provide an opportunity to determine the spatial extent of the stocks, to fine-tune the assessment and TAC review process, and build the relationship between CAA, CDFG, and San Miguel Island interest groups.

Indicator 1.1.2 - Reference points

The use of the Biological Reference Points are outlined in the Market Red Abalone Fishery Operating Guidelines (MRAFOG) document (Section 3.5). The use of model based Reference Points is also indicated in the Jiao and Leaf (2009) document. However, there are significant issues with both sets of Reference Points (see below). As the fishery is not yet operating, all reference points other than fishery-independent RP's are speculative.

MRAFOG Biological Reference Points

The fishery-independent survey program will produce high quality Reference Points that would be the envy of most abalone fisheries elsewhere, if continued on an annual basis. The survey design has been externally reviewed, and considered to be of a high standard.

The program of fishery-dependent data collection is comprehensive, and in particularly, catch-effort trends could be used as Reference Points as in most abalone fisheries elsewhere. While the documents provided articulate fine-scale fishery-dependent data collection practices that are in line with those in place or under consideration in abalone fisheries elsewhere, many of the proposed variables may be impractical to measure, such as the manual recording of effort at 10m x 10m grids. It is admirable that the CAA proposes a log book system for divers to complete in order to provide fine-scale information. However, there is a considerable risk this will compromise the collection of simple, but critical data like fishing effort. It is essential that fishery-dependent data be collected with limited bias, either among

fishers, or through time. Further, as with any data collection system, if there is deterioration in the rigor and conviction with which these data are recorded, then the change in bias will make it difficult to discern real changes in the fishery from changes in the quality/method of the data being recorded. Accurate, unbiased, high-quality, fishery-dependent data are essential in this fishery, and these data need to be collected in an automated and structured manner that does not impede the activity of fishing. If the fishery is re-opened even on a trial basis, the fishers need to be allowed to focus on fishing rather than encouraged to collect research data while fishing.

Model-based Reference Points
The Jiao and Leaf (2009) SCA model, unusually, is age-based and relies on a length-to-age conversion matrix. Presumably, the use of an age–based approach is a consequence of the short time period and minimal funding provided to develop a modeling framework for the proposed SMI fishery, rather than a conscious choice (note that all Australasian abalone fishery assessment models are length-based). Use of an age-based, rather than length-based approach adds a complication to the already difficult challenge of creating a modeling framework capable of producing sensible results. Improvement to the SCA model, and the data on which model population dynamics are based, will be a fundamental requirement should the fishery re-open (see section 1.1.3), and prior to the outputs serving any purpose such as production of Reference Points. This is not seen as a major impediment given the success of length-based models for modeling abalone fisheries elsewhere.

The most fruitful use of a modeling framework will not be the production of TAC estimates, but for testing catch and size limit scenarios, and incorporating longer term effects of periodic fluctuations in sea surface temperature (SST) and disease prevalence, and kelp canopy area. Ongoing collection of length frequency (population and commercial catch) and recruitment data will be essential to the reliability of any model based reference points.

Indicator 1.1.3 - Stock rebuilding
Clear action was taken (fishery closure) in response to a determination of apparent low stock levels in southern California, to allow a rebuilding process to commence. Unlike the fishery at adjacent islands of Santa Cruz and San Rosa, the magnitude of the San Miguel Island Red Abalone catch in 1997 at the time of closure was similar to that observed over the past two decades. It is reasonable, therefore, to assume that the population present from 1997 would have provided a strong platform for population growth in the absence of commercial and recreational fishing. The ARMP (Chapter 6) provides clear guidelines for stock rebuilding, with 3 explicit criteria to be met prior to re-opening of fisheries. These criteria require a return to a 'normal' size distribution (Criteria 1), followed by densities reaching pre-determined levels (Criteria 2 and 3). Fishery independent surveys conducted at San Miguel Island in 2006, 2007, and 2008 suggest that Criteria 1 may already be satisfied, although densities have not yet reached the level required by either Criteria 2 or Criteria 3.

The extent of population growth that has occurred in the decade following the 1997 Moratorium on taking of abalone in southern California, is however, uncertain (see 1.1.1 above). Information in the documents made available are contradictory. This is due largely to three factors; 1) historic data on relative abundance appears limited and of doubtful quality providing limited capacity to contrast historic data with recent extensive, high quality relative abundance data; 2) an absence of spatially representative data on growth and size at reproductive maturity; and 3) a modeling framework that appears to produce unrealistic results.

The modeling suggests that the populations are in decline, even in the absence of fishing. However, the fishery-independent length frequency data provided in the Jiao and Leaf (2009) document show substantial changes between 1993 and 2007 that are indicative of stock rebuilding, rather than of a degenerative process as suggested by the model. In 1993, there were few abalone greater than 200mm, and the modal size class appears to be around 160mm. The 2008 length frequency data, show a modal size class of approximately 200mm, with substantially greater numbers of abalone in general through the larger size class bins. This strongly suggests there are some issues surrounding the operational model and the data on which the model is based. The conflict between the model outcomes and what appears to be reality must be resolved.

Given the magnitude of the red abalone fishery at various times in the past, it will be important to demonstrate a continued commitment to stock rebuilding, with clear time frames, should the fishery reopen.

Indicator 1.2.1 - Harvest strategy

Given the closure of the fishery in 1997, a "forensic" review of the weaknesses in the historic management and FD/FI data collection, and the response of stakeholders to stock declines is critical. While some attempt has been made to do this by researchers associated with the Californian commercial abalone fishery in the past (Karpov et al. 2000), these reviews have largely concluded that failure to monitor and manage serial depletion were key issues. This conclusion is obvious. The key issue is to determine the components of the assessment and management framework that contributed to this failure. A clear identification of the failures of the previous fishery, and how the current program resolves those weaknesses, would increase confidence in Harvest Control Rules and Management Tools for any new commercial abalone fishery in California.

Indicator 1.2.2 - Harvest control rules and tools

The harvest control rules and management tools to control the exploitation of the fishery are not well described in the documents provided. The Butterworth et al. 2009 (Review Committee) and Jiao et al. 2009 (Technical Panel) documents largely focus on delivering an initial decision supporting/ rejecting the commencement of commercial fishing in SMI, and what magnitude the initial TAC might be, should the fishery be opened.

The decision tree provided in the MRAFOG document is very broad, lacks detail in design, and is not entirely plausible (see Section 1.2.4). Assessment model outcomes are also absent from the MRAFOG decision tree. Equally, Section 2 of the final report of the Technical Panel on developing a TAC framework for San Miguel Island suggests the TAC "… will be a qualitative decision that will ideally be informed by quantitative models, population surveys, abalone population dynamics and AAG, TP and Review Committee input." Fishery-dependent indicators are not mentioned here, and it is not clear from the TP document whether in the advent of conflicting information from these sources, one source takes priority, or whether a precautionary approach will be applied to decision making in the case of conflicting signals.

These documents do not provide detailed descriptions of the Harvest Control Rules and Management Tools for an ongoing fishery. Should the fishery be reopened improvements to these documents are crucial. We regard this lack of clarity and detail as the largest risk in ensuring the continued sustainability of the proposed SMI fishery.

Of additional concern is that the Recreational size limit is smaller than the commercial size limit. Depending on the extent of the Recreational harvest, this has the potential to undermine the attempts to ensure any harvest is sustainable. Identical recreational and commercial size limits would reduce the complexity of interpreting the impacts of fishing on stocks

Indicator 1.2.3 - Information & monitoring

The current program of fishery-independent surveys, the planned data reporting requirements for fishers, and the compliance/enforcement arrangements will provide suitable datasets for assessing performance of the fishery against Harvest Control Rules.

A key part of the MRAFOG plan for spatially controlled harvest is the assignment of catch and a diver to micro blocks. This has some merit in theory, although prior to commencement of micro-block control of harvest, information must be gathered to inform the initial allocation of harvest to each micro-block. Such information cannot be obtained from the FI survey data, as the coverage will not be sufficient to inform harvesting at such fine scales as proposed under the Micro Block Harvest plan. For this to succeed, a spatially-controlled, pilot-fishing program may be required to inform the initial spatial allocation of harvest. The challenge of establishing a TAC for each micro-block, and then reviewing the TAC for each micro-block on an ongoing basis is substantial, and a review of this harvest strategy is advised.

The key weakness in the existing information base for SMI is spatially representative data on abalone growth and size at reproductive maturity (note that some existing data on fecundity could be reworked to provide an indication of size at reproductive maturity). The growth information is critical for two components –

reviewing or defending the choice of size limit and, more importantly, forming the basis of the age/size transition matrix of the SCA model. The model will be highly sensitive to variation in growth, and understanding of the variation in growth rate of populations forming the productive elements of the proposed fishery is essential if the model is to be at all useful. Without such data, the model is at best indicative and at worst misleading.

Indicator 1.2.4 - Assessment of stock status

The procedures identified for assessing performance of the fishery, stock status, and subsequent management changes are not well established. A shared management framework is described in MRAFOG Section 5.5, and a decision tree assessment process is described in MRAFOG Section 2.3. These sections identify data collection and data collection responsibilities, but reference to an assessment model is absent, despite progress towards YPR and SCA models. The conceptual flow chart of the decision tree provided in Figure 2, page 22 MRAFOG, has several weaknesses that are likely to result in ambiguity. Experience elsewhere has shown that fishery-independent abundance surveys and CPUE can provide conflicting signals on stock status (e.g. Abundance surveys suggest stocks increasing, CPUE decreasing, or vice versa). Consequently, successive steps in the decision tree may reverse outcomes of previous steps. The decision tree also incorporates changes in Temperature, Kelp Cover, and Disease, whereas these factors are best utilized in the context of a model, as the effect of changes in these parameters may be broader than simply on the exploitable biomass in the current and next harvest year.

MSC Principle 2

Indicators 2.1.1, 2.1.2, 2.1.3 Retained species (Status, management strategy and information/ monitoring)

There are no other species part of the retained catch apart from the targeted species for the proposed SMI abalone fishery. In other words, no other species besides the targeted species, *Haliotis rufescens*, will be retained in the proposed abalone fishery at SMI.

Indicators 2.2.1, 2.2.2, 2.2.3 Bycatch species (Status, management strategy and information/ monitoring)

Hookah diving and hand selection of abalone will be used in the proposed SMI fishery (Appendix J, "Guidelines"). With the exception of a variety of algal and invertebrate species living on the abalone shells there is no bycatch. Considering that only a few thousand shells are to be harvested and none of these species are known to live solely on abalone shells, the risks to any of these species due to the abalone fishery are considered to be very low.

Indicators 2.3.1, 2.3.2, 2.3.3 ETP species (Status, management strategy and information/ monitoring)

While none of the species living on the shells of abalone are known to be endangered, threatened or protected (EPT), sea otters (*Enhydra lutris* (L.) prey on abalone and are listed by the International Union for Conservation of Nature (IUCN) as an endangered species (see under ecosystem indicators 2.5). However, sea otters are currently not present on the island and feed on a variety of other benthic invertebrate species (Hines and Pearse 1982). For example, sea urchins are a common prey of sea otters (Pearse 2006). Therefore the proposed abalone fishery is unlikely to pose the risk of serious or irreversible harm to this species through the removal of its prey. However, the only management strategy is a statement that if populations expand further a zero TACs would be set for the abalone fishery at SMI (Prince and Valencia 2009). Little information is provided how sea otter interactions and occurrences will be monitored at SMI.

Indicators 2.4.1, 2.4.2, 2.4.3 Habitats (Status, management strategy and information/ monitoring)

The harvesting methods proposed for the SMI abalone fishery, like many other abalone fisheries worldwide, are highly selective and involve significantly less damage to the habitat compared with other fishing methods. Nevertheless, some potential impacts, such as mechanical damage from anchors, catch bags and hookah hoses, can be identified (Jenkins 2004). Considering the size of the proposed SMI abalone fishery, these factors are considered to have limited physical impact on the habitat. The ecological effects of fishing on the habitat and associated species are not well studied (Tegner and Dayton 1999). However, the proposed approach to harvest only from a sub-section of SMI would provide the experimental framework to assess the impacts of fishing on the habitat and ecosystem by applying a BACI design and comparing areas inside and outside the proposed fishery area before and after fishing started (Butterworth et al. 2009; see also 2009 Survey protocol).

Indicators 2.5.1, 2.5.2, 2.5.3 Ecosystem (Status, management strategy and information/ monitoring)

Whilst abalone are prey for a variety of fishes, crustaceans and molluscs like octopus, the sea otter (*Enhydra lutris*) also feeding on abalone is believed to have an important role in facilitating biodiversity within the kelp forest communities along the North Pacific Coast (Fanshawe et al. 2003). However, none of these predator species are regarded as dependent solely or mainly on abalone as a food source. Sea otters were hunted nearly to extinction throughout their range but recovered in many places following a moratorium in 1911 (Fanshawe et al. 2003). The authors found that sea otters and recreational harvest alter the density, size distribution and microhabitat distribution of red abalone in a similar way. The effect of sea otters was however stronger than the effect of recreational harvest. Sea otters are absent

at SMI and if populations expand further into Southern California the abalone fishery is thought to be unsustainable and a zero TACs would be set to minimize any additional risks (Prince and Valencia 2009). The idea that abalone fisheries are not sustainable in the presence of sea otters otters is widely accepted (Tegner et al. 1992).

It is recognized that information on predator-prey interactions is limited and data on the ecological impacts of abalone fishing are insufficient for coastal environments off California (Hines and Pearse 1982).
Together with sea urchins, abalone are the dominant benthic herbivore in the ecological community and feed predominantly on brown algal (kelp) species (e.g. *Macrocystis pyrifera*). There is anecdotal evidence of the practice of cutting back algae to prevent entanglement of hookah hoses; however there is no evidence to suggest that this practice would be allowed in the SMI abalone fishery.

Habitats can alternate between kelp forests that are grazed by herbivores (sea urchins and abalone), and areas dominated by sea urchins and non-geniculate coralline red algae, which are relatively low in species richness, often referred to as sea urchin "barrens" (Pearse 2006). The decline of abalone in some areas may have led to the increase in sea urchin populations (North and Pearse 1970). Alternatively, abalone may out-compete sea urchins for space when food is abundant as there is some indication that abalone are a better competitor for space (Lowry and Pearse 1973). Detailed experimental studies on the effect of abalone fishing on sea urchin populations are missing.

Other possible ecosystem impacts include translocation of marine pests and diseases. Withering syndrome is a chronic wasting disease of the California abalone (*Haliotis* spp.) that was first observed in the Channel Islands in the mid-1980s. This fatal disease played a significant role in the demise of southern California black abalone and may also be contributing to the lack of recovery of other species like the red abalone (Moore et al. 2002). Withering syndrome pathogens are known to be present at SMI and disease monitoring is ongoing. Friedman and Finley (2003) suggested that the pathogen was potentially distributed by out planting efforts in some parts of northern California. They also state that the threshold density of the host below which transmission is unsuccessful is unknown for this pathogen. This is directly temperature-dependent, particularly at temperatures exceeding 15^{o}C (Moore et al. 2000). There is upwelling around SMI and temperatures are generally lower than along the rest of the southern Californian Coast. Prince and Valencia (2009) provide details on the operation of the harvesting cooperative which includes that future TACs would be set to zero in the event of a disease outbreak, to minimize any additional risk. Further information is needed to establish how the endemic pathogen, a rickettsia-like prokaryopte, is transmitted among and between populations in the natural environment and if fishing can provide a significant risk.

MSC Principal 3

Indicator 3.1.1 Legal and/or customary framework

Documentation provided indicates that the proposed SMI abalone fishery will operate under three 'legal' and one 'customary' framework. The three legal frameworks are the *California Marine Life Management Act* (MLMA), the California Fish and Game Commission's policy on *Restricted Access Commercial Fisheries* (RACF) and the *Abalone Recovery and Management Plan* (ARMP). The customary framework comprises the Market Red Abalone Fishery Operating Guidelines (MRAFOG), developed by the California Abalone Association (CAA).

The legal frameworks describe a focus on, and requirement for, target species and ecosystem sustainability (i.e. MSC Principals 1 and 2). For example, the MLMA, that was enacted in January 1998, prioritizes long-term benefits and places a high emphasis on maintaining ecosystem integrity. Similarly, the RACF outlines the need to match fishing effort to resource status, thereby also helping to promote sustainable fisheries. Along with providing a mechanism to fund the diverse array of activities associated with modern fisheries management (e.g. management, research, compliance), the RACF promotes resource stewardship by providing an elevated responsibility to fishery participants for maintaining sustainability. The ARMP, a 'formal' Management Plan, adopted by the California Fish and Game Commission, has been designed explicitly to manage abalone fisheries in California, although primarily relates to the active recreational fishery. This Plan has two key objectives. These are to prevent further declines in the abalone stocks, and to ensure current and future stocks will be sustainable.

The MRFOG, developed by the CAA, provides a description of the potential customary framework under which the proposed fishery will operate. At the core of the MRAFOG is the development of a fishing 'co-operative' that will operate within a formal legal structure as required by both the State of California and the relevant federal legislation (Fisherman's Collective Marketing Act). Membership of the co-operative will be open to all individuals whom held a commercial abalone permit in 1996/97. In combination, these two elements will aid the management system for the proposed fishery to observe the "legal rights" of those people dependent on the resource for their livelihood.

The management system appears subject to Californian State and federal law for the resolution of legal disputes.

Indicator 3.1.2 Consultation, roles and responsibilities

The proposed abalone fishery at SMI has apparent high levels of consultation among all stakeholder groups, and the roles and responsibilities of the different organizations involved appear clear. For example, in March 2006, the California Fish and Game Commission instructed the California Department of Fish and Game (CDFG) to develop a formal process for evaluating the potential for a limited abalone fishery at SMI. This formal process included the creation of the San Miguel Island Abalone Fishery Advisory Group (AAG), which comprised a diverse array of

stakeholders. This committee included representatives from marine conservation groups, recreational fishers, CDFG, CAA, the Channel Islands Marine Sanctuary and the Channel Islands National Park. The conservation, preservation, recreational, commercial and Government groups will collectively undertake the development of four alternative management scenarios for abalone at SMI. The alternatives will be evaluated by the CDFG that, in turn, will provide a recommendation to the California Fish and Game Commission for final decision. Thus, while all stakeholders appear to be being consulted, the roles and responsibilities for each participating group seem well defined, with the final decision resting with the California Fish and Game Commission. The MRAFOG indicates that this process could form the basis for a "shared management framework" between the CAA and CDFG.

Development of the ARMP appears to have been undertaken through a formal, consultative process. Biologists within CDFG developed the plan, in consultation with the ARMP panel (that included representative groups with an interest in abalone), and other stakeholders including the Recreational Abalone Advisory Panel and the Commercial Abalone Advisory Panel. Constituent workshops were used to gather public comments on the initial plan concepts, which were followed by formal presentations to the public, for comment and feedback, once the draft plan had been prepared. The draft plan was formally reviewed, and revised prior to adoption following formal public comment.

Indicator 3.1.3 Long-term objectives

Long-term objectives are described for the proposed SMI abalone fishery. These management objectives are outlined in the 'legal' and 'customary' frameworks under which the fishery is proposed to operate. Two legal frameworks, ARMP and MLMA, provide a long-term vision for sustainability of the target species and the ecosystem. Notably, the MLMA prioritizes long-term benefits for resource use over short-term gains, and emphasizes maintaining ecosystem integrity. This is also the case with the ARMP, where the two key objectives are to prevent further declines in the abalone stocks, and to ensure current and future stocks will be sustainable. The MRAFOG, including Appendix G (A new beginning for abalone management in California: critique and comment on the Abalone Advisory Group's discussions) clearly articulates the use of precautionary approaches in development of the proposed harvest strategy for the fishery. A precautionary, adaptive approach using science-based, measurable criteria is the basis of the ARMP.

Similarly, the mission of the CAA, as stated in the MRAFOG, is "to restore and steward a market abalone fishery in California that utilizes modern management concepts, protects and enhances the resource, and guarantees a sustainable resource for the future". This mission statement is succeeded by a series of goals and objectives, including a commitment by the CAA to (1) actively rebuild abalone populations; (2) use science-based fishery management methods to prevent overfishing; and (3) work with local, regional, State and federal authorities to enact systems to ensure resource sustainability.

Indicator 3.1.4 Incentives for sustainable fishing

There was no evidence that the proposed SMI abalone fishery would operate with subsidies that would contribute to unsustainable fishing. Rather, the management system proposed may provide for incentives through the achievement of MSC Principals 1 and 2. For example, Figure 2 in the MRAFOG indicates potential adjustments to the TACC following consideration of a diverse range of relevant information. Thus, under conditions where catches appear below sustainable levels, and increases in catch are warranted, fishers may receive additional catch allocations. Given the high value of abalone, this would provide a high degree of incentive to achieve stock sustainability.

Indicator 3.2.1 Fishery-specific objectives

Short- and long-term objectives are described within the fishery's management system that would be consistent with achieving outcomes relevant to MSC Principals 1 and 2. For example, the ARMP identifies interim and long-term recovery plans. Specifically, the goal of the Interim Recovery Plan is to "reverse the decline of abalone populations that are in danger of extinction, and rebuild populations to self-sustaining levels throughout historic abalone ranges", whilst the goal of the Long-term Recovery Plan is to "rebuild abalone populations in at least three quarters of the historic range, and to prepare for establishing fisheries, allocating resources, ... and further developing the Long-term Recovery Plan". The ARMP also describes measurable criteria, based principally on the estimates of recruitment and population abundance, that can be used to evaluate progress in achieving the recovery and management goals identified.

Similarly, the CAA mission statement and objectives, which are encompassed in the proposed SMI abalone fishery through the MRAFOG, also describe long- and short-term objectives for the fishery. For example, the CAA is committed to rebuilding abalone populations (short term), and the development of science-based management to prevent future overfishing (long term). They also intend to develop a harvesting co-operative that will further support sustainable fishing practices.

Indicator 3.2.2 Decision making processes

Decision-making processes to achieve the fishery management objectives have been described. Firstly, the ARMP stipulates the measurable criteria by which changes in the status of the abalone stocks will be determined. For example, within the Interim Recovery Plan, Criterion 1 will be deemed to have been satisfied when "a broad range of size classes is present in the abalone populations". Following this, minimum viable populations are specified for both initial (2,000 abalone.ha^{-1}) and fishery-density levels (6,600 abalone.ha^{-1}). Further, Table 7-2 in Chapter 7 of the ARMP is the TAC adjustment decision table, based on a series of measurable criteria.

Secondly, the MRAFOG also describes the use of both formal 'decision tables' and a 'decision tree' for undertaking the decision-making process. However, the process outlined in the MRAFOG appears less advanced and 'finalized' than that described in the ARMP. Thus, while the MRAFOG describes a 'structure' for decision making, the 'detail' by which the process will achieve decisions was not clear. For example, the triggers (both positive and negative) to adjust the TAC through the process outlined in the decision tree (Figure 2) were not described in any detail. Appendix G (Prince and Valencia 2009) of the MRAFOG recommends development of a specific decision tree for red abalone at SMI. The interaction between the decision processes described in the MRAFOG and ARMP was unclear. Thus, mechanisms for resolving differences and disputes are not identified.

Developing clear decision making guidelines should be a key priority of the fishery and will be required as part of the full assessment process and to receive certification (see indicator 1.2.2).

Both the ARMP and MRAFOG suggest a precautionary approach and each indicates that decisions will be made on the basis of the best available scientific and other relevant information. Further, each indicates the need to consider a wide array of information through the decision-making process. Notably, Figure 2 in the MRAFOG proposes formal consideration of water temperature, kelp cover and level of disease in TAC determination. Predation by otters has also been put forward as a factor requiring consideration.

Indicator 3.2.3 Compliance and enforcement

Chapter 8 of the ARMP describes the abalone enforcement activities undertaken in California. The enforcement program appears a joint undertaking between CDFG, the Coast Guard, Channel Islands National Parks Service and the Channel Island National Marine Sanctuary. The primary tasks undertaken are (1) to protect areas closed to fishing and (2) ensure compliance with regulations. The latter is undertaken through both enforcement and educational approaches, and is a common mechanism used to ensure compliance with fishery management measures. The tagging of individual abalone, thus indicating their legitimate capture by commercial and recreational fishers, has also been considered.

In addition to Government enforcement, the proposed co-operative to harvest abalone from SMI plans to undertake a high level of "community enforcement" to ensure compliance with the regulations by their own members. This will likely include a "single port of landing", harsh penalties, VMS and implementation of an "island watch program".

Indicator 3.2.4 Research plan

The MRAFOG describe a potential data collection and resource assessment program for the prospective abalone fishery at SMI that is focused around the 'monitoring' of stocks and fishery performance. Thus, fishery-dependent data are proposed to be

obtained through a catch and effort log, which will require fishers to report information at fine spatial and temporal scales. In the short term, fishery-independent surveys are planned to continue to be undertaken and calibrated with the fishery-dependent data. The MRAFOG proposes to use both fishery-dependent and fishery-independent data to undertake annual stock assessments to set the TAC and other fishery parameters (e.g. size limits). In combination, these will provide measures of fishery performance including size structure of the catch, trends in catch, effort and CPUE, independent density estimates and a comparison with un-fished locations, all of which are consistent with monitoring performance of a fishery such as the one proposed for SMI. It is notable that the proposed research program will be very expensive to maintain. The small size of the planned fishery is likely to make acquisition of sufficient research funds problematic. This will affect the financial viability, and tenure, of the planned research program.

The ARMP describes the "essential fisheries information" required under the Plan. As with the MRAFOG, this comprises both fishery-dependent and fishery-independent data needs, with the primary use being monitoring of the stocks. The needs for research data vary spatially, and this is also described in the ARMP.

There was, however, no evidence of a 'strategic' research plan to acquire additional information about the red abalone stocks at SMI that will be needed to refine the existing model. These include data on growth rates and size at maturity, and connectivity within and among populations at San Miguel Island. Anecdotal information in the documents provided allude to research underway to examine growth, and to monitor juvenile abundance in recruitment modules, although it is not clear if these are ad hoc studies or part of a broader plan. Nevertheless, the need to rationalize the more expensive fishery-independent surveys in future years has been identified.

Indicator 3.2.5 Monitoring and management performance evaluation

There was no evidence of a formal review of the fishery-management system, or documentation evaluating the performance of the management system against the specified objectives. However, the performance of the fishery management system could be formally monitored through the assessment of stock status against the criteria described in the ARMP, in relation to the short and long-term recovery and management plans, and against the objectives of the CAA described in the MRAFOG.
There is, however, evidence of components of the management process being internally and externally reviewed. For example, the ARMP was subjected to a diverse array of internal and external reviews, including formal academic peer review, prior to adoption and implementation. Also, the red abalone stock assessment for SMI was reviewed by a scientific, peer-review panel including two international scientists. Further, publication of scientific papers on abalone in California, particularly those concerning red abalone and/or the Channel Islands, provides a strong external, peer review of the assessment system for the fishery.

State of Preparedness of Assessment

By "the state of preparedness of assessment" we mean the extent to which the fishery system is based upon MSC principles and criteria and the ability to provide evidence to an independent certification team that measures for protecting the sustainability of the resource and health of the ecosystem are not only in place, but working. This pre-assessment has been unique and provided some challenges as it is a proposed fishery only.

To determine if a fishery is considered a good candidate for a full MSC assessment, the most direct approach is to determine how the fishery might comply with existing MSC standards during a pre-assessment. The MSC assessment process is based on a set of performance measures that have been established by the MSC (see MSC Fishery Assessment Methods, Assessment Tree and Figure 1). These performance indicators are scored using guidance provided by the MSC.

This pre-assessment report uses the pre-set performance indicators to determine whether the abalone fishery could meet MSC standards. The performance indicators and our rational can be found in sections 3-5 and are summarized in Appendix A.

It is our opinion that the Red Abalone Fishery at San Miguel Island, if re-opened, could pass an MSC certification process using the standardized assessment tree and fishery assessment methods (FAM) if the issues listed below are addressed. There are several indicators that did not achieve a “green” ranking in our assessment and many of these fall under Principle 1: status of the stock and the harvest strategy (Appendix A). Under the FAM every fishery under full assessment must achieve an average score of 80 or above for each of the three principle to be certified. Therefore there is still a possibility that under the current circumstance the fishery would not pass because this average score may not be achieved for Principle 1. However, it is likely that more information will become available to allow a more full assessment of the stock status and particularly indicator 1.1.1 if fishing commences and the fishery is reopened at SMI.

Under the MSC system, when an evaluation team finds the fishery does not meet the MSC standard in a given area, the area is identified as a non-conformance. A non-conformance needs to be corrected either prior to certification, or after initial certification and within the timeframe of the certificate (5 years). There are a number of areas where this may be required in the SMI abalone fishery:

Potential Non-Conformance Issues

1. Stock Assessment Model – The use of an age-structured model for a species that cannot be aged needs to be fully justified. The alternative is to use a length (= size) structured model for future assessments. In addition, there is no evidence of sensitivity testing of the model performance.

2. Harvest control tools – While roles and responsibilities are clearly defined, there is no evidence of an agreed assessment framework between the CAA and the DFG, for reviewing the performance of the fishery, and for TAC decisions in the presence of conflicting performance indicators. Developing clear decision making guidelines is a priority, and should be informed by errors in the previous management system that led to the closure of the fishery. We regard this lack of clarity and detail as the largest risk in ensuring the continued sustainability of the proposed SMI fishery.
3. Ecosystem impact - Further information is needed to establish how the endemic pathogen, a rickettsia-like prokaryopte that cause the fatal disease "withering syndrome", gets transmitted among and between populations and if fishing could pose a significant risk in spreading the disease.
4. Fishery-specific management system – There is no evidence of a 'strategic' research plan. A gap analysis and development of a strategic research plan is needed should the SMI abalone fishery be re-opened.

The issues raised are real and could have significant economic ramifications should 'Conditions' be placed on the fishery to improve the stock assessments, harvest control rules, ecosystem impacts and management system of the fishery.

The Certification Process

To carry out a successful certification of the SMI red abalone fishery, the certification team must make sure it follows the required steps. We have outlined the steps below to inform the readers as to what would occur should a full certification be sought by the fishery. We also believe that a successful full assessment will depend on a comprehensive stakeholder consultation process, which in and of itself will be a significant portion of the MSC evaluation process given the number of fishing sectors and conservation groups interested in these fisheries.

Assemble Evaluation Team

SCS would select a team with appropriate expertise and experience. Before making a final selection of team members, stakeholder groups (industry, government, and conservation groups) would be interviewed for their concerns and their opinions on the available and appropriate experts.

The most significant issue at this step will be to ensure that at least one agreed expert has significant expertise in management of fisheries and in specific management of abalone.

Setting Performance Criteria

A generic set of 'Performance Indicators' and scoring guidelines for fisheries has been assembled by the MSC (see above). The team will review the set of "Performance Indicators' and scoring guides to determine if adjustments should be sought.

Information Gathering

Stakeholder Consultation

The MSC certification process requires that the evaluation team meets with stakeholders of the fishery and allow them to provide input regarding the certification of the fishery. There is no specific requirement to address directly or indirectly the concerns raised by the stakeholders, but it is obvious that if legitimate concerns are raised they must be taken into consideration by the evaluation team. Stakeholder consultation is necessary for two reasons:

1. It allows the stakeholders to voice opinions so they are engaged in the process, and
2. It provides the evaluation team with the widest possible views of the fishery so that the team can successfully cover all aspects of the fishery in the evaluation process.

The stakeholder consultation is not designed to be an open-ended process, nor one of casting aspersions. Stakeholders will be asked to submit issues in writing and to provide supporting documentation. Political arguments and arm-waving accusations are less likely to merit much consideration, as they provide nothing for the evaluation team to critically examine with regard to the fishery's performance.

Data collection and review

With indicators and performance levels identified, and stakeholders interviewed, the team will collect and review all necessary and relevant information to assess the fishery. This will mean meeting with and interviewing all relevant scientists and staff engaged in the assessment and management of the fishery. The team will be requesting documentation on the status of stocks, management operations, management regulations, enforcement, environmental impacts, gear, etc.

Performance scoring

After all data are reviewed, the team will meet to work through a consensus process of scoring each performance indicator to determine if it meets or exceeds the minimum performance levels set forth by the MSC Principles and Criteria. The findings of this meeting will determine if the fishery passes the certification process.

Draft report

A report will be drafted and sent to the Client for internal review. This helps to ensure that the team has not missed or misinterpreted any information pertinent to the evaluation of the fishery. The evaluation team will then use the comments from the Client to revise the report as appropriate.

Peer review

The final draft report must be peer reviewed by two experts of equal or greater stature to those conducting the evaluation. Several issues need to be addressed by the peer review process.

1. Peer reviews must determine if the information included in the assessment has been accurately reported and that there are no other data, which have been ignored or overlooked which would give a contrary picture of the fishery.
2. A peer review must determine if the management in the fishery is comprehensive and that arrangements for management and research investigations which have, or are planned to be undertaken, for the fishery, are adequate for resource protection and management of this type of fishery.
3. A peer review must determine if the assessment procedures, practices, and results meet the certification standards of the MSC.

To accomplish all these tasks, the peer review team should have a high level of technical competence, regional expertise, and objectivity (especially as defined by stakeholders outside the industry).

Public comment draft report and final report

After review by the client and peer reviewers, the report will be made available for comment by stakeholders for a period of 30 days. The report will include all reviewer comments. After the 30 day period the draft report will be reviewed by the assessment team taking account of all stakeholder and peer reviewers' comments and a final determination will be made with the release of a final report. The final report will be posted on the MSC website.

Dispute Resolution

There is always the need to prepare for the contingency that formal complaints could be lodged against the certification effort.

The MSC requirements are clear. The first step to be taken by any organization or individual wishing to complain about the certification process or outcome is to lodge a formal complaint with the certification body or organization that conducted the evaluation. The Certification Company and its team of experts must then with reasonable effort answer the complaint and try to come to some agreed conclusion.

If the complainant cannot be satisfied by the Certification Company and its expert team, then the complaint can be elevated to a formal complaint to the MSC itself. Once elevated to this level, the MSC will require that the certification company and its experts provide answers to the specific issues in the complaint to the MSC Accreditation Officer, the MSC Standards Committee, and finally to the MSC Board of Directors.

The time commitments for resolving disputes can vary considerably, especially if there are numerous complaints. As stated previously, we believe that there are no significant issues that should generate complaints in this fishery. However, as a contingency we would advise the Client to be prepared if a dispute is lodged to follow the resolution process through both in terms of time and budget.

Budget Estimate and Justification

Professional Services

Each fishery assessment differs in terms of the amount of time required to travel to and meet with fishery managers, scientists, and stakeholders. In addition, each fishery has a different amount of information to review. All of these factors play a role in estimating a final budget. We have given all these factors careful consideration and used past experience to estimate the time requirements for the different steps in the certification process in preparing an estimated budget for this project. The tasks required to complete a full assessment are shown below:

1. Team Selection
2. Review and Revise Performance Indicators
3. Review CAA Submitted Fishery Data
4. Interview Key Fishery managers, scientists, and stakeholders
   a. Managers, Scientists
   b. Stakeholders (industry and conservation organizations)
5. Fishing Vessel Inspections
6. Evaluate and Score Fishery against Performance Indicators
7. Reporting
   a. Draft Report
   b. Discuss Conditions/Requirements with Applicant/Client
   c. Revise Draft Report based on Client Comments
   d. Revise Draft Report based on peer review comments
   e. Revise Draft Report based on public review process

A full budget showing person-days required for each task, as well as the estimated costs will be provided separately to protect confidential information.

Expenses

Expenses vary based on location of each assessment team member, the number of meetings required between the team and fisheries managers, fisheries scientists, and stakeholders; and the changing market structure for airlines and hotels. It is estimated that the assessment team will need to have at least 3 main meetings and working sessions. The first meeting will be to initiate the project and develop a first draft of the performance indicators and scoring guidelines. This meeting will also include a consultation with the client and with key stakeholders. A second meeting is typically held to interview fishery scientists and managers, and key stakeholders. A third meeting is required to evaluate and score the fishery against the performance indicators. Due to the extended nature of the possible stakeholders (multiple fishing groups and conservation groups), it is not yet clear if more than one meeting concerning stakeholder input will be necessary. The decision on an additional meeting to talk with stakeholders will only be able to be made after initial consultations with stakeholders.

To estimate expenses we will assume that the team working sessions can be held in one place located as centrally as possible to the locations of the key people identified for interviews (this may be Santa Barbara). Should there end up being a need to hold meetings in more than one location to successfully interview managers, scientists, and stakeholders, then travel related expenses would be increased.

In summary, expenses are estimated on best available information and at current market rates, and are subject to change. Estimates will be provided under separate cover to protect confidential information, and will be based on:

- Airfares
- Accommodation
- Food
- Ground Transport
- Meeting Facilities
- Miscellaneous (phone, fax, copying, etc.)

Post-Certification Costs

Dispute Resolution

The MSC has instituted an Objections Procedure that is an avenue for any person or organization to dispute the findings of an MSC fishery assessment. The initial step in the Objections Procedure involves the assessment team, and involves responses to specific complaints that may be raised by an objecting party. The costs for this are hard to predict, but estimates are provided with the budget under separate cover.

The second part of the MSC Objections Procedure involves a major review of the assessment process by an Objections Panel convened by the MSC. This is not the responsibility of the client, but the MSC Objections Panel does have the right to call on the original evaluation team to answer questions. At this time we are unable to provide any additional guidance on the possible costs for this part of the objections process.

Chain of Custody

Under the MSC program, each processor must also get qualified to make the claim that products come from a certified fishery and can carry the MSC logo. The Chain of Custody would be examined and documented to the extent possible for the client. A separate cost estimate could be prepared to cover this issue should the fishery be certified.

Annual Surveillance

An MSC certification requires that there is an annual audit of random aspects of the fishery and its operations. This is normally a limited operation, conducted by 2-3 of the original team members in a period of a few days site visit and a brief report. The cost of a routine annual surveillance for this fishery could be expected to be up to 15% of the initial certification costs. This will vary depending on the findings of the full evaluation.

Time Requirements for Certification

From the initiation of a certification evaluation on SMI red abalone fishery, we anticipate that it will take a minimum of 8-10 months to complete the entire certification process. This is based on 3 items:

1. Full cooperation from CAA and CDFG in providing information/data about the policies, fishing practices, and management of the fishery.
2. Cooperation from stakeholders in eliciting comments
3. Availability of appropriate experts to participate on the evaluation team and on the peer review panel.

References

Erlandson, JM, TC Rick, TJ Braje, A Steinberg, RL Vellanoweth. 2008. Human impacts on ancient shellfish: a 10,000 year record from San Miguel Island, California. Journal of Archaeological Science 35(8):2144-2152.

Fanshawe, S, GR VanBlaricom, AA Shelly. 2003. Restored top carnivores as detriments to the performance of marine protected areas intended for fishery sustainability: a case study red abalones and sea otters. Cons. Biol. 17:273-283.

Hines, AH, JS Pearse. 1982. Abalones, Shells, and Sea Otters: Dynamics of Prey Populations in Central California: Ecology 63: 1547-1560.

Jenkins, G. 2004. The ecosystem effects of abalone fishing: a review. Marine and Freshwater Research 55(6):545–552.

Littler, MM. 1980. Overview of the rocky intertidal systems of southern California. Pp 265-306 in Power, D.M. (ed.) The California Islands: Proceedings of a Multidisciplinary Symposium. Santa Barbara Museum of Natural History, Santa Barbara, California.

Lowry, LF, JS Pearse. 1973. Abalone and sea urchin in an area inhabitat by sea otters. Marine Biology 23:213-219.

Karpov, K, Haaker, P, I Taniguchi, L Roger-Bennett. 2000. Serial depletion and the collapse of the California abalone (*Haliotis* spp.) fishery. In Workshop on Rebuilding Abalone Stocks in British Columbia. Edited by A .Campbell. Can. Spec. Publ. Fish. Aquat. Sci. 130. pp. 11-24.

North, WJ, JS Pearse. 1970. Sea urchin population explosion in Southern Californian waters. Science 167:209.

Tegner, MJ. 1989. The California abalone fishery: production, ecological interactions, and prospects for the future. Pp. 401-420 In J.F. Caddy eds. Scientific approaches to Management of Invertebrate Stocks. Wiley and Sons, New York, New York.

Tegner, M.J., Breen, P.A. and Lennert, C.E. (1989) Population biology of red abalones, Haliotis rufescens, in southern California (USA) and management of the red and pink, Haliotis corrugata, abalone fisheries. Fish. Bull. 87(2), 313–339.

Tegner, M, J. DeMartini, K Karpov. 1992. The California red abalone fishery: a case study in complexity, in S Shepherd, M Tegner, and S Guzman del Proo eds., Abalone of the World: Biology, Fisheries and Culture: Oxford, Blackwell Scientific Publications Ltd., p. 370-383.

Tegner MJ, PK Dayton. 1999. Ecosystem effects of fishing. Tree 14:261-262.

Appendix A – Overview of performance of the San Miguel Island Abalone Fishery against indicators - based on the MSC standard

	Performance Indicators			Scoring
Principle 1 **Stock status**	Outcome	1.1.1	Stock status	
		1.1.2	Reference points	
		1.1.3	Stock rebuilding	
	Harvest strategy (Management)	1.2.1	Harvest strategy	
		1.2.2	Harvest control rules & tools	
		1.2.3	Information & monitoring	
		1.2.4	Assessment of stock status	
Principle 2 **Ecosystem**	Retained Species	2.1.1	Status	N.A.
		2.1.2	Management	N.A.
		2.1.3	Information	N.A.
	Bycatch	2.2.1	Status	
		2.2.2	Management	
		2.2.3	Information	
	ETP Species	2.3.1	Status	
		2.3.2	Management	
		2.3.3	Information	
	Habitats	2.4.1	Status	
		2.4.2	Management	
		2.4.3	Information	
	Ecosystem	2.5.1	Status	
		2.5.2	Management	
		2.5.3	Information	

Principle 3 **Management and Governance**	Governance and policy	3.1.1	Legal & customary framework	
		3.1.2	Consultation, roles & responsibilities	
		3.1.3	Long term objectives	
		3.1.4	Incentives for sustainable fishing	
	Fishery specific management system	3.2.1	Fishery specific objectives	
		3.2.2	Decision making processes	
		3.2.3	Compliance & enforcement	
		3.2.4	Research plan	
		3.2.5	Management performance evaluation	

Good Probability of Success = Score of 80 or above

Some probability of success, however impediments for certification are identified =
Score 60-80

Score below 60 = low probability of success

APPENDIX D: OPTIMAL DESIGN AND MANAGEMENT OF A COMMERCIAL FISHING COOPERATIVE FOR THE SAN MIGUEL ISLAND RED ABALONE FISHERY

From the 2009-2010 Bren School Group Project Description. Group Members: Kristen Bor, Heather Hodges, Ariel Jacobs, Dan Ovando, Josh Uecker. Faculty Sponsor: Christopher Costello

This project will evaluate the viability of a self-funded commercial harvesting cooperative for San Miguel Island red abalone, while providing management recommendations to our client, the California Abalone Association, for obtaining optimal environmental and economic benefits.

Problem Statement

Red abalone (Haliotis rufescens) is a sedentary species that is extremely prone to overfishing and has been poorly managed worldwide. In Southern California additional pressure was placed on the resource by disease and pollution. In 1997, a statewide moratorium was placed on the commercial harvest of abalone, due to a severe decline in most stocks. Since the passage of this moratorium, some California abalone populations have displayed evidence of recovery. In particular, surveys and stock assessments have shown the red abalone population at San Miguel Island to be both healthy and stable (California Department of Fish and Game 2005). In response, the California Fish and Game Commission is currently considering opening a small-scale commercial red abalone fishery at San Miguel Island. Subsequently, this has created a debate as to how the fishery should be managed once it is opened.

Our client, the California Abalone Association (CAA), a group of former commercial abalone fishermen, has been a key player in the development of a management plan for the proposed fishery. In anticipation of the opening of this red abalone fishery, the CAA has developed a design for a member owned shared management fishing cooperative. The CAA also intends to utilize a catch-share approach in the design of their proposed fishery, by creating a cooperative in which the catch and profits of the fishery, as well as responsibility for funding research and management, are distributed between the members. Recent studies have demonstrated the potential benefits of catch share fishery management systems (Costello et al. 2008, Deacon et al. 2008). Under catch share systems, fishermen are allocated specific rights to the fishery in question, creating an incentive for sustainable management and alleviating the “race to fish” symptomatic of open access fisheries (Costello et al. 2008). The CAA intends to self-fund research and management of the fishery. The CAA has investigated several cooperative designs and needs guidance as to which is the optimal cooperative model if a sustainable abalone fishery is to be opened.

The CAA requires assistance in assessing the economic and environmental viability of the proposed fishery. Many different management strategies are possible for the cooperative, depending on the Total Allowable Catch (TAC), catch share allocation and structure, number of participants, length and timing of the season, costs of operation and management, and state of the abalone resource. Customization of the design is key to the success of a fishing cooperative. As such, the strategy selected must be in line with the specific objectives and characteristics of the proposed abalone fishery; to maximize profits while ensuring the long-term sustainability of the abalone population at San Miguel Island (Costello 2009).

Project Significance

Abalone is an important economic and cultural resource to the State of California. A properly designed and implemented commercial cooperative fishery would:

1. Support local fishermen, restaurant owners, and the local food movement
2. Provide an example to fishery managers worldwide in the design and implementation of a catch-share and community based management strategies
3. Demonstrate the potential for member owned and managed fishing cooperatives to be both sustainable and profitable, and in doing so help shape future fishery policies.

Project Objectives

1. Utilize environmental and economic data to perform a cost-benefit analysis of the CAA's cooperative management structure, in order to evaluate the long-term financial viability of the proposed fishery.
2. Determine alternative management structures for the cooperative, developed from discussions with the CAA and recommendations drawn from collected case studies of similar fishing cooperatives across the globe.
3. Conduct cost-benefit analyses of these alternative plans, and synthesize economic viability reports in order to provide the CAA with concrete data on the economic performance of available management options.
4. Evaluate the economic viability of available management options, under potential environmental and economic states.

Deliverables

1. Develop a comprehensive report assessing the economic viability of a self-funded SMI commercial red abalone fishing cooperative along with providing recommendations for optimizing profits while ensuring the sustainability of the resource.

2. Develop a bio-economic cost-benefit analysis of the CAA's proposed fishery, usable by the cooperative to evaluate the economic impacts of available management options.
3. Present findings to the CAA, which they may then utilize in the formation and implementation of a cooperative that best promises economic viability and environmental sustainability.

Current Status Report

At the end of November 2009 much of the data required for the comprehensive analysis of the costs and revenues available to the cooperative, environmental and population data, and case studies of other similar worldwide cooperatives have been collected. The basic costs likely to be faced by the cooperative have been compiled, and preliminary estimates of revenues and profits have been calculated.

Initial assessments of the abalone stock at SMI are also completed, taking into account survey data, abalone biology, and past trends in ocean temperatures. The goal of this assessment is to provide a grounded estimate for the catch available to the cooperative, and is not intended to serve as a precise simulation of the real abalone stock at SMI.

Remaining research to be conducted includes refinement of cooperative operating costs, assessment of marketing and sales options, expansion of population data, and analysis of the legality of potential management actions. This remaining information should be collected by mid January 2010 and a final report on the economic viability analysis with recommendations for the cooperative management structure is expected in February 2010.

Works Cited

California Fish and Game Commission. Abalone Recovery and Management Plan. (2005). http://www.dfg.ca.gov/marine/armp/pdfs/entire_armp.pdf

Costello, C. (Lecture 1/9/2009). Bren School of Environmental Science and Management

Costello, C., Gaines, S.D., Lynham, J. (2008). "Can catch shares prevent fisheries collapse?" Science. 321(5896): 1678 – 1681.

Deacon, R.T., Parker, D.P., Costello, C. (2008). "Improving Efficiency by Assigning Harvest Rights to Fishery Cooperatives: Evidence from the Chignik Salmon Co-op." Arizona Law Review. 50(479): 479-509.

APPENDIX E: SUGGESTED REGULATIONS

It is anticipated that CDFG will develop regulatory language when the fishery is reopened. The cooperative would like to work jointly with CDFG to develop that regulatory language. This appendix contains suggested regulations based on:

- Commercial Fishing Provisions 95-01 for Abalone Diving (as of January 1, 1995)
- Excerpts from Fish and Game Code
- Excerpts from California Code of Regulations (Title 14)

3. Fishermen proposed regulatory modifications regarding the cooperative

1. Commercial Abalone Permit / Title 14. Abalone

Every person who takes, assists in taking, possesses or transports abalone while on any boat, barge or vessel, or who uses, operates, or assists in using or operating any boat or equipment to take abalone must have obtained a valid abalone permit and must be in possession of said permit while engaged in such activities.

2. Diver Participation

Divers "participating" in the fishery will be required to:

a) Purchase/renew their commercial abalone diver permit within the timeframe and guidelines set forth by the California Department of Fish & Game (department)
b) Possess a valid commercial fishing license issued by the California Department of Fish & Game
c) Comply with all requirements set forth by the department
d) Become a member of the cooperative

CDFG Code 5522. (e) states "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."

Cooperative Operating Standard: At the time of the fishery closure in 1997 there were approximately one hundred licensed commercial divers (prior permittees) that could potentially participate in the designated access fishery. The Total Allowable Market Catch (TAMC) will be issued to the cooperative and then divided equally among the "participating" pool of cooperative divers with valid permits.

(1.) Classes of Permits / Abalone Diving Permits

Any applicant who qualifies as a prior permittee in the 1996/97 permit year can apply to the department for an abalone diving permit. The number of permits available to new entrants, shall be the difference between the number of permits issued to individuals qualifying as prior permittees and 35, if the number of prior permittees is less than 35. Abalone diving permits shall be issued in two categories, as follows:

(a.) Prior Permittees

Eligible applicants shall consist of abalone diving permittees who possessed a valid abalone diving permit in the 1996/97 permit year. No abalone diving permit authorized pursuant to this subsection shall be issued by the department following June 30 of each license year. Any person denied an abalone diving permit pursuant to these regulations may request a hearing before the commission to show cause why his request for such permit should not be denied.

3. Permit Year/Season

ARMP Table 2.2 states that the spawning season for Southern California red abalone is year round. For the purposes of this section the abalone permit year shall be from April 1 to March 31 of the following year. If it is necessary to designate a season the cooperative will work in conjunction with CDFG to select a season based on:

a) Biology
b) Enforcement requirements
c) Market conditions

The department shall permanently revoke the commercial fishing license and any commercial fishing permits of any person convicted of a season violation. That person shall not, thereafter, be eligible for any license or permit to take or possess fish for sport or commercial purposes.

4. Limitations and Conditions of Permits

The provisions of the Fish and Game Code and this section relating to abalone shall be a condition of abalone diving permits. An abalone diving permit shall not be assigned or transferred without prior approval by the department, and any right or privilege granted there under may be revoked or cancelled without notice by the commission upon violation of any regulation pertaining to the take of abalone; or violation of any of the terms and conditions of the permit by the holders thereof, their agents, servants, employees, or those acting under their direction and control. A person whose abalone permits has been revoked by the Commission, or who has

violated the laws or regulations pertaining to the take of abalone may be required to appear before the commission when applying for other fishing permit.

5. Gear, Equipment, and Method of Take

Every abalone diving permittee shall carry an accurate measuring device and shall measure all abalone before detaching the abalone from its place of attachment. If any abalone under the minimum size is detached by a permittee, he or she shall immediately replace the abalone at its place of attachment. No abalone diving permittee shall throw, cast or drop any abalone into the ocean.

A diver shall be equipped with and use underwater diving gear which shall consist of above-surface air pump operated from a boat and at least 100 feet of air hose, and must be fully submerged while taking abalone.

Abalone may be taken only by hand or with abalone irons. For the purpose of this section, an abalone iron is defined as a flat device not more than 24 inches in length and not less than three-fourths inch wide and not less than one sixteenth inch thick; all edges of the device shall be rounded and smooth. The device may be curved but the radius of the curve shall not be less than eighteen inches.

6. Vessel Identifications

The permit number of the boat operator shall be displayed in 10" high by 2" wide black Roman alphabet letters and Arabic numerals. Figures shall be black on a white background on both sides of the vessel. Numbers shall be displayed at all tunes while operating under an abalone permit. All permittees aboard the boat shall be mutually responsible for the proper display of the numbers.

7. Possession

No person aboard any boat engaged in taking abalone shall take or possess sea urchins on any day or on any fishing trip when abalone have been taken.

8. Black Abalone

Black abalone may not be taken or possessed at any time for commercial purposes.

9. Commercial Permit / §8300.1. Permit Fees; Abalone Diving Permit

Abalone shall not be taken for commercial purposes except under a revocable abalone diving permit issued by the department under regulations adopted by the commission. The diving permit fee is three hundred thirty three dollars ($330).

10. 88301. Unlawful to Remove Abalone from Shell; Penalty.

It is unlawful to remove abalone from the shell or to possess abalones which have been removed from the shell.

The court shall order the department to permanently revoke, and the department shall permanently revoke, the commercial fishing license and any commercial fishing permits of any person convicted of a violation if the court finds that the person possessed more than 24 abalone removed from the shell at the time of the offense. That person shall not, thereafter, be eligible for any license or permit to take or possess fish for sport or commercial purposes.

11. §8302. Food purpose taking only.

Abalone may be taken only for food purposes.

12. §8303. Diving Requirements While Taking.

Only diving apparatus authorized by the commission may be used to take abalone for commercial purposes. Abalone may be taken only when the permittee is submerged.

13. Minimum Size Limit / §8304. Minimum diameter of shell.

It is unlawful to take, possess, sell, or purchase any red abalone, the shell of which, measured in greatest diameter, and is less than 8 inches. Cooperative harvesters intend to select animals above the new 8 inch shell diameter.

The court shall order the department to permanently revoke, and the department shall permanently revoke, the commercial fishing license and any commercial fishing permits of any person convicted of a violation. If the court finds that the person possessed more than 24 undersized abalone at the time of the offense. That person shall not, thereafter, be eligible for any license or permit to take or possess fish for sport or commercial purposes.

14. §8305.9. Authority to open; areas for commercial taking.

The commission may, whenever necessary to prevent overuse, rehabilitate the resource, or otherwise carry out the provisions of this article, close or open areas for up to two years for the commercial taking of abalone, provided that the area opened is also opened or the area closed is also closed to sport taking of abalone.

15. Area.

The area for the initial designated access red abalone fishery will be San Miguel Island (SMI) excluding designated Marine Protected Areas (MPA).

16. Landing Port.

All abalone harvested at SMI by the market sector will be landed at the Santa Barbara Harbor.

17. §8305.10. Opening and Closing Designated Areas.

If the commission opens or closes a designated area pursuant to Section 8305.9, the commission shall not open or close any other area to mitigate or offset the opening or closing of the designated area.

18. Transferring Commercial Permit / §8307. Transferring Permit.

An abalone diving permit may be voluntarily transferred by the permittee, if the permittee has no charges pending for a punishable violation, under either of the following conditions:

a) The permittee held an abalone diving permit in the 1996/97 permit year.
b) The permittee has had a permanent injury or illness that prevents the permittee from commercial diving, and that fact is evidenced by a written finding by a licensed physician and surgeon.

Until the total number of abalone diving permits is 35 or less, a permit may only be transferred if a second, third, or fourth permit (whichever option is selected) is surrendered to the department for cancellation at the same time the application for the transfer is submitted to the department.

An abalone diving permit may be transferred pursuant to this section to a person only if that person meets all of the following qualifications:

a) The person, at that time, holds a commercial fishing license.
b) The person has held an abalone diving permit and the person has not had any commercial fishing license or permit suspended or revoked, has never been convicted and no charges are pending for a violation of any provision of Fish and Game Code or of Title 14 of the California Code of Regulations pertaining to abalone regarding seasons, area closures, size limits, bag limits, possession of shucked abalone, or buying or selling any fish illegally taken in California waters.

c) The person submits to the department's headquarters a notarized letter from each of the permittees described above, each of which includes a statement identifying the person to whom the abalone permit is to be transferred and setting forth the conditions of the transfer, and any necessary documentation that the department may reasonably require to prove that the permittee is eligible to transfer the permit.

The application for the transfer of an abalone diving permit shall be submitted by the person to whom the permit is to be transferred to the department together with the proof that the department may reasonably require to establish the qualifications of that person. The applicant for the transferred permit shall include with the application a transfer processing fee of two hundred fifty dollars ($250). The department may increase the transfer processing fee as required to pay the costs of conducting any additional search of the records for violations committed by the parties.

Upon determining that the transferee of the abalone diving permit under this section is qualified, the department shall issue an abalone diving permit to the transferee which is valid for the remainder of the then current season. An abalone permit issued pursuant to this subdivision shall be renewed in the next succeeding season notwithstanding the any landing requirements.

After the transfer of a person's abalone diving permit, that former permit holder may not take, possess, transfer, or control any abalone for commercial purposes unless otherwise permitted by law.

19.§8307.2. Transfer of Permit in Estate of Deceased Permittee.

An abalone diving permit shall be transferred to the estate of a permittee who has died only for the purpose of transferring the abalone diving permit to another person if both of the following conditions are satisfied:

a) The deceased permittee had no charges pending for a punishable violation punishable at the time of the permittee's death.
b) The deceased permittee held an abalone diving permit in each of the preceding three years.

The abalone diving permit in the estate of a deceased permittee may be transferred to any person who meets all of the following qualifications:

a) The person, at that time, holds a commercial fishing license.
b) The person has not had any California commercial fishing license or permit suspended or revoked, has never been convicted, and no charges are pending, for a violation of any provision of Fish and Game Code or of Title 14 of the California Code of Regulations pertaining to abalone regarding

seasons, area closures, size limits, bag limits, possession of shucked abalone, or buying or selling any fish illegally taken in California waters.

The application for the transfer of an abalone diving permit under this subdivision shall be submitted within one year of the permit holder's death to the department's headquarters by the administrator of the estate of the deceased permittee, identifying the person to whom the permit is to be transferred and setting forth the conditions of the transfer, together with the proof that the department may reasonably require to establish the validity of the transfer request. The application for permit transfer shall be accompanied by a transfer processing fee of two hundred fifty dollars ($250).

Upon determining that the transferee of the abalone diving permit is qualified, the department shall issue an abalone diving to the transferee that is valid for the remainder of the then current season. An abalone permit issued shall be renewed by the department in the next succeeding season notwithstanding any landing requirements.

After the transfer of the deceased person's abalone diving permit, the estate of the deceased permit holder may not possess, transport, or control any abalone for commercial purposes unless otherwise permitted by law.

20. §8309. Sunset/Sunrise Restrictions.

It is unlawful for the holder of a permit to commercially take abalone from one-half hour after sunset to one-half hour before sunrise.

21. §8310. Unlawful Purchase.

It is unlawful for any person to purchase, receive, possess, or sell any abalone, or pans thereof, which were taken illegally in California waters.

22. Revoked or Confiscated Permits

Any revoked or confiscated permit will be eliminated from the overall number of permits and cannot be reissued by the department, until the total number of abalone diving permits is 35 or less. The former permittees catch share will revert back into the TAMC held by the cooperative and be divided evenly among all the identified “participating” divers.

23. Tags

The cooperative will coordinate with CDFG regarding certification and distribution of the tags. These tags will be fixed to each abalone upon harvest. Each tag will identify the permit holder, be sequentially numbered, tamper proof, and use a bar

code system. The tag will remain on the abalone all the way to its final destination (i.e., restaurant, etc.) to identify legally harvested abalone in the marketplace. Tags are only valid in the season they are issued for.

24. Landing Receipt

Abalones possessed above the high-water line are considered landed and shall have a valid landing receipt as per Fish and Game Code 8043. Wholesale buyers/fish receivers shall reference the landing receipt on sale invoices and keep appropriate records as per Fish and Game Code 8050 and according to cooperative abalone tracking procedures. The Market Catch Tag numbers will be included on Landing Receipts and transfer tickets.

APPENDIX F: EVALUATION OF THE RED ABALONE STOCK ASSESSMENT BY THE REVIEW COMMITTEE IN SUPPORT OF DELIBERATIONS OF THE ABALONE ADVISORY GROUP

I. Introduction

Review Committee: Schoeter, Butterworth, Gorfine, and Weber

The Review Committee (Doug Butterworth, University of Cape Town; Harry Gorfine, Victorian Department of Primary Industries and University of Melbourne; Stephen Schroeter, University of California, Santa Barbara; Ed Weber, NOAA Fisheries) considered the report from the Technical Panel and associated documents, aided by an interactive discussion with the Panel and other stakeholders. Although data for a stock assessment of the abalone at San Miguel Island (SMI) are limited, the Committee considers that it is not necessary to wait for further data collection before a change in the current moratorium at SMI might be elected. There would be value in a parallel process where some removal was permitted on an experimental basis to provide additional information to that already being collected. Such a level of experimental take must be set conservatively, must be subject to monitoring, and should be reviewed immediately if monitoring indicates adverse trends in abundance that are likely linked to removals.

Here the Committee reviews the input data used in the assessment (Section II), the statistical catch-at-age assessment model (Section III), and risk considerations and computations (Section IV). It then proceeds to comment on experimental removal as a possible way forward (Section V), and on-going resource monitoring that would be necessary to accompany such a program (Section VI). Section VII summarizes the next steps recommended if the proposed approach is to be implemented. This document meets the objectives of the revised Terms of Reference (TOR) for the Review Committee.

II. Data

1. The recent surveys are very good and provide important data that are not normally available to managers. The Committee agrees with the Technical Panel that these are the best data available.

2. Data collection protocols for these surveys should nevertheless be reexamined and altered appropriately to better estimate absolute abundance and proportion of suitable habitat (i.e. non-sand). This can be done by positioning transects along predetermined, randomly chosen azimuth to avoid possible bias. Transect directions should not be altered to avoid sand.

3. It may be possible to include zeros for the areas that were avoided as nonhabitat, and thus calculate a more accurate estimate of abundance in the kelp area for existing surveys. In the future, it may be better to estimate densities and totals based on the survey design (almost a two-stage stratified design in 2006–2008) instead of using geostatistics.

4. The data collected in 2006–2008 should be evaluated to see if it is possible to develop a stratification scheme that would permit similar power with fewer transects. This might involve analysis of hierarchical structure of data to determine appropriate scales of stratification. It is also important to check that stratification actually succeeds in reducing variance. Numbers of samples should also be allocated among strata optimally (e.g., Neyman allocation) based on variance estimates from the existing surveys. Cochran (1977) and Thompson (2002) describe appropriate sampling designs, allocation of effort, and sampling estimators.

5. Use data from existing surveys to determine appropriate sample size and estimate power to detect biologically important effect sizes for comparisons among years. Future surveys must have sufficient statistical power (i.e., precision of effect-size estimates) to detect biologically important changes in abundance of abalone.

6. The assessment of relative strengths and weaknesses of the other survey data by the Technical Panel were accepted given the absence of full documentation. The Channel Island National Park Kelp Forest Survey may not adequately represent the general trends in population vital rates at SMI. It reflects a small area only, and the low densities relative to other areas may indicate marginal habitat.

7. Growth rates of larger, older red abalone reported in the Haaker *et al.* (1998) manuscript are likely to have been biased because the study area was fished, and the relation for larger animals was largely extrapolated. This probably leads to underestimates of $L\infty$ and growth rates, perpetuated through the per-recruit and other analyses for larger red abalone. The Committee notes that this problem is being addressed through additional data collection (Section 6, Bullet 5).

III. Assessment (statistical catch-at-age model approach)

1. The record should be checked for reasons (regulations perhaps) to explain the trend up and then down of the historic catch during the 1990s immediately before the closure of the abalone fisheries.

2. A flexible functional form should be used to model selectivity-at-length for abalone sampled in the 2006+ surveys, and used in providing model predicted values for proportions at length and abundance corresponding to these surveys.

3. The report tabled did not fully explain some of the details of the assessment model, perhaps because it had to be prepared in a very short time; future reports need to provide the specifications of this model in complete detail. Furthermore, such reports should contain summaries that present their conclusions in a form more readily understood by non-specialists.

4. A baseline assessment should be considered based on input from the most reliable data only – likely past catches and the proportions-at-length and abundance estimates from the 2006+ surveys. The effects of adding further relative abundance information should be explored through sensitivity tests.

5. More model fit diagnostics should be reported so that the quality of fits can be judged better, and with a view to clarifying which elements of the inputs have the greatest influence on key features of the outputs (such as recent resource trends): for example, both data and model predictions should be compared for each data series input, together with the value of the associated residual standard deviation, for maximum penalized likelihood estimation.

6. Use of a multinomial with the actual number of animals sampled each year for the likelihood for proportions-at-length likely over weights these data because of their lack of independence. Use of a lower effective sample size, and its effects on results, should be investigated.

7. Consideration should be given to augmenting estimates of more recent year-class strength by shrinkage (Darby and Flatman 1994; Shepherd 1997) to the mean of past values to improve precision (this being a special case of fitting a stock recruitment relationship within the statistical catch-at-age assessment).

IV. Risk considerations and computations

1. Risk should be evaluated in relation to the statistical catch-at-age assessment by projecting the population trajectory estimated into the future, probably for 20 years so that the differing consequences of different options are more readily evident.

2. For the immediate future, risk should be evaluated by projecting forward under different fixed catch levels. At a later stage this should be extended to consider the impact of catches set under some feedback control rules.

3. Future year-class strength in projections should be determined by sampling from a lognormal distribution with mean, variance and first-order autocorrelation determined from the previous 20 years of estimates from the assessment.

Appropriate choices for the values for these parameters might be informed by considering such values evaluated for similar resources elsewhere.

4. Performance statistics reported should include median and 90% probability intervals for the spawning stock abundance, and where relevant for the cumulative catch made.

5. The values for some conventional fishing mortality based reference points (e.g. *F*40%, as is applied in the case of groundfish) can be established within this framework by projecting the assessment model forward under a fixed catch or fishing mortality until the age-structure stabilizes. The effect of changing the age at first capture should be investigated within this framework, giving consideration also to the population density and hence ease of capture of abalone above the associated minimum size limit.

6. The adequacy of the Abalone Recovery Management Plan (California Department of Fish and Game 2005) generic minimum-viable-population threshold value of 2,000 abalone per hectare for SMI should be evaluated in the context of 20 years of apparent population stability.

7. Application of this value would effectively preclude the re-opening an abalone fishery at SMI at present. However, initiation of an experimental fishery that is (for example) restricted to the Southwest Zone and takes only 5–10 % of the population above 203 mm is a risk-averse alternative, and likely to be well within the level the resource could sustain.

8. The current estimate of an average density of 1,200 red abalone per hectare at SMI is effectively similar to densities for commercially viable abalone populations in other countries once the relative size of, or space occupied by, red abalone is taken into account. A modeling study by Hobday & Tegner (2002) showed that adult (≥ 90 mm) red abalone densities at San Miguel could be expected to be 860 per hectare under a stable catch regime equating to 30% of harvestable size.

V. A Way Forward?

Although the following section extends beyond the Review Committee's terms of reference to some extent, discussions with conveners and stakeholders suggested that there would be value in providing broad indications of a possible way forward for management of SMI abalone based upon review of the analysis presented. What follows should be read understanding that it refers only to initial steps in what would be an adaptive approach, and that subsequent sections enlarge upon associated monitoring requirements and other prerequisites.

1. A program of experimental fishing should be considered for the Southwest Zone as an initial step in pursuing the option for removals. If specific sustainability

criteria are met then this might subsequently be expanded in a stepwise post moratorium process that is consistent with the Abalone Recovery and Management Plan (California Department of Fish and Game 2005). An increased minimum legal size would provide additional resource protection without unduly reducing the available stock. For instance, if set to 203mm as tabled in the 2007 SMI survey report, the stock size would be 9–15% less than at the current minimum legal size of 197mm. A conservative risk-averse approach could be based on the 95% lower confidence level of estimated abundance from the 2007 abundance survey. For instance, an experimental TAC of 8,300 red abalone would provide a viable harvest whilst leaving 90% of the available stock (to which recruitment would be added the next year). Given such a relatively high age at first capture, this 10% proportional take is well below standard fishing mortality reference points.

2. The experimental harvest could be timed to occur during a defined period, allowing for weather and market considerations. This would ensure that concerns regarding regulatory compliance could be more readily satisfied without undue cost.

3. The Southeast Zone should remain as an unfished control region that enables the detection of changes in abundance caused by environmental effects. This region could also be used as a source for brood-stock transplantation as per the option for a non-consumptive TAC.

4. If an experimental commercial harvest is implemented, then recreational stakeholders should be provided with equitable resource access without compromising the integrity of the experimental strategy.

VI. On-going resource monitoring

1. Commercial access to experimental harvesting in any area of SMI should be conditional upon acquisition and provision of adequately precise, spatially resolved, fishery dependent data, and on-going commercial diver participation in fishery independent abundance surveys.

2. Recreational access to experimental harvesting should be conditional upon provision of logbook catch data.

3. On-going fishery independent abundance surveys should occur in all three nonprotected zones of SMI via adherence to a defined sampling protocol. This protocol would be affordable in the medium to longer term with surveys conducted at an intensity and frequency that will enable detection of change at an agreed probability and effect size.

4. The design of recent surveys should be evaluated to seek a less intensive approach without an undue sacrifice of estimation precision. The option of less

intensive but annual surveys is preferred over more intensive but less frequent surveys. Estimation of a trend in abundance from these surveys is important, but will likely require at least 5 years of data before reliable inferences become possible.

5. A tag release-recapture program has been initiated to collect data to support estimation of biological parameters for growth and natural mortality, and is welcomed.

6. Periodic sampling should be implemented to estimate changes in reproductive capacity.

7. The length-frequency distribution of the current stock contains enough large animals to better estimate growth and fecundity in the size range that is actually fished (> ~200mm). The current growth and fecundity models are largely extrapolations of functions that were fit using smaller animals. Some additional growth and fecundity data should be collected with an emphasis on larger animals. The study need not be as extensive as that reported by Haaker *et al.*(1998), which was used in the current assessment.

VII. Next Steps

If the approach outlined above for a possible way forward is taken further, there are certain prerequisites to implementation and permitting removal of abalone.

1. The details of a monitoring program must be specified and agreed to.

2. A power analysis must be conducted to confirm that the monitoring will be able to detect effects of importance, in particular that of reduction in abundance as a result of removals.

3. The statistical catch-at-age assessment methodology should be advanced in line with the advice given above, and used in projection mode to estimate the range of possible consequences for SMI abalone abundance of any level of removals that comes under consideration.

References

California Department of Fish and Game. (2005). Abalone recovery and management plan. Final report dated 9 December 2005. http://www.dfg.ca.gov/marine/armp/index.asp, accessed 24 February 2009.

Cochran, W. G. (1977). Sampling techniques. Third edition. John Wiley and Sons, New York, New York.

Darby, C. D., and S. Flatman. (1994). Virtual population analysis: Version 3.1 (Windows/DOS) User Guide. MAFF Directorate of Fisheries Research IT Report 1. 85 pp.

Haaker, P. L., Parker, D.O., Barsky, K.C., and Chun, C.S.Y. (1998). Growth of red abalone, *Haliotis rufescens* (Swainson), at Johnsons Lee, Santa Rosa Island, California. Journal of Shellfish Research. 17:747–753.

Hobday, A. J. and Tegner, M.J. (2002). The warm and the cold: influence of temperature and fishing on local population dynamics of red abalone. California Cooperative Oceanic Fisheries Investigations Reports 43:74–96.

Shepherd, J. G. (1997). Predictions of year-class strength by calibration regression of multiple recruit index series. ICES Journal of Marine Science, 54: 741–752.

Thompson, S. K. (2002). Sampling. Second Edition. John Wiley and Sons, New York, New York.

APPENDIX G: A NEW BEGINNING FOR ABALONE MANAGEMENT IN CALIFORNIA: CRITIQUE AND COMMENT ON THE ABALONE ADVISORY GROUP'S DISCUSSIONS

By Jeremy Prince and Sarah Valencia – October 2009

THIS DOCUMENT WAS PROVIDED UNDER SEPARATE COVER TO THE CALIFORNIA FISH AND GAME COMMISSION ON DECEMBER 10, 2009.

This document can be obtained by contacting California Abalone Association President Chris Voss at vossfam@west.net

APPENDIX H: 2009 SURVEY PROTOCOL FOR SAN MIGUEL ISLAND (SMI)

The primary goal of this survey method is to detect changes in year-to-year (relative) abundance between impact areas (fished) vs. control areas (unfished). This approach sets up a Before-After-Control-Impact (BACI) experimental design that will help evaluate impacts on red abalone (*H. rufescens*) stocks on the southwest side of San Miguel Island (SMI). The procedure outlined here draws on methods currently used to monitor fished stocks in Victoria and South Australia and adapts them to best fit red abalone ecology and the logistics at SMI.

1. Selection of Survey Areas

Areas will be surveyed that exhibit abalone densities that could potentially support a sustainable commercial fishery. Using the previous three years of survey data and utilizing knowledge of the area from commercial fishermen and biologists, four survey sites were chosen: 1) two in the Southwest zone, which will be the location of a pilot fishery, 2) a reference site in the Southeast zone, which would remain unfished during the pilot fishery, and 3) a site in the Judith Rock marine reserve, in which all commercial and recreational fishing is banned. Each site consists of 10-12 micro-blocks (approximately .1 square nautical mile) of kelp forest habitat. See Figure 2 for sample station map

2. Selection of Survey Stations

Potential survey stations were produced by generating GPS coordinates for up to four (4) stations per micro-block depending on available kelp habitat. From these possible survey stations, two (2) stations per block were randomly selected for this year's survey based on a projected survey effort of 80 stations over a three day survey period. The other two (2) stations per block will serve as alternate points. These stations will be surveyed provided they can be accessed safely due to weather, current, and other considerations, and provided they appear to adequately represent abalone habitat. If a station is not used an alternate station location is provided. Once divers descend they will complete four (4) transects, in the shape of a cross, regardless of bottom habitat.

3. Transect Methodology

a) Required Equipment

Each diver, in addition to normal diving safety equipment, shall have the following equipment in order to complete a survey:

(1.) Watch
(2.) Depth gauge

(3.) Compass
(4.) Measuring calipers
(5.) 1 meter PVC stick
(6.) Data sheets (may include sheets for several dives)
(7.) Slate to hold data sheet
(8.) Pencil
(9.) Forestry crayon

Each dive team will have the following equipment in order to complete a survey:

(1.) GPS unit (on boat)
(2.) Descent line with anchor and float
(3.) Transect line or tape

b) Transect Line

The transect line is a 30m long line or tape on a reel. When the line is deployed, the reel is on the "30m" end of the transect line. The line is marked at each 5m increment. This pattern will assist the divers in recording the data into 5m segments. A transect line will be laid at a pre-determined station, where a dive team will run the survey. The extended transect line is used to guide the divers over a 30m long by 1m wide area on each side of the line. The 1m distance from the transect line is measured by the use of a 1m long PVC stick (Figure 3).

c) Transect Line Deployment

The direction (Transect Heading) is determined before the dive and pre-printed on the datasheet. The transect line is deployed in as straight a line as possible on the transect heading. Secure and begin deploying the 30m transect 5m from the weight of the station-marker buoy line on the same heading as transect. When the line is completely deployed, the reel or line is again secured. A clip on the reel or line can be used to secure it to kelp or a rock can be used to anchor the reel/line end.

4. Survey Procedures

The captain of each dive vessel will use a GPS for navigation to assigned stations, and verify site location prior to diving. A line attached to a weight will be deployed precisely at latitude and longitude coordinates of stations. At each station four (4) transects will be completed in the form of a cross. Compass headings for transects on a station were determined by random selection and are printed on the datasheets. The compass headings for the other three transects are set at 90-degree intervals from this primary heading. For example, if the first heading is 240^{o}, the

reciprocal heading will be 60°. The next set of transects for this station will have headings of 330° and 150°. Divers will work in pairs, and conduct two (2) reciprocal transects per station.

Information on block, grid, site number, site location (latitude/longitude), and headings are printed on the data sheets. Divers must record diver names, date, and transect orientation (Left or Right side of transect) on the data sheets prior to descending. Diver pairs will descend with a transect line or tape, two 1-meter long reference rods (to define transect width), calipers, and slates with attached data sheets The weight of the station-marker line will provide a central starting point for all four (4) transects. Divers will begin to roll out their transect line along the pre-determined compass heading five (5) meters from the central starting point. The diver pair will then swim along the transect line to record data, with one diver on each side of the transect line.

Each diver will be responsible for counting all visible abalone encountered and recording habitat within one (1) meter of the transect-line on their side of the line. Dive teams will then roll up the transect line and repeat the procedure along a reciprocal compass heading. Divers will complete all transects (regardless of habitat/ bottom type) provided they can safely do so. In the event that a survey station or part thereof cannot be completed, due to a drop off, prolonged shallow area, or other environmental hazard, make a notation of the circumstances on the data sheet, and move to the next station site.

Do not re-use a pre-printed datasheet from an aborted survey site. An aborted station sheet is to be returned to the Data Manager with comments. If you survey an alternate site use a blank datasheet and fill in all fields normally pre-printed.

5. Abalone Length-Frequency and Abundance

All abalone encountered on transect will be counted with a tick mark in the appropriate 5m segment. The first 15 abalones encountered along each side of transect will be measured using calipers. The length (in millimeters) and transect segment (1-6) in which they are found will be recorded.

a) Abalone Data

(1.) The first 15 measurable red abalone encountered on the line are measured (*See: Measuring and Identifying abalone*) with calipers and recorded in the respective boxes on the data sheet. The first 15 abalone measured and all other abalone along the line are counted and recorded with a tick in the respective 1m x 5m section of the data sheet.

(2.) All observed abalone are included in the survey, even those in crevices and under ledges found without the use of a light.

(3.) Abalone that occur near the edge of the one meter area are counted as long as some portion of the abalone falls within the one meter area
(4.) Abalone other than red abalone will be measured and noted by the addition of an identifying letter to the measurement ("F" – flat abalone, "P" – pinto abalone, "Pk" – pink abalone). These abalone species are not part of the first 15 measured red abalone.
(5.) Each abalone should be marked with a forestry crayon so that abalone will not be re-measured inadvertently.
(6.) Abalone data are recorded by 1m x 5m segments along the transect line.

b) Habitat and Depth

Diver pairs will record the depth in feet at increments along each transect. In addition, diver pairs will record the percent of substrate type (reef, boulder, cobble, or sand) and the relief of each substrate (high= greater than 3m, medium= 1-3m, low= less than 1m) for each 5m increment of transect.

c) Habitat Data

(1.) **Depth:** The depth is taken at the 0, 10, 20 and 30m points on the transect line
(2.) **Habitat Relief:** The overall habitat relief is recorded for the previous 5m surveyed at each 5m mark along the transect in the following categories:
   a. Low (< 1 meter height)
   b. medium (1 – 3m)
   c. high (> 3m)
(3.) **Habitat Type:** The habitat type is recorded for the previous 5m at each 5m mark along the transect line using these categories:
   a. Reef any rock substrate that can't be moved
   b. Boulder – rock > 0.5m that can be moved
   c. Cobble - all rock < 0.5m
   d. Sand – substrate fine enough to be able to insert your finger

6. The Data Sheet

It is important that all the data requested on the Abalone Survey Data Sheet be completed (Figure 4). Each data sheet is specific to a pre-established station. If a station cannot be surveyed, note this on the data sheet, and proceed to the next station, using its specific data sheet: do not substitute locations on a given sheet. All data sheets are to be returned to the Data Manager upon return to the main vessel.

a) Data Sheet Entry

(1.) Diver is the person filling out this form
(2.) Buddy is the accompanying diver
(3.) Dive Date use mm/dd/yy
(4.) Block # pre-printed on form
(5.) Grid # pre-printed on form
(6.) Station # pre-printed on form
(7.) Latitude/longitude pre-printed on form
(8.) Transect Heading is the compass course of transect in degrees and is pre-printed on the form
(9.) Orientation is the side of transect you are on when using the "0" to "30" reference direction, circle either L for Left and R for Right
(10.) Abalone Counts are entered in respective 5m sections along transect line
   a. Enter size to mm for first 15 encountered
   b. Enter segment # in which measured abalone are found
   Note: Abs are assumed to be red. If another species is found, put the initial letter of the common name beside the size or tick mark (F – flat, p – pinto, pk= pink).
   Note: Any abalone that appears to be withered, put a "W" after the measurement.
(11.) Depth record depth at "0", "10", "20", and "30" m along the line
(12.) % Relief record relief within 5m segments. Category percentages should total 100%
   a. Low = < 1m
   b. Medium = 1-3m
   c. High = >3m
(13.) % Substrate record substrate type within 5m segments. Category percentages should total 100%
   a. Reef immovable rock
   b. Boulder movable rocks > 0.5m
   c. Cobble all rock < 0.5m
   d. Sand sandy

7. Completion of the Survey

After completion of the fourth transect, the dive team will retrieve the transect line and ascend with all survey gear. After a suitable safety stop, the divers return to the surface and retrieve the surface float and anchor.

8. **Finalizing the Datasheet**

In the Abalone Counts and Measurements section, count the number of abalone by segment and record number in "total abs" box. Dive teams will check each other's completed datasheet for errors, accuracy and legibility and then initial the "checked by" box.

Upon returning to the main vessel, the divers should give the data sheets to the **Data Manager**, who will also check the data sheets for completion.

9. Measuring and Identifying Abalone

a) Measuring Abalone. Abalones are measured by the greatest diameter of the shell that is typically from the edge of the shell behind the spire towards the leading edge of the shell near the pores (Figure 1). Be sure to measure only the shell and not include any attached invertebrates such as barnacles.

b) Abalone Species Identification. There are three species of abalone that occur subtidally at San Miguel Island, red *Haliotis rufescens*; flat, *H. walallensis*; and pinto, *H. kamchatkana assimilis*. Although red abalone is the most common species, the other two are occasionally encountered. Divers must be able to identify these species to insure that counts and measurements for red abalone are accurate during the survey. The following is a brief description of each species:

(1.) Red Abalone *Haliotis rufescens*

a. **Shell** – color is usually brick red (especially along the inside edge of the shell) but is often masked by encrusting organisms.
b. **Open Pores** - three to four
c. **Epipodium** (edges of the foot) – color is black or barred with black and grey color.
d. **Size** - This is the largest abalone species reaching up to 12.3 inches but is usually between seven and nine inches in diameter.

(2.) Pinto Abalone, *H. Kamtchatkana assimilis*

a. **Shell** – color is a green and rust mottling. The shape is oval and dorsal/ventrally deep with a surface marked with prominent ribs. There is a prominent groove that runs along the outside edge of the pores
b. **Open Pores** – four to six pores that are moderately elevated
c. **Epipodium** – color is mottled a pale yellow to dark brown with a pebbly appearing surface and frilly edge
d. **Size** - reaches six inches but is usually smaller

(3.) Flat Abalone, *H. walallensis*

a. **Shell** – color is a brick red and can often be confused with small reds. The shape is oval and dorsal/ventrally flatten with narrow low ribs on the surface of the shell
b. **Open Pores** – four to eight pores
c. **Epipodium** – color is mottled yellowish and brown with a pebbly appearing surface
d. **Size** - to seven inches but is usually less than five

Complete descriptions and pictures can be found in the following literature:

California Abalone. 1986. Peter L. Haaker, Kristine C. Henderson, and David O. Parker. State of California Department of Fish and Game Marine Resources Leaflet No. 11. pp.16.

Guide to Marine Invertebrates Alaska to Baja California. 1994. Daniel W. Gotshall. Sea Challengers. pp.105.

Diver completing data sheet

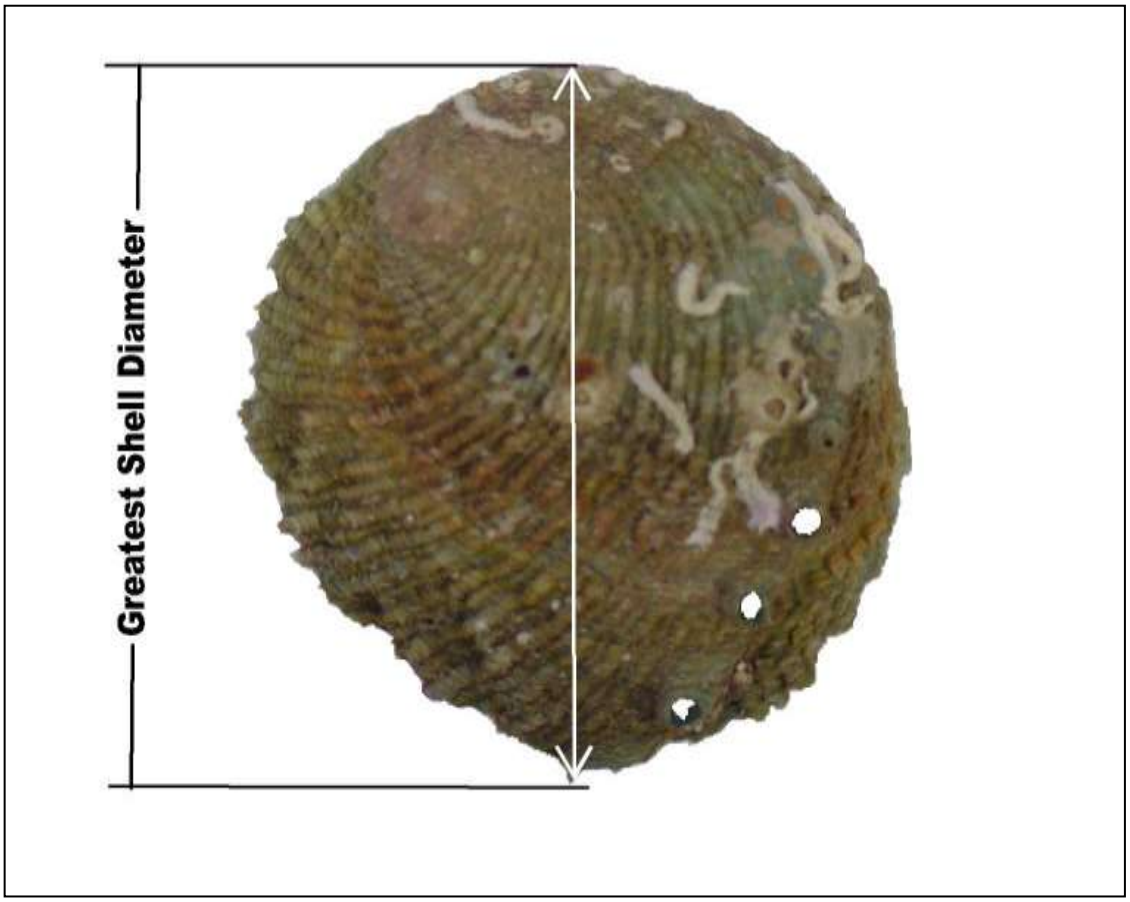


Figure 1. Proper measurement of an abalone.

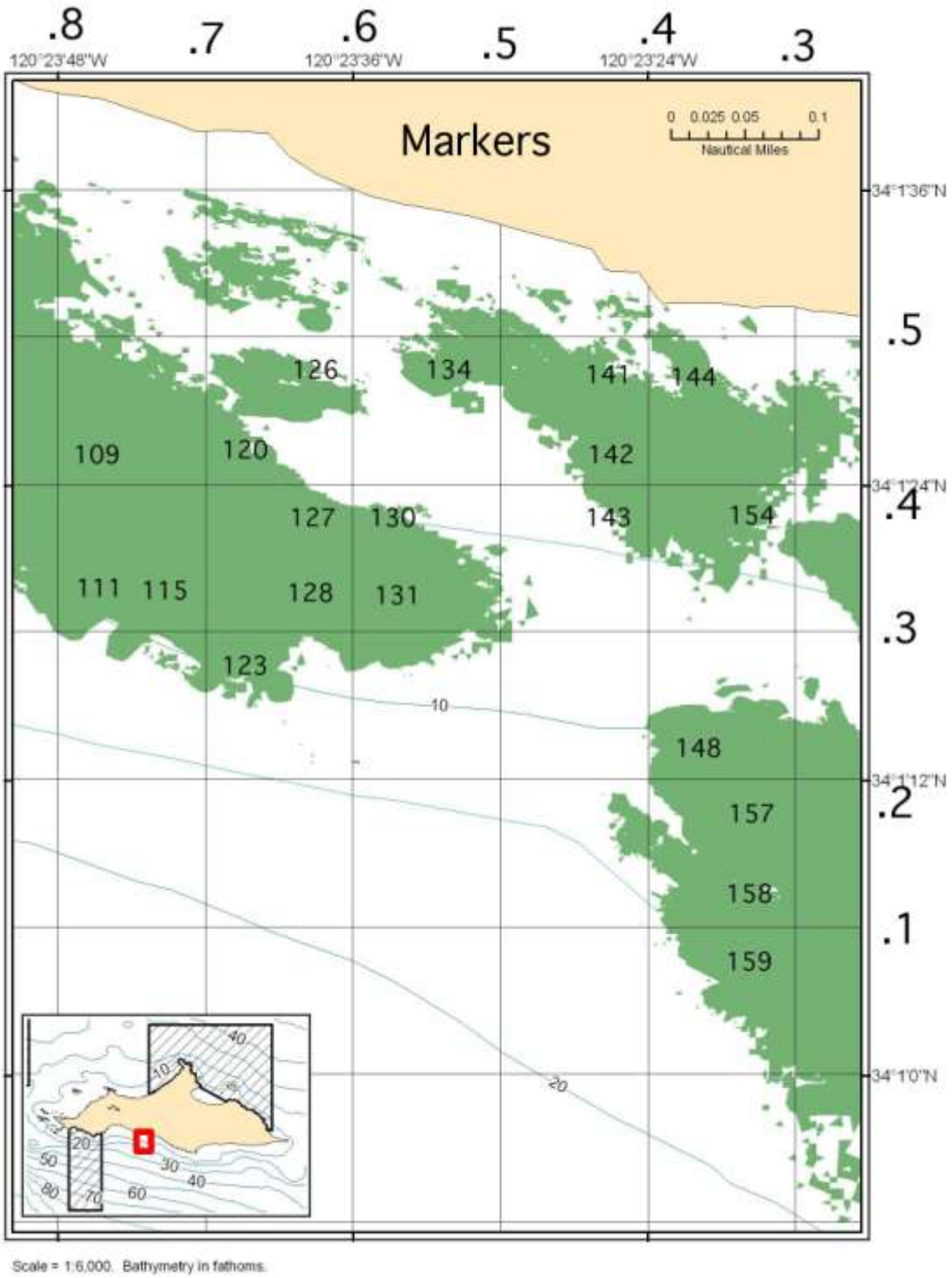


Figure 2. Example of map with grid numbers and survey station numbers for Markers in the Southwest Zone.

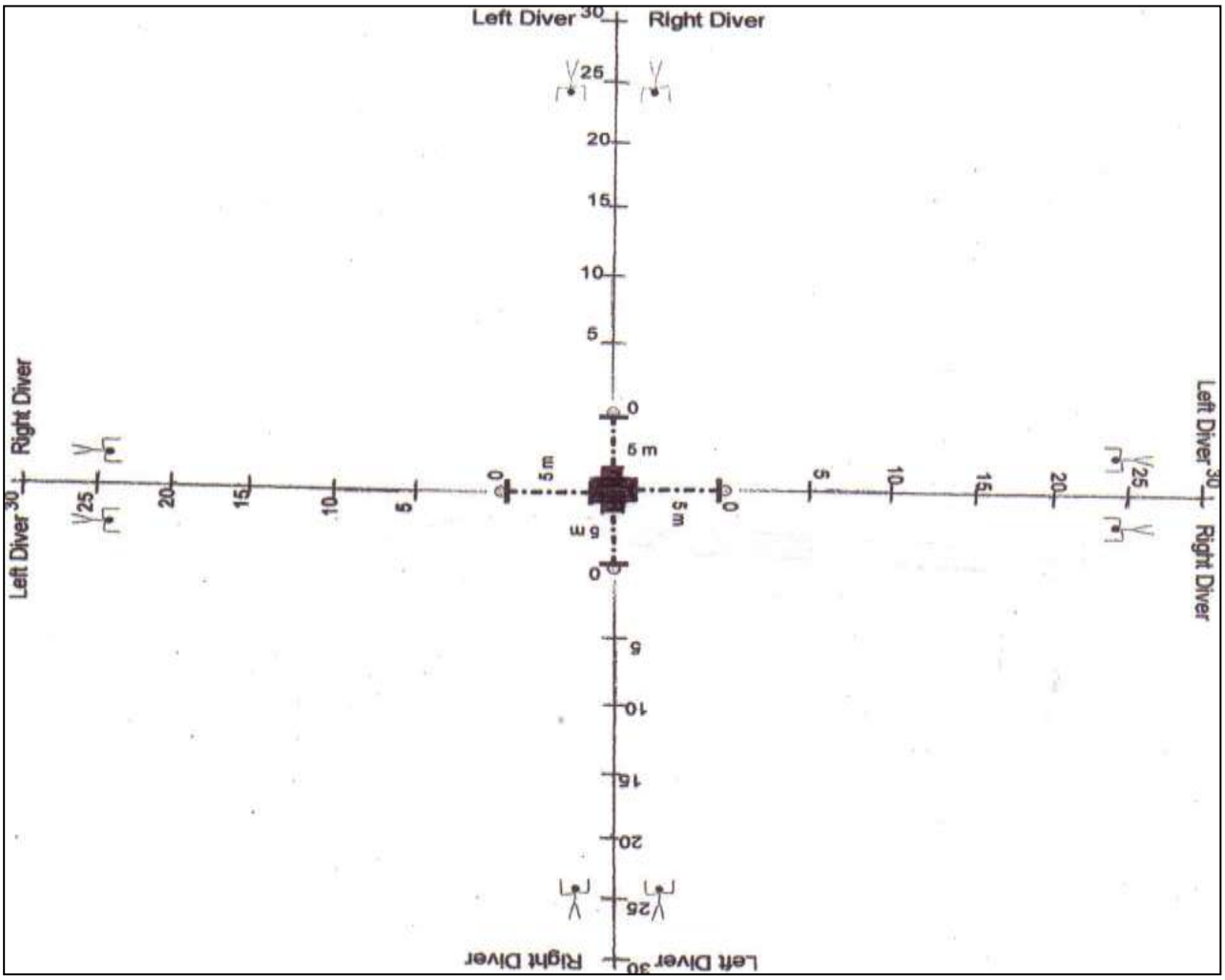


Figure 3. Drawing of a deployed transect viewed from above. Both divers will work side by side along transect.

SAN MIGUEL ISLAND RED ABALONE SURVEY 2009

Block: 690-83	Station: 1	Diver: Moe	Buddy: Joe	Checked By: Joe	
Grid: 28	Latitude: 34 01.725	Longitude: 120 26.275		Date: 10/20/09	
Transect Heading: 240	Orientation (circle) L R				
Segments:	0-5m (1)	5-10m (2)	10-15m (3)	15-20m (4)	20-25m (5)	25-30m (6)
Count of Total Abalone (use tick mark)	𝍸 ||	||	0	𝍸 ||	0	𝍸 𝍸
	Total: 7	Total: 2	Total: 0	Total: 7	Total: 0	Total: 10
Substrate	% Reef: 90	% Reef: 20	% Reef:	% Reef: 70	% Reef:	% Reef: 100
	% Boulder: 10	% Boulder: 20	% Boulder:	% Boulder: 30	% Boulder: 30	% Boulder:
	% Cobble:	% Cobble: 30	% Cobble: 20	% Cobble:	% Cobble: 60	% Cobble:
	% Sand:	% Sand: 30	% Sand: 80	% Sand:	% Sand: 10	% Sand:
Relief	% Low (<1m): 90	% Low (<1m): 100	% Low (<1m): 100	% Low (<1m): 70	% Low (<1m): 100	% Low (<1m): 80
	% Med (1-3m) 10	% Med (1-3m)	% Med (1-3m)	% Med (1-3m) 30	% Med (1-3m)	% Med (1-3m) 10
	% High (>3m):	% High (>3m):	% High (>3m):	% High (>3m):	% High (>3m):	% High (>3m): 10
Length (mm) of first 15 abs and Segment #	Segment (1-6)	1 1 1	1 1 1	1 2 2	4 4 4	4 4 4
	Length (mm)	166 212 197	156 110 224	175 170 190	254 234 195	205 200 160
Depth @ 0m 25'	Depth @ 10m 20'	Depth @ 20m 23'	Depth @ 30m 18'		
Transect Heading: 60	Orientation (circle) L R				
Segments:	0-5m (1)	5-10m (2)	10-15m (3)	15-20m (4)	20-25m (5)	25-30m (6)
Count of Total Abalone (use tick mark)						
	Total:	Total:	Total:	Total:	Total:	Total:
Substrate	% Reef:	% Reef:	% Reef:	% Reef:	% Reef:	% Reef:
	% Boulder:	% Boulder:	% Boulder:	% Boulder:	% Boulder:	
	% Cobble:	% Cobble:	% Cobble:	% Cobble:	% Cobble:	% Cobble:
	% Sand:	% Sand:	% Sand:	% Sand:	% Sand:	% Sand:
Relief	% Low (<1m):	% Low (<1m):	% Low (<1m):	% Low (<1m):	% Low (<1m):	% Low (<1m):
	% Med (1-3m)	% Med (1-3m)	% Med (1-3m)	% Med (1-3m)	% Med (1-3m)	% Med (1-3m)
	% High (>3m):	% High (>3m):	% High (>3m):	% High (>3m):	% High (>3m):	% High (>3m):
	Segment (1-6)					
	Length (mm)					
Depth @ 0m	Depth @ 10m	Depth @ 20m	Depth @ 30m		

Figure 4. Example of completed Data Sheet.

APPENDIX I: FEDERAL ANTITRUST ISSUES RELATED TO FISHERMEN'S COOPERATIVE MARKETING ASSOCIATIONS

From Joseph M. Sullivan of Mundt MacGregor L.L.P. - March 2, 2009

A. The antitrust laws of the United States prohibit certain anticompetitive activities. The classic example is price fixing—two or more entities that would otherwise compete on price instead agree to sell their products for the same (and more profitable) price. Such conduct eliminates price competition and is therefore "anticompetitive."

B. A limited exemption to the general prohibition on price fixing and other anticompetitive activities is provided by the federal Fishermen's Collective Marketing Act ("FCMA"), 15 U.S.C. §§ 521-522, for certain activities of qualified fishermen's cooperative marketing associations. To qualify for the FCMA's limited antitrust exemption, an association must meet the following four requirements:

1) Association membership must be limited to "fishermen."

a) There is no bright-line test of what is a fisherman. Rather, consideration will be given to a member's:

(i.) Activities;
(ii.) Degree of vertical integration (i.e., engagement in, or a relationship with parties that are engaged in, processing or marketing of products from the fishery); and
(iii.) Functions historically performed by fishermen in the area.

b) A member's processing "on the side" is problematic. However, the type of processing and the extent to which it is historically done by bona fide fishermen in the area must be considered before it can be determined whether the member is or is not a "fisherman" under the FCMA.

(i.) Another complicating factor, besides a member's own processing, is a member's service as an agent, employee, or contractor for a third-party processor.

c) One member's failure to qualify as a fisherman can potentially destroy the FCMA antitrust exemption for the entire association.

d) Avoid even the appearance that the association includes non fishermen as members.

2) Association may deal in product of members and nonmembers, but the value of members' product must be greater than or equal to the value of nonmembers' product.

   a) Sales by association members outside the association could impact the association's ability to meet this requirement and also affect its long term viability.

   b) Product purchased by association members from nonmember sources and marketed through the association counts as nonmember product because it is not produced (that is, harvested) by association members.

3) Association must be operated for the mutual benefit of its members.

4) Association members are limited to one vote or dividends limited to 8% per annum.

C. Activities falling within the FCMA's antitrust exemption:

1) Fishermen "may act together in associations … in collectively catching, producing, preparing for market, processing, handling, and marketing" of "aquatic products." 15 U.S.C. § 521.

   a) Multiple FCMA associations may share a common "marketing agency." 15 U.S.C. § 521.

2) "Marketing" has been defined as "the aggregate of functions involved in transferring title and in moving goods from producer to consumer, including among others buying, selling, storing, transporting, standardizing, financing, risk bearing, and supplying marketing information." Treasure Valley Potato Bargaining Ass'n v. Ore-Ida Foods, Inc., 497 F.2d 203, 215 (9th Cir. 1974).

3) Protected activities include:

   a) Members of an FCMA association agreeing to a price floor below which they will not sell; and

   b) An FCMA association—or two or more FCMA associations acting through a common marketing agency—conducting collective price negotiations on behalf of association members.

D. The FCMA's antitrust exemption is limited. Areas of antitrust risk for FCMA associations include the following:

1) Price agreements.

   a) An FCMA association may not engage in simultaneous price negotiations with two or more buyers if, during the negotiations, the association discloses to Buyer A the price it is attempting to negotiate with Buyer B, or vice versa. In such situations, the association would be acting as an impermissible conduit of price information between buyers.

   b) Members of an FCMA association may not reach agreements on price with non-member competitor fishermen who are not part of another FCMA association. However, when acting as a fish buyer, an FCMA association may post or otherwise freely transmit to the public the price at which it is offering to purchase fish.

2) Transmission of competitively sensitive information.

   a) Competitively sensitive information includes:

      (i.) Price, output or cost data;
      (ii.) Customers or territories; and
      (iii.) Operating plans or future business plans.

   b) The FCMA does not protect transmission of competitively sensitive information by members of an FCMA association to buyers, processors or non-member competitor fishermen. Such information could be used by such entities for anticompetitive purposes. The classic example would be non-member competitor fishermen obtaining the price at which an FCMA association's members intended to sell their product to a particular buyer and then selling their product to that buyer for the same price—thereby contributing to a "fixing" of the price.

   c) Besides direct transmission of competitively sensitive information, FCMA association members also should avoid indirect "price signaling" to buyers, processors or non-member competitor fishermen. This could occur if association members make sales outside the association while the association is negotiating price with a buyer or processor.

3) Collaboration with entities not qualified under the FCMA.

   a) FCMA associations may collaborate with entities not qualified under the FCMA, but any such agreements will be evaluated under the full range of antitrust laws and will not be protected by the FCMA's antitrust exemption.

4) Predatory conduct.

   a) General test: Is conduct anticompetitive and does it lack a legitimate business justification?

   b) Examples: Coercing non-member competitor fishermen to join the association and comply with its members' price agreements; campaigning against a store that sells product of the kind produced by the association's members, but obtained from other sources.

   c) Essential facilities doctrine: An entity with an "essential facility" may be under an obligation to make the facility available to its competitors under reasonable circumstances.

5) Member selection.

   a) Reasonable conditions on membership in an association are generally permissible.

      (i.) Examples: Applicant must qualify as a fisherman, sign membership and marketing agreements, and pay a membership fee. Other legitimate justifications for limiting membership may include an association's limited capacity to handle product and the need for a potential member to produce product meeting the association's quality standards.

   b) Denying membership in an association may raise antitrust issues if membership is essential to staying in business and competing with the association's members.

6) Customer selection.

   a) In general, an association may sell all its product to one buyer. However, an association's refusal to deal with other buyers may violate antitrust laws if such a refusal is a means to acquire a monopoly, fix prices, or drive out competitors.

7) Undue price enhancement.

   a) The FCMA authorizes the Secretary of Commerce to issue cease-anddesist orders to an FCMA association if "such association monopolizes or restrains trade in interstate or foreign commerce to such an extent that the price of any aquatic product is unduly enhanced by reason thereof." 15 U.S.C. § 522.

APPENDIX J: "MOE"

This is a hypothetical diving trip in the life of a cooperative abalone diver in the re-opened red abalone fishery at San Miguel Island (SMI).

Moe had held an abalone diving permit when the fishery was closed. He has been actively engaged in the activities of the California Abalone Association (CAA) since he had become a diver and became a member of the California Abalone Cooperative (CALAB) when it was formed. Moe has helped with several research projects and has participated in collaborative surveys at SMI in previous years. Along with Moe's commercial abalone fishing experience he has also worked sea urchin and sea cucumbers at SMI. All of this knowledge and experience makes him thoroughly familiar with SMI and provides him intimate knowledge of its reefs, weather, and habitat.

Moe has attended meetings with CDFG at which the Total Allowable Market Catch (TAMC) was established and then cooperative meetings which allocated that harvest to the various areas and divers. He has been fully trained in survey protocol procedures and understands that the allocation for each area was determined by using survey data and diver input.

Moe checks the weather and sees the weather is perfect today for getting to and diving at SMI. The south and west swells are down and the wind is forecast to be 10 knots. His boat is ready to go as he's been harvesting red urchin and sea cucumbers recently.

As Moe prepares to leave the harbor he calls the cooperative phone line that records his abalone trip intentions. This includes: a) name, b) license information, c) harvest blocks or grids he expects to fish, and d) planned return time. This information is recorded and available to CDFG wardens. As Moe motors from the Santa Barbara Harbor he turns on his Scielex GPS tracker (www.scielex.com.au). This device records his position every ten (10) minutes and data from the logger can be downloaded by CDFG wardens if they want to audit his fishing trip positions and provides accurate mapping of catch locations for further refinement of cooperative harvest strategies.

Moe will be diving in the Southwest zone of SMI. No abalone harvest is allowed in Judith Rock Marine Protected Area and the Southeast, Northeast, and Northwest zones are also off-limits. It is estimated that there are one million emergent red abalone at SMI and approximately 680,000, or 70% are in these no-take reserves. Moe and other cooperative divers will harvest 10% of the abalone over 8 inches in the Southwest zone. This is about 3% of the abalone in the harvest area and 1% of the total emergent population at the island.

As Moe passes Crook Point and enters the fishing zone his tender gets his gear ready. He finds his first assigned zone and the tender sets the anchor. He uses a hookah air system and carries a small mesh bag as well as his abalone bar, a slate, and a pencil. When he's suited up and ready to go the tender pushes a button on the Scielex that records the start time and position of the first dive. Moe descends to the bottom to select the 24 abalone allocated to him in this zone. He swims a preliminary search around the boat and as he moves along the bottom he sees some shorts and a few legal sized abalones. On his slate he notes the character of the bottom and nature of the abalone population at this position.

After his preliminary data collection, during which he discovered some aggregations, he starts to harvest. Following the cooperative harvest plan he can take no more than 30% of the abalone in any aggregation. He measures the largest abalone and selects seven legal sized abalone from a group of 25. In the next group of 15 there are 12 of legal size he harvests only five. Moe and the other divers understand that preserving the aggregations will help ensure successful spawning.

When he gets back on the boat the tender pushes the end button on the Scielex that records the time (about an hour) and boat's position at the end of the dive. Moe's tender weighs, measures and applies a numbered tag to each abalone as soon as they are brought aboard. Moe adds length/weight information and the tag numbers to his logbook entry.

Moe has now harvested half of the abalone assigned to him in this block and decides to move over about 100 meters to another location within the same zone. Before ascending he had noted the size of the groups remaining after harvest and the aggregation's relative position to the boat on his slate. He also noted that there were two areas of rubble reef that contained aggregations of all sizes deep in cracks that were not harvested.

During his rest period between dives Moe transfers the pertinent information from his slate to the logbook and maps the relative positions of habitat and abalone seen on the dive. As he descends again the tender again pushes the begin button on the Scielex. Moe repeats the procedure of his first dive and after an hour or so ascends with another twelve abalone. Again the tender pushed the end button on the Scielex then weighs, measures and applies a numbered tag to each abalone as soon as they are brought aboard. The Moe adds length/weight information and the tag numbers to the logbook entry. He has now harvested the abalone from the zone according to his assignment. While his map of the zone is incomplete, it will provide the next harvest assignment in this zone. Over time a complete picture of the habitat and population within this block will emerge.

If Moe is boarded by CDFG, NPS, CINMS, or Coast Guard fisheries enforcement, they will find all the abalone aboard are tagged and logged. Moe knows if he violates the rules he might lose his special permit to harvest abalone and sea urchin. In fact, if the violation is serious, he would lose his California commercial fishing license which is a prerequisite for any commercial fishing privilege. Without that abalone permit, Moe would also be ineligible for membership in the cooperative.

After lunch Moe and his tender move to another zone. The next zone is an area where the population was estimated to be higher than the first. Moe has been allocated 36 abalone in this area. He again follows the procedure of his previous dives. After two more dives Moe harvests his allotment from the zone. He and his tender go to Tyler Bight and anchor for the night.

On the next day they visit three other micro-blocks and follow all the same procedures. By the end of his two-day trip Moe has harvested 120 abalone from the micro-blocks he was assigned. This equals his individual fishing quota for the year. He has stored the abalone in receiver boxes inside his live well to ensure his abalone will be alive and healthy upon reaching the harbor.

Sunrise at San Miguel Island

As Moe motors home he calls the cooperative Data Coordinator to report his catch and arrival time. This information is also available to CDFG. When he arrives at the Santa Barbara Harbor, Moe may be checked by a CDFG warden. The warden could download his Scielex data to confirm his dive locations, measure and check tagged abalone, and see that all landing paperwork is in order. Paper work and Scielex data are available to CDFG enforcement personnel for audit at any time and the abalone can be tracked through paperwork (FGC 8043 and 8050).

Once in the harbor, this information is also entered into the Trace Register system where the catch data will be recorded and stored and then updated as it travels through the custody chain to include all information on transport and distribution of the abalone. This information is password accessed and available to consumer and CDFG wardens as well as cooperative personnel at any time.

Moe has harvested his allocation but his work is not over. He and his tender must transfer the abalone to the California Abalone Cooperative's live tank station. The cooperative handles all abalone initially. The cooperative broker's sells to consumers and cooperative members help where and when needed. The Saturday Fisherman's Market at Santa Barbara Harbor is a major sales point and each

member takes a turn selling his product and talking with the public. They also distribute pamphlets on how to prepare abalone along with an explanation of the fishery regulations and procedures used to ensure sustainability.

The fishery has been planned to extend through the summer (three months). While the harvest of the initially small allocation could occur in a week, the landings are extended through the season by staggering assignments to individual divers to avoid glutting the market and assuring realization of maximum value. The members of the cooperative have agreed to pool all catches and values. This means that they are all paid an agreed price initially and later after the complete allocation is taken and business concluded, any further net profit is equally distributed to the members. In this way Moe does not feel he's missing anything at spots others harvest. He knows he will share in any profit the members of the cooperative realize. He also knows next year, with the increased amount of information collected during this season's harvest, he and other members will be more efficient due to the increased knowledge of abalone beds within the individual micro-blocks.

Moe's work continues throughout the year. All the harvest log and other fishery dependent data will be entered into a data base for storage and future analysis. Moe and other cooperative members will also participate in ongoing monitoring and research projects. Tagging of abalone for growth/movement studies and settlement/recruitment monitoring projects are underway at SMI and elsewhere. These data and fishery independent data, will also be entered and stored in the data management system which will be available to the cooperative, managers and researchers for decisions made using the Decision Tree Assessment Process.

These projects are paid for from monies collected from the fishery and matching grants. As research evolves and questions are answered the information is used to adaptively adjust regulations as necessary. Moe and other members of the cooperative attend shared management meetings with CDFG and academics to discuss the year's abalone monitoring and research plans and assess the need to adjust any regulations or quotas. He also attends regular cooperative meetings to deal with infrastructure and marketing issues.

Moe and the other divers are motivated to do all this because they have a stock in the future of the fishery. They make some money today and if they make good choices they will see their bottom line increase in the future. The members of the cooperative are working to husband the resource and if they transfer a cooperative membership to a new diver they will be transferring the privilege to make a little money, as well as the responsibility to work to sustain the fishery and increase profit. A new member, who now has an investment in the future of the fishery, will work toward that end, as Moe and the others have.

APPENDIX K: GLOSSARY OF TERMS

Adaptive Management	In regard to a marine fishery, 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.
Aggregation	A group or mass of abalone of the same species living closely together
CAA	California Abalone Association. The Association was founded in 1971 and its mission is "to restore and steward a market abalone fishery in California that utilizes modern management concepts, protects and enhances the resource, and guarantees a sustainable resource for the future. "
CALAB	California Abalone Cooperative. The cooperative will be formed in 2010 and it will "place the health and habitat of the abalone resource above all other considerations and will co-manage an abalone fishery while recognizing the link between stewardship of the resource and a successful cooperative. "
Catch Share	An equal division of TAMC among cooperative members.
CPUE	Catch-per-unit-of-effort. The number of individual animals harvested within a given period of time.
DAP	Designated Access Privileges. An output control whereby an individual fisherman, community, or other entity is granted the privilege to catch a specified portion of the TAC. With this assurance in place, there is no longer an incentive for fishermen to fish harder and faster because each could only catch his or her share of the total. The incentive would then be to catch the full share at a low cost and sell the best quality fish at the highest obtainable price.

GIS	Geographic Information Systems. A system of hardware and software used for storage, retrieval, mapping, and analysis of geographic data. Practitioners also regard the total GIS as including the operating personnel and the data that go into the system.
GPS	Global Positioning System. A worldwide radio-navigation system that was developed by the US Department of Defense. In addition to military purposes it is widely used in marine, terrestrial navigation and location based services.
High-Grading	Harvesting one abalone and then coming across another larger abalone and discarding the first one.
Restricted Access Fishery	A fishery in which the number of persons who may participate, or the number of vessels that may be used in taking a specified species of fish, or the catch allocated to each fishery participant, is limited by statute or regulation.
Sustainable	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.
TAC	Total Allowable Catch. The total quantity of a species of animals allowed to be harvested from defined areas during a given time period, typically one (1) year.

Option B: San Miguel Conditional Demonstrational Fishery
Abalone Advisory Group

Additional Information

Exponent's notations

1) 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 reevaluated. 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. The guidelines governing the contractor's responsibilities will be developed jointly by the Department and potential fishery participants with approval by the Commission. The 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 un-fished 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 years [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:

o 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.

o 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.

o Restricted landing locations - This would help prevent illegal activities by limiting the number of areas where abalone could be landed.

o 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.

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

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

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.

3.) Potential Impact of El Niño Events on San Miguel Island Red Abalone Health and Survival by Jim Moore, CDFG Shellfish Health Lab Bodega Marine Laboratory Bodega Bay CA 94923 jdmoore@dfg.ca.gov

4.) Summary of Red Abalone Genetics Presentation given at 11/29/07 AAG meeting. Using the first two methods, COI and nuclear microsatellites, as well as information from prior research, the investigators did not find significant genetic differences among all populations and locations. This suggests that there is high gene flow or high genetic connectivity between populations. However, due to other possible factors and the ease of homogenizing allele frequencies among populations this conclusion of high genetic connectivity should be interpreted with caution. Contrary to the other methods used and results of previous studies, application of the AFLP technique offered a reliable and efficient method for scoring neutral genetic variation at many loci presumably spread genome-wide, enhancing the ability to detect differentiation. The researchers in this study were able to increase the number of markers for *H. rufescens* by 70 fold compared to earlier studies. Using the AFLP technique they did find significant differentiation among populations, which is the first evidence of such genetic differences. This finding suggests low connectivity across a broad spatial range (i.e. the entire coast of California) or in other words more localized spawning and recruitment. While the AFLP markers provided strong evidence for low connectivity, no diagnostic AFLP markers were obtained to successfully identify source populations for individual abalone. The investigators concluded that continued research is needed to further examine the spatial scale and temporal stability of genetic subdivision in this species.

5.) Pg 69 last paragraph, last sentence of the "Improving the Stock Assessment of California Red Abalone (Haliotis rufescens) at San Miguel Island" modeling work report.

6.) AAG Review Committee Report section V a way forward.

Abalone Advisory Group Option C: Experimental Harvest to Aid Recovery: a Precautionary, Conservative Approach

Additional Information

All information required for this management option summary is included in Parts I and II of the Option C Executive Summary. This option does not contain an additional information section.

Abalone Advisory Group Option D: The Assurance Approach: High Density Required for Harvest.

Additional Information

Lead: Daniel L. Geiger, AAG. Contributors: Jessie Altstatt, AAG; Dan Richards, AAG

a) Summary

The current state of the red abalone population at San Miguel Island, and best available science does not support any long-term sustainable harvest. A demonstration fishery has the potential of disrupting recovery and to further imperil the most-recovered population of red abalone. Best modeling efforts predict a declining population even with zero TAC, hence, any TAC will accelerate the predicted population decline.

Accordingly, the population should be further monitored, population models should be refined and tested, applying precautionary principles.

b) Goal of Demonstration Fishery

Any fishery—be it regular, test, or demonstration fishery—should meet the expectation of being long-term sustainable. The fished population is expected to remain long-term (decadal scale) near or above minimum viable population. In quantitative terms, with a 90–95% confidence interval, it is expected that only every 10–20 years MVP densities of 2000/ha as specified in the ARMP will not be attained. Given the multiple collapses of marine fisheries around the globe and in California, a new fishery needs to be demonstrably long-term sustainable.

c) Modeling

Current best modeling predicts a natural decline of the population even with zero take. While some see this result as indication of a faulty model, no alternate models suggesting a growing population are available.

d) Assumption in TAC calculation

Option 1 uses the widely held assumption, that a fishing pressure equal to natural mortality (m) is safe. This assumption is conceptually flawed, and fishing pressure should be expressed as fraction (e.g., 1/10 = 10%) of surplus production [= growth rate (r) - m] multiplied by the population size (N): e.g., (r-m)N/10. The problem with using m is, that when TAC = m > r-m, the population will decline.

r has been exceedingly difficult to determine. For one, it may be quite variable due to highly stochastic recruitment. Additionally, detailed long-term survey data are not available.

e) Survey data

Survey data do not positively show an increase in the population. While the power of detecting a change with the current survey data is not satisfactory (only changes of >30–50% can be detected), the mean trend is one of stagnation: SE/SW zones: 2006 = 1367/ha; 2007 = 1377/ha; 2008 = 1539/ha (see survey results for 2006–2008). The difference between 2006 and 2008 is 12%, or 6% per year, hence, not statistically

significant. The current population levels of 1100–1800/ha are below minimum viable population densities of 2000/ha as specified in ARMP, and certainly below historical maximum levels presumed to represent carrying capacity (K) of 6000–10000/ha.

Given the Allee effect, slower than expected population growth at population densities below MVP are to be expected, and seem to be borne out by the survey results.

Natural mortality (m) is usually taken around 10% of N (broadly supported by the background mortality of the control group in the El Niño warming experiment by Bodega Marine Laboratory). If there was a surplus production similar to m, then the population should have grown over three years of surveys by at least 33% (1.1^3), which is close to the statistically significant detection level of the surveys. However, for all intents and purposes, the survey showed no change in population densities.

If one argues that population growth is pulsed due to irregular recruitment, then such recruitment pulses should be visible in the size frequency histograms as new peaks at smaller sizes in the later surveys. No such peaks are visible (see histograms of size frequencies of surveys 2006–2008), hence, the pulse-recruitment concept does not seem to be detectable in the natural population.

f) Minimum Viable Population (MVP)

The ARMP suggests a MVP density of 2000/ha, which agrees well with data from the literature for other species. It has been pointed out, that along the Central Coast of California, thriving populations at 800/ha exist in areas inhabited also by sea otters. This apparent discrepancy has been taken by some as an indication that the MVP of the ARMP is excessively high. However, two separate and distinct parameters need to be distinguished:

- overall large-scale density expressed in numbers per hectare
- small scale density better measured by nearest-neighbor distance (NND)

The NND is biologically more relevant in broadcast spawners, as fertilization success and potential recruitment is determined by it. In comparable biotic/abiotic conditions, overall density (number/ha) and NND are tightly correlated as an exponential function (r^2 = 0.98, Button & Rogers-Bennett, in prep.). Along the central coast, NND at 800/ha is approximately the same as it would be in the south coast at 2000/ha because the abalone in sea otter areas are concentrated in microhabitats that cannot be reached by sea otters.

Accordingly, the 800/ha central coast comparison is inappropriate and positively misleading. 2000/ha seems to be an appropriate minimum density for red abalone on SMI.

The effect of reduced fertilization success (Allee effect) is much more pronounced below population densities of 2000/ha. Given that dispersal of abalone is on the order of 10–100 m (McShane *et al*.,1988), the lower cut-off for start of a fishery at *overall* density of 4000/ha is warranted. Current high-density micro-patches in the non-reserve areas are serving the function as localized sources of new recruits, a function that cannot be fulfilled by the abalone in the reserve areas several miles away. Accordingly, arguments to permit limited harvest based on high micro-densities are biologically unsound.

g) Southern California abalone may no longer be fishable

Despite historical abundance of the resource, significant physical and biological parameters have changed. The population genetics seems to suggest a large genetic

population due the high haplotype diversity in microsatellites/SNPs, hence, red abalone seem have to escaped serious genetic problems associated with bottleneck conditions.

However, withering foot syndrome (WFS) is a new reality in abalone. WFS effects are strongly dependent upon temperature, and with global warming, ocean temperatures rising, the WFS problem is exacerbated. Laboratory experiments suggest an excess mortality due to WFS during El Niño years of 50% of total population, or total El Niño year mortality of 60%. In order to remain long-term above MVP, fishing should only start at a population density of Minimum Viable Fishing (MVF) 4000–5000/ha, so that the population after an El Niño event still is near or above MVP of 2000/ha, in accordance with the long-term sustainable fishery expectation presented above.

Given the slow population growth in general, it is questionable, that the population will recover in the ~10 years between El Niño events (see Null, 2009) from MVP of 2000/ha to MVF of 4000–5000/ha. Therefore, abalone in general, may no longer support any fishery. Population surplus production would need to be 7.2% to 9.6% (50% mortality = doubling of population over ten years: necessary rate = 2^{-10} = 1.072. 60% mortality = 2.5 times population growth over 10 years: necessary rate = 2.5^{-10} = 1.096), assuming exponential growth. If fishing should be continued during recovery, surplus production would need to be 7.2–9.6% plus fishing rate. E.g., with 5/10% fishing mortality, surplus production would need to be 12.2–14.6/17.2–19.6%. per year. As discussed above under Survey Data, not even a 10% surplus production is evident at present. A 12.2/19.6% surplus production would result in a 41/71% population increase in three years (duration of SMI surveys), which would be demonstrable by statistical techniques.

All these simple calculations are overly optimistic for two reasons. For one, exponential population growth is assumed, which will be undermined to an unknown degree by the Allee effect at population densities around MVP. Second, it ignores weak and moderate El Niño events that occur in between strong events. Those are also expected to have elevated abalone mortalities associated with them as demonstrated by the Bodega Marine Laboratory experiments, though "only" 20–30% above background. To properly address these factors, modeling of El Niño events and associated expected mortalities need to be carried out. Only once it can be demonstrated that with expected El Niño events the population remains long-term (decadal scale) above MVP, then a fishery can be contemplated.

Questions about and hope for resistance to spread or decrease in virulence of the disease to decrease have been discussed, but no signs of it can be detected at this time. Such resistance is more likely to develop the larger the number of individuals, another argument against fishing.

There are famous precedents for non-recovering collapsed fisheries. The southern anchovy is possibly the most famous. That case even involves a species with a much shorter life cycle. Biotically mediated stock collapses are known from other fisheries (Dashkalov & Mamedov, 2007).

The final report of the Technical Panel cautions, that "a failed experimental fishery at SMI could put in jeopardy the spatial recovery of red abalone elsewhere on the island, at neighboring islands, and potentially in the region". Combined with our monitoring ability to only detect a 30% change in the population, the sensitivity and importance of red abalone at San Miguel Island dictates prudence in managing this resource. Note that for

the new survey protocol no power estimate is available, hence, given the smaller sample size, may even have larger errors and worse detection capabilities than the 2006–2008 surveys.

h) Enforcement

A continued no-take policy will simplify enforcement as any abalone from southern California will remain illegal. All other options complicate enforcement and an increase in poaching is to be expected.

Poaching is a sad reality, now and in the future. The non-ideal recovery of abalone populations in general, as well as the SMI population specifically, may be in part due to poaching. Unfortunately, there are no poaching estimates available, hence, that parameter cannot be used in modeling efforts. It may well be that the population is actually growing, but that current poaching offsets those population increases. This consideration, however, cannot be used in support of opening a fishery.

On the converse, it is widely agreed, that opening a legal fishery will increase poaching above current levels, though the degree of increase is also unknown. Additional deleterious non-take mortality will incur due to injury of animals during harvest. Although *codes of conduct* are laudable, enforcement potential is very limited.

i) What if wrong?

The best science backing option 4 may be mistaken. Under a high density option, the population is continued to be monitored, and if a sudden increase in population densities well above MVP of 2000/ha is demonstrated, the population model can be adjusted, a surplus-production-based TAC can be developed, and a fishery may begin with a higher TAC right from the beginning. It will have beneficial economy-of-scale effects as well, and may permit a broader participation base in the new and safer fishery.

However, if the population is fished and is declining, decades of recovery may be destroyed, as noted by the Review Committee quoted above, which will then further delay the beginning of a sustainable fishery later on. Note that the Allee effect has an exponential function with nearest neighbor distance, and the nearest neighbor distance is exponentially correlated with population density (Button & Rogers-Bennett, in prep.). As the shape of those two curves is congruent, their effects are superadditive, hence, small errors at the lower spectrum of population densities have major detrimental effects on fertilization success, recruitment and subsequent population growth.

We must avoid the Concorde-Fallacy trap. Considerable human and monetary resources were expended during the AAG's efforts of exploring options of a demonstration fishery of red abalone at SMI. The decision of whether or not to open the fishery must remain independent of exploratory expenses, which are sunk cost.

j) References

Daskalov, G. M., and Mamedov, E. V. 2007. Integrated fisheries assessment and possible causes for the collapse of anchovy kilka in the Caspian Sea. ICES Journal of Marine Science, 64: 503–511.

McShane, P.E. Black, K.P. Smith, M.G. 1988. Recruitment processes in *Haliotis rubra* (Mollusca: Gastropoda) and regional hydrodynamics in southeastern Australia imply

localized dispersal of larvae. Journal of Experimental Marine Biology and Ecology 124: 175-203.

Null, J. 2009. El Niño and La Niña Years and Intensities. http://ggweather.com/enso/oni.htm [accessed 6/30/2009].