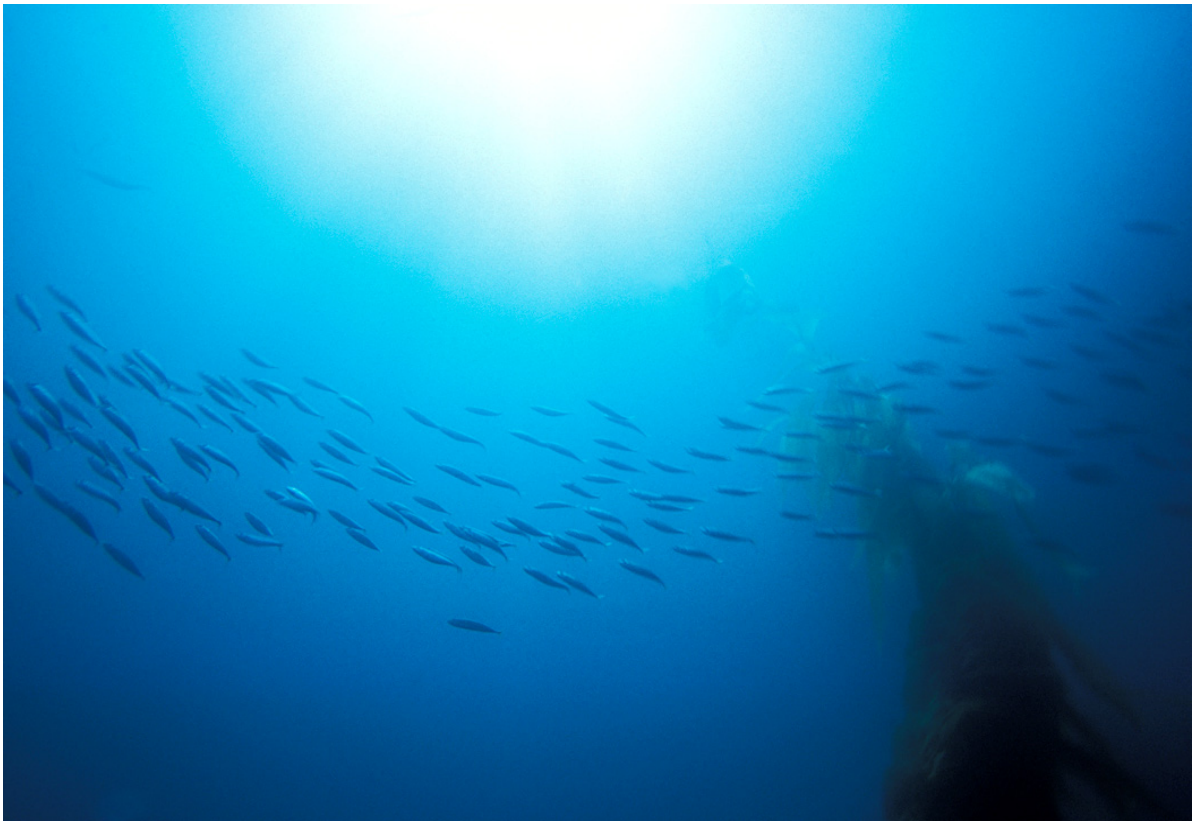
Open Ocean Aquaculture in the Santa Barbara Channel:

An emerging challenge for the Channel Islands National Marine Sanctuary



Wild Pacific sardines (Sardinops sagax) *off Santa Cruz Island (©2006 Jaimi Kercher).*

A report by the Conservation Working Group of the CINMS Advisory Council

Adopted by the CINMS Advisory Council July 20, 2007

Project Director:

Linda Krop, Conservation Chair, CINMS Advisory Council
Chief Counsel, Environmental Defense Center

Prepared by:

Shiva Polefka, Marine Conservation Analyst
Environmental Defense Center (*primary contact*; shiva@edcnet.org)

Sarah Richmond and John Dutton, Program Interns
Environmental Defense Center

Supported by the Marisla Foundation

Timeline of document development, review and approval

21 September, 2006	Draft report approved by Conservation Working Group (CWG)
12 January, 2007	Draft report distributed to Sanctuary Advisory Council (Council) members for review and feedback
19 January, 2007	Major findings and recommendations presented to the Council; formal solicitation of feedback to Council members
28 February, 2007	Presentation of findings and recommendation to Research Activities Panel (RAP) at UCSB, solicitation to RAP members for review/feedback
16 March, 2007	Presentation to the Council of major comments received from Council members, summary of corresponding revisions to be made to Final Draft, extension of review/comment period to March 30, 2007
18 May, 2007	Presentation to the Council of final draft, focusing on new recommendations and major substantive changes made as a result of SAC member feedback
20 July, 2007	Final report and recommendations amended and adopted by unanimous vote (15-0) of the Council, and forwarded to CINMS Superintendent

The Sanctuary Advisory Council's deliberation of this report is documented in meeting notes posted online at: http://www.channelislands.noaa.gov/sac/minutes.html. See notes posted for the January 19, May 18, and July 20, 2007 Council meetings.

The Conservation Working Group (CWG) is an advisory body to the Sanctuary Advisory Council of the Channel Islands National Marine Sanctuary (CINMS). The Sanctuary Advisory Council, a 21-member advisory body, provides community and inter-agency stakeholder advice to the CINMS Superintendent on a variety Sanctuary management issues. The opinions and findings of the CWG and the Sanctuary Advisory Council do not necessarily reflect the position of the CINMS or the National Oceanic and Atmospheric Administration.
For more information on the CWG and the Sanctuary Advisory Council, visit http://www.channelislands.noaa.gov/sac/main.html.

Table of Contents

Recommended citation: Conservation Working Group, Channel Islands National Marine Sanctuary Advisory Council. *Open Ocean Aquaculture in the Santa Barbara Channel: An emerging challenge for the Channel Islands National Marine Sanctuary*. July 20, 2007. Prepared by the Environmental Defense Center, Santa Barbara, CA. 81 pp.

1. Introduction and Executive Summary:

Designated in 1980, the Channel Islands National Marine Sanctuary (CINMS or the Sanctuary) encompasses the waters from the Mean High Water Line to six nautical miles (NM) offshore around the five northern Channel Islands-- Anacapa, Santa Cruz, Santa Rosa, San Miguel and Santa Barbara Islands, as well as Richardson Rock and Castle Rock. This 1,113-square-NM[1] region is one of 13 sites overseen by the National Marine Sanctuary Program (NMSP), which is authorized by Congress to "identify, designate, and manage areas of the marine environment of special national, and in some cases international, significance due to their conservation, recreational, ecological, historical, research, educational, or aesthetic qualities."[2] Congress ordered the NMSP to "maintain the natural biological communities" of designated Sanctuaries, and "to protect and, where appropriate, restore and enhance the natural habitats, populations, and ecological processes."[3] Based on these responsibilities, the stated primary goal of CINMS managers "is to protect the natural and cultural resources contained within [Sanctuary] boundaries."[4]

Of course, the physical and biological resources of the Sanctuary are not confined within those boundaries, but flow, drift or move in and out of them. Many sea birds, fishes and mammals of the Sanctuary and Santa Barbara Channel (SBC, or "Channel") congregate here after traveling hundreds or even thousands of miles, while ocean waters of the area gyrate, ebb and flow in cycles of far greater scale than the Sanctuary's 1,113 square NM. This dynamic setting requires that CINMS resource managers and stakeholders take a keen interest in issues and activities beyond Sanctuary boundaries, which can and often do impact CINMS resources despite being geographically removed from the Sanctuary itself.

The rise of open ocean aquaculture (OOA)— the controlled cultivation or rearing of marine species[5] in the open ocean waters of the US Exclusive Economic Zone (3-200 NM from shore)— exemplifies this fundamental management challenge. Due to rising human demand for seafood, a growing US trade deficit in seafood, decreasing availability of wild fish[6], and growing interest in developing alternate uses for Santa Barbara Channel (SBC) offshore oil platforms after decommissioning (motivated by the multi-million dollar cost to remove decommissioned rigs, as required by law)[7], the SBC region surrounding the Sanctuary appears increasingly likely to become a setting for OOA.

---

[1] CINMS. *Final Environmental Impact Statement for the Establishment of Marine Reserves and Marine Conservation Areas*. April, 2007. Updated area estimate located on page *iii*.
[2] 15 CFR 922.2(a).
[3] 16 U.S.C. 1431(b)(3).
[4] CINMS: About the Sanctuary. http://www.cinms.nos.noaa.gov/focus/about.html (Viewed 2/3/06).
[5] Open ocean aquaculture is possible with many species, including aquatic plants, shellfish, and fin fish, and is generally classified as either extractive aquaculture – the growing of filter feeding shellfish and aquatic plants that remove ambient nutrients and minerals from the water – or fed aquaculture – the rearing of shrimp and fin fish that need nutrients and minerals added to the water, potentially resulting in pollution. McVey, J., NOAA Sea Grant Program. "The Role of Offshore Aquaculture in Integrated Coastal Management." See http://www.lib.noaa.gov/docaqua/presentations/aa_offshorepanel.htm (Viewed 4/30/06).
[6] Naylor, R. L., R. J. Goldburg, J. Primavera, N. Kautsky, M. C. M. Beveridge, J. Clay, C. Folke, J. Lubchenco, H. Mooney, and M. Troel. (2000). "Effect of aquaculture on world fish supplies." Nature 405: 1017-1024.
[7] McGinnis, Michael V., Linda Fernandez, Caroline Pomeroy (March 2001). *The Politics, Economics, and Ecology of Decommissioning Offshore Oil and Gas Structures*. MMS OCS Study 2001-006. Coastal

Use of offshore oil and gas structures for OOA is not a new idea; public discussion of the concept has occurred since at least the mid-1990s[8]. However, the reality of this trend— consisting, as it does, of these large-scale ecological and economic forces (oil interests, international trade imbalances, growing unmet global fish demand)— crystallized with the 2003 emergence of a proposal to convert Platform Grace, approximately 3 NM north of CINMS, into an OOA facility.

The Grace Mariculture proposal focused the attention of CINMS stakeholders and resource managers on aquaculture as an industry, and revealed the general lack of understanding of the implications of conducting OOA in the Santa Barbara Channel. The need for a thorough review of the activity was subsequently articulated by the CINMS Advisory Council (SAC), and OOA was identified as a priority issue in the SAC's 2005 workplan[9]. Meanwhile, CINMS managers included OOA within the *Emerging Issues Action Plan* of the June 2006 Draft Management Plan (DMP), asserting:

> *...aquaculture operations have the potential to impact resources and qualities beyond their immediate environs, operations adjacent to and within the Sanctuary region...may impact Sanctuary resources and qualities.*[10]

The existing and emerging CINMS regulatory framework appears to effectively exclude any type of aquaculture from occurring within the Sanctuary itself. Unfortunately, research into the array of harmful byproducts and adverse environmental effects associated with concentrated fin fish aquaculture corroborate the DMP's assertion. It is critical to note that many forms of aquaculture can be environmentally benign or even beneficial; many examples of California's long-standing shellfish cultivation industry demonstrate this fact. However, evidence suggests that fin fish would be the primary focus of regional offshore aquaculture, and even if conducted outside CINMS, OOA to produce *fin fish* could result in serious impacts to a cross section of the resources and qualities within Sanctuary boundaries.

This report compiles information on open ocean fin fish aquaculture for CINMS managers, stakeholders and the public, and aims to provide an overview of the potential environmental implications of this practice if— or when— it is conducted in the SBC. Four major areas of potential impact to Sanctuary resources (and the existing uses associated with them) are identified and explored:

1. Food web impacts: raising predator species yields a net loss of fish
2. Biological pollution: escape of farmed fish and the spread of parasites and disease
3. Discharges: fish farm emissions that could degrade CINMS water quality and harm biological communities
4. Degradation of marine habitat: attraction, underwater noise and entanglements

---

Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-30761. 98 pages.

[8] Dougall, D., (1996). "Oil and Gas Views on Use and Reuse of Petroleum Structures for Mariculture," In: Proceedings: Fourteenth Information Transfer Meeting, Nov. 17, 1994, New Orleans, LA. OCS Study MMS 96-0050. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

[9] CINMS. "2005 Sanctuary Advisory Council Work Plan." Revised: March 17, 2005. Available at http://channelislands.noaa.gov/sac/report_doc.html (Viewed 7/9/07).

[10] U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program (2006). *CINMS Draft Management Plan / Draft Environmental Impact Statement.* Silver Spring, MD.

The report also surveys the existing regulatory framework for federal management of open ocean aquaculture in- and outside of Sanctuary boundaries, and the emerging legislation and rulemaking that could change this framework. Because the State of California has taken a leadership role in establishing progressive, environmentally protective laws for management of aquaculture in waters under its jurisdiction, the report reviews California's framework to compare and contrast with the federal arrangement. Existing regulatory gaps and challenges for Sanctuary resource protection are identified in the discussion of these frameworks. Similarly, opportunities to improve federal management of aquaculture and enhance protection of Sanctuary resources from adverse impacts from certain forms of aquaculture are also identified and discussed.

Integrated throughout the report are ten recommendations for CINMS stakeholders, resource managers, and the general public. The recommendations are presented for the express purposes of preventing degradation of Sanctuary resources, ensuring that any future SBC aquaculture is environmentally sustainable, and that CINMS resource managers are prepared and empowered to constructively address fin fish aquaculture in the Santa Barbara Channel.

However, these recommendations are encompassed by an overarching recommendation for Sanctuary resource managers, Sanctuary stakeholders, and the general public, to support, and where possible carry out management of open ocean aquaculture with a *precautionary* approach. While much data exists on the environmental effects of certain forms of aquaculture, expansion of the commercial practice into the public trust areas of federal waters is new and fraught with uncertainty. Accordingly, strong, comprehensive environmental standards should be insisted on by the public and established by decision-makers in advance of permit issuance for any open ocean aquaculture facility in the Santa Barbara Channel area. Incidentally, the recommendation for such an approach echoes published advice from the Pew Oceans Commission, NOAA's Code of Conduct for Responsible Aquaculture, and the January 2007 report from Woods Hole Oceanographic Institute's Marine Aquaculture Task Force.

This report's ten specific recommendations, excerpted and summarized below, stem from, and aim to actuate, a precautionary approach to open ocean aquaculture in the Santa Barbara Channel area surrounding the Channel Islands National Marine Sanctuary.

Rec. 1: In recognition of the ecological importance of coastal pelagic fisheries, and the increasing pressure a growing fin fish aquaculture industry will likely exert on these stocks locally and abroad, CINMS staff and stakeholders should support the ensuring of ecologically, economically and socially sustainable use of wild fish inputs for proposed fish farm operations, whether as whole fish, or feed comprising fishmeal and fish oil ingredients, and advance disclosure of feed sources and impact analysis on feed production. In addition, CINMS should support research and sound management of California coastal pelagic species.

Rec. 2: Proposed farming of non-indigenous or genetically modified (GM) aquatic plant and animal species (including specimens of non-local genetic stock) in the Santa Barbara Channel region should be rejected by CINMS resource managers and stakeholders. While certain theoretical genetic modifications could be considered precautionary (such as engineered infertility or disease resistance), tremendous uncertainty surrounds this technology and the potential impacts from genetically modified escapees interbreeding with Sanctuary-area wild stocks. Until more certainty exists, disallowing GM stocks remains the most precautionary and appropriate approach to protect Sanctuary resources and existing uses.

Rec. 3: To protect wild stocks from the spread of parasites and pathogens associated with commercial fish farming, CINMS stakeholders and resource managers should evaluate OOA facility proposals with specific, science based criteria for the maximization of the health of farmed fish, and the minimization of potential for the facilities to act as pathogen and parasite incubators.

Rec. 4: a) CINMS resource managers and stakeholders should support current and potential future aquaculture approaches that minimize water quality degradation from untreated discharges often associated with fish farming. These may include use of closed systems, cultivation of shellfish and integrated polycultures rather than fin fish monocultures, use of plant based, rather than fish or animal-byproduct based feeds, abstaining from use of chemical pesticides and pharmaceuticals, and deliberate siting in areas of oceanographically high pollution absorption capacity and low habitat value.

b) CINMS staff should require that during environmental review, fish farm applicants 1) demonstrate that fish farm discharges won't impair CINMS water quality, and 2) analyze and disclose potential cumulative impacts to CINMS-area resources from fish farm proliferation and other factors.

Rec. 5: Best available technologies and deliberate siting of aquaculture facilities should be required to minimize entanglement, migration disruption, attraction, and habitat abandonment, that fish farms are documented to cause among marine wildlife.

Rec. 6: In line with the recommendations outlined by the WHOI Marine Aquaculture Task Force, CINMS stakeholders and staff should be resolved that any future aquaculture facilities in the Santa Barbara Channel region be sited deliberately, based on specific, science-based criteria, and robust data demonstrating that the chosen location is optimal for avoiding or minimizing adverse effects on Channel and Sanctuary resources and uses, rather than sited opportunistically based solely on the existence of useful infrastructure.

Rec. 7: CINMS staff and stakeholders should actively participate in federal policy development and rulemaking on aquaculture, and leverage existing research and policy recommendations to influence these federal processes to ensure protection of natural resources, existing uses, and goals of the local Sanctuary management and the National Marine Sanctuary Program.

Rec. 8: To protect resources under NMSP jurisdiction from potentially deleterious aquaculture practices within and around CINMS boundaries, CINMS staff should adopt the Sanctuary regulatory updates comprising Proposed Actions 3, 4, and 12 of the Draft Management Plan/Draft Environmental Impact Statement

Rec. 9: CINMS staff and stakeholders should formally acknowledge California's current leadership in marine fin fish aquaculture management, support and leverage the State's existing standards for aquaculture siting, operations, and reclamation, and, in the absence of a federal framework, generally encourage extension of the state's standards and policies as established by the Sustainable Oceans Act into the federal waters of the EEZ.

Rec. 10: To best ensure that Sanctuary regulations are upheld and its natural resources and existing uses protected, CINMS staff should participate, consult and comment *directly* in the permitting processes for any future Santa Barbara Channel region aquaculture facility proposals. Concurrently, the SAC should uphold its general mandate by reviewing application materials for future fin fish aquaculture proposals and formally advising CINMS staff on the Council members' findings and concerns.

2. Background

2.1 Open ocean aquaculture: the promise and the threat

The National Aquaculture Act of 1980[11] defines aquaculture as "the propagation and rearing of aquatic species in controlled or selected environments, including, but not limited to, ocean ranching." Aquaculture operations can involve hatcheries (land-based facilities to spawn and rear broodstock), nursery culture (to rear juveniles to a size conducive to growout), and growout facilities (to bring caught or hatched organisms to full or harvestable size) in an array of aquatic and marine settings ranging from onshore ponds and tanks, to sheltered coastal areas, to floating pens and cages moored offshore.[12]

Aquaculture now provides approximately 40% of all fish products worldwide.[13] The raising of fin fish, crustaceans and bivalves makes up approximately three-quarters of global aquaculture production; and 90% of aquaculture currently occurs in Asia.[14] In 2000, the global industry produced 36 million metric tons of fish and shellfish (including gastropods); since 1990 the industry has been growing at an average compound rate of around 10% a year, making it the fastest growing sector of the global food economy (in comparison, farmed meat production grew by 2.8% over the same period).[15]

Comparatively, the U.S. aquaculture industry is still small, composed mainly of catfish and shellfish rearing; domestic marine aquaculture focuses on Atlantic salmon, shrimp, oysters, and hard clams, which collectively account for about 25% of total U.S. production.[16] Over 70% of the seafood Americans consume is imported, and of that at least 40% is farmed.[17] These factors collectively result in an annual U.S. "seafood trade deficit" of more than $7 billion and growing, larger than any other natural resource deficit except oil.[18]

The Bush administration has made the reduction of the seafood trade imbalance a policy priority, and is working actively to promote and grow the domestic aquaculture industry—and OOA in particular— as the centerpiece of its efforts. Administration officials assert that aquaculture will also reduce impacts to existing wild fisheries, bring economic benefits, and, perhaps most importantly, reduce pressure on basic coastal resources like space and water quality, which are already heavily competed for.[19] In February of 2006, U.S. Secretary of Commerce Gutierrez stated:

---

[11] 16 U.S.C. 2801.
[12] Naylor, et al. "Effect of aquaculture on world fish supplies." *Nature* 405: 1017-1024.
[13] Eichenberg, Tim, D. Jacobson, and K. Wing. May 11, 2006. "Ocean Fish Farming Standards Approved: Legislation Provides a National Model to Protect Consumers and Marine Life." Press Release.
[14] Id.
[15] "Fish farming: The promise of a blue revolution." *The Economist*. August 7, 2003. Available at: http://www.economist.com/business/displayStory.cfm?story_id=1974103
[16] Naylor, Rosamond. Spring, 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology*. Available at: http://iis-db.stanford.edu/pubs/21062/Naylor.NAS.Sci.Tech2006.pdf.
[17] U.S. Aquaculture and the National Offshore Aquaculture Bill of 2005: Backgrounder. See http://www.nmfs.noaa.gov/mediacenter/aquaculture/docs/06_AQ%20backgrounder_External%20May%2027.pdf (Viewed 2/3/06).
[18] Rogers, Paul. March/April 2006. "Economy of Scales." *Stanford Magazine*. See http://www.stanfordalumni.org/news/magazine/2006/marapr/features/fishfarming.html (Viewed 3/23/06).
[19] Written Statement of Dr. William T. Hogarth, Assistant Administrator for Fisheries, National Marine Fisheries Service, National Ocean and Atmospheric Administration, US Department of Congress.

> *…The United States must explore the potential of offshore aquaculture to help meet the growing demand for seafood in this country and to create jobs and economic opportunity for coastal communities. To support that, we are making the National Offshore Aquaculture Act of 2005 a priority for this department and this country.*[20]

Similarly, in a recent speech President Bush stated: "Congress needs to move forward with my administration's plan [the NOA Act] to build a well-managed system of offshore aquaculture … And when we get this right, these farmed fish can provide a healthy source of food and reduce pressure on the ocean ecosystems."[21]

The NOA Act of 2005 expired in congressional committee with the conclusion of the 109th Congress.[22] However, on April 24, 2007, U.S. Representative Nick Rahall, Chairman of the House Natural Resources Committee, and Congresswoman Madeleine Bordallo, Chair of the House Natural Resources Committee, Fisheries, Wildlife, and Oceans Subcommittee jointly introduced the Administration's National Offshore Aquaculture Act of 2007 as H.R. 2010.[23] While slightly evolved, like its predecessor the NOA Act of 2007 is designed primarily to facilitate development of commercial OOA. Bush Administration officials have articulated hopes that the NOA Act can expand domestic aquaculture production fivefold by 2025, into a $5 billion-per-year industry.[24]

Should the NOA Act be signed into law, several existing legal and bureaucratic obstacles to the proliferation of OOA in Channel waters will be eliminated. Unfortunately, such growth could represent a significant challenge to conservation of Channel species and ecosystems; many experts have criticized several aspects of the legislation as inadequate for preventing many of the environmental impacts associated with aquaculture (see Section 4.1.5). This report discusses this emerging legislation and these impacts in the sections below. However, the origins of the NOA Act provide important background for understanding the potential future scenario of open ocean fish farms in the SBC region.

In addition, two separate commissions, the private Pew Oceans Commission and the Congressionally-established U.S. Commission on Ocean Policy, completed prominent, comprehensive analyses of U.S. ocean management. In recognition of the continued growth in seafood demand and the growing significance of aquaculture, both commissions examined marine aquaculture (also known as mariculture) in their reports, and offered suites of national policy and

---

Legislative hearing on Offshore Aquaculture before the National Ocean Policy Subcommittee of the Commerce, Science and Transportation Committee, US Senate. April 6, 2006.

[20] Id.

[21] President George W. Bush. June 15, 2006. Speech announcing the Establishment of Northwest Hawaiian Islands National Monument. Available at http://www.whitehouse.gov/news/releases/2006/06/20060615-6.html (viewed 8/29/06).

[22] Library of Congress, THOMAS online legislative database. "S.1195." November 7, 2006. http://thomas.loc.gov/cgi-bin/bdquery/z?d109:SN01195:@@@L&summ2=m& (Viewed 11/7/06).

[23] NOAA Aquaculture Program. 2007. "2007 National Aquaculture Act." http://www.nmfs.noaa.gov/mediacenter/aquaculture/offshore.htm (Viewed 5/9/07).

[24] Conrad C. Lautenbacher, Jr., NOAA Administrator. April 13, 2004. Dedication speech for the Kauffman Aquaculture Center, Topping, Virginia. Available at: http://www.noaa.gov/lautenbacher/kauffman2004.htm (Viewed 8/28/06). Also, see US Department of Commerce "Aquaculture Policy" (06/01/01): http://www.lib.noaa.gov/docaqua/docaquapolicy.htm (Viewed 8/29/06),

management recommendations. However, the commissions diverged in their respective attitudes toward future mariculture operations. According to Dr. Rosamond Naylor of the Center for Environmental Science and Policy at Stanford University,

> *…The U.S. Commission recommended that the [U.S.] pursue offshore aquaculture, acknowledging the need for environmental sustainable development,[while] the Pew Commission recommended a moratorium on the establishment of new marine farms until comprehensive national environmental standards and policy are established.*[25]

The Pew report, which categorizes aquaculture as one of nine "major threats to our oceans," identifies five main areas of risk from OOA, including biological pollution, harvest of fish for fish feed, organic pollution and eutrophication, chemical pollution, and habitat modification.[26] The Pew recommendations attempt to address these risks, in order to guide marine aquaculture toward sustainability.

On the other hand, the report from the U.S. Commission on Ocean Policy, *An Ocean Blueprint for the 21st Century*, finds that OOA may bring more positive impacts, including a reduction of user conflicts and environmental problems associated with nearshore aquaculture. In contrast to the Pew report, the U.S. Commission identifies only two major concerns with the OOA-- "environmental problems associated with some aquaculture operations, particularly net-pen facilities," and "a confusing, inconsistent array of state and federal regulations that hinder private sector investment."[27] Consequently, it offers promotional recommendations that focus on streamlining the regulatory framework for OOA, and reducing or eliminating what it identifies as bureaucratic obstacles preventing the industry from "realizing its potential."[28]

The Bush Administration was formally required by Congress to respond to the U.S. Ocean Commission's report and recommendations, and did so in *The U.S. Ocean Action Plan: President Bush's Response to the U.S. Commission on Ocean Policy.* With respect to aquaculture, first and foremost of these actions is the submittal to Congress of the NOA Act.[29]

Few if any of the aquaculture recommendations from the Pew report, a document less promotional of the activity, have been enacted at the federal level. While the State of California has passed environmentally-protective ocean and aquaculture legislation influenced by the Pew conclusions, by definition OOA occurs in the US Exclusive Economic Zone (EEZ), the federal waters that extend from beyond the 3NM limit of State jurisdiction to 200 NM offshore.

Meanwhile, irrespective of the fate of the NOA Act, federal agencies have already begun formally preparing for the review, permitting and regulation of OOA under the existing federal regulatory framework, a sign of their expectations for industry growth. In 2004, the US EPA conducted a final rulemaking to establish wastewater controls for "concentrated aquatic animal

---

[25] Naylor, Rosamond. Spring, 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology*.
[26] Pew Oceans Commission. 2003. *America's Living Oceans: Charting a Course for Sea Change*. A Report to the Nation. May 2003. Pew Oceans Commission, Arlington, Virginia.
[27] U.S. Commission on Ocean Policy. September 2004. *An Ocean Blueprint for the 21st Century*. Final Report. Washington, DC.
[28] Id.
[29] The U.S. Ocean Action Plan: President Bush's Response to the U.S. Commission on Ocean Policy (December 17, 2004). See http://ocean.ceq.gov/actionplan.pdf (Viewed 3/19/06).

production facilities," or fish farms.[30] The regulation applied to about 245 existing fish farms upon enactment, specifically facilities producing at least 100,000 lbs. of fish per year and either discharging waste water from ponds or tanks, or using net pens or submerged cages. But perhaps more importantly, the rulemaking established pollution standards for future aquaculture operations applying for National Pollution Discharge Elimination System (NPDES) permits under the Clean Water Act.[31] This action also suggests an agency expectation for growth in aquaculture permitting activity.

Subsequent to the reports, responses and actions described above, in December 2005 NOAA Fisheries Service released a technical memorandum, *Guidelines for Ecological Risk Assessment of Marine Fish Aquaculture* to provide preparatory information and a basic set of guidelines for resource managers and decision makers assessing future aquaculture proposals. The report identified *ten* major areas of risk to the environment, and analyzed each for their respective degree of potential adversity and required mitigation. Their extensive list includes:

- increased organic loading,
- increased inorganic loading,
- residual heavy metals,
- transmission of disease organisms,
- residual therapeutants [e.g. antibiotics and hormones],
- biological interaction of [farm animal] escapees with wild populations,
- physical interaction with marine wildlife,
- physical impact on marine habitat,
- using wild juveniles for growout, and
- harvesting [wild] fisheries for feed.[32]

The Memorandum also offers important advice for regional and local "resource managers and decision makers" such as those of CINMS, specifically that they review the risk assessments and "establish their relevance in their own geographic region and to the particular local ecosystem where marine aquaculture facilities are to be sited … [since] …the chances of risk can differ greatly in accordance with natural characteristics of the local ecosystem and its geographic location."[33]

Finally, the Energy Policy Act signed into law by President Bush in 2005 includes a provision (Section 388) authorizing the US Minerals Management Service (MMS) to review and permit alternative uses—including OOA—for oil and gas facilities in the Outer Continental Shelf (OCS), or EEZ[34]. According to MMS,

> *Section 388 clarifies the* [Interior] *Secretary*'s *authority to allow an offshore oil and gas structure, previously permitted under the OCS Lands Act, to remain in place after oil and gas activities have ceased in order to allow the use of the structure for other energy and*

[30] 40 CFR 451. "Effluent Limitations Guidelines and New Source Performance Standards for the Concentrated Aquatic Animal Production Point Source Category." August 23, 2004.
[31] US EPA (May 15, 2006). Final Rule Fact Sheet: "Effluent Guidelines: Aquatic Animal Production Industry." http://epa.gov/guide/aquaculture/fs-final.htm (Viewed 8/28/06).
[32] Nash, C.E., P.R. Burbridge, and J.K Volkman (2005). "*Guidelines for Ecological Risk Assessment of Marine Fish Aquaculture."* U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-71.
[33] Id.
[34] U.S. Public Law 109-58. 109th Congress. 8 August 2005. Energy Policy Act of 2005. Section 388. Alternative Eenrgy-Related Uses on the Outer Continental Shelf.

> *marine-related activities. This authority provides opportunities to extend the life of facilities for non-oil and gas purposes, such as research, renewable energy production, aquaculture, etc., before being removed.*[35]

As of May 2007, MMS is receiving comments on its completed draft EIS for the agency's new alternative energy and alternate use program.[36]

This new legal framework, and the rulemaking process it has initiated, illuminates an important commercial linkage between offshore oil and gas developers and the concept of OOA— one that is fundamental to a discussion of the future of both industries in the SBC region.

The submerged net pens, cages and automated feeding technologies that will likely be used in commercial scale OOA have begun to be deployed with moderate success in two experimental fish farms in near shore waters off Hawaii and Puerto Rico, and offshore mainland New Hampshire near an isolated group of islands. These facilities are producing and marketing shellfish and predatory fin fish species, and are documented by aquaculture experts, scientists and journalists as having low levels of detectable environmental impact.[37] However, all three of these facilities continue to operate as "pilot" research projects, at small scales and with the supporting partnership from NOAA and other various universities and agencies.[38,39] No evidence yet appears to exist that OOA can be commercially successful (or "economically viable") in the EEZ without either a much higher scale of production—thus exacerbating the likely environmental impacts—or without some form of subsidy (public or private), which may exact costs on the environment or the economy in other ways.[40] The findings of Dr. Rosamond Naylor's assessment of the New Hampshire facility exemplify this paradigm:

> *Scientific results from an experimental offshore system in New Hampshire indicate no sedimentation or other benthic effects, even when the cages are stocked with more than 30,000 fish. However, commercial farms will likely have 10 or more times this density in order to be economically viable; commercial salmon farms commonly stock 500,000 to a million fish at a site.*[41]

---

[35] MMS. "Alternate Uses of Existing Oil and Gas Platforms." OCS Renewable Energy and Alternate Use Programmatic EIS Information Center: http://ocsenergy.anl.gov/guide/platform/index.cfm (Viewed 8/29/06).

[36] MMS. "About the OCS Renewable Energy Programmatic EIS." OCS Renewable Energy and Alternate Use Programmatic EIS Information Center: http://ocsenergy.anl.gov/eis/index.cfm (Viewed 5/9/07).

[37] Naylor, R.. "Environmental Safeguards for Open-Ocean Aquaculture": "Scientific results from an experimental offshore system in New Hampshire indicate no sedimentation or other benthic effects, even when the cages are stocked with more than 30,000 fish."

[38] NOAA Sea Grant. August 2003. "Offshore Aquaculture Investments Address Our Nation's Growing Demand for Seafood – Sea Grant NOAA Offshore Aquaculture Investments." Pamphlet, 4 pages. Available at: http://www.nmfs.noaa.gov/mediacenter/aquaculture/docs/08_%20Backgrounder%20on%20Open%20Ocean%20Pilot%20Projects.pdf (Viewed 8/30/06).

[39] NOAA Aquaculture Program Office. May 2005. "Aquaculture Backgrounder – May 27, 2005." 1 page. Available at: http://www.nmfs.noaa.gov/mediacenter/aquaculture/docs/06_AQ%20backgrounder_External%20May%2027.pdf (Viewed 8/30/06).

[40] Naylor, Rosamond. Spring, 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology*.

[41] Id.

This suggests in turn that OOA in the Sanctuary area would have at least one of the two characteristics—high intensity, high density production, or some form of direct subsidy that exacts its own toll on the public resources of the SBC. Unfortunately, both have strong potential to impact SBC and Sanctuary resources, and thus both should be of concern to CINMS resource managers and stakeholders.

The Grace Mariculture proposal—which emerged in 2003, initiated regional awareness of OOA, and sparked concern and interest among the CINMS Advisory Council that led to the report at hand[42]— appears to bear out this theory.

2.2 The Grace Mariculture Project

In 2003, the Hubbs-Sea World Research Institute (HSWRI) of San Diego proposed a "pilot" scale OOA facility on Platform Grace, located approximately 9 NM offshore Ventura County. Originally installed as a production facility by the ChevronTexaco Corporation in 1979, Grace ceased producing oil and natural gas in 1997 and subsequently had hydrocarbon production equipment removed.[43] However, the facility remains interconnected via pipelines with Platform Gail and Venoco's onshore oil and gas processing facilities in Carpinteria, so the platform will not be removed until all oil and gas production ceases on Platform Gail. Chevron Corporation sold Platform Grace to Venoco Inc. in 1999, but, importantly, retained liability for the facility in the deal.[44] In turn, Venoco "leased" Platform Grace to HSWRI in August 2003,

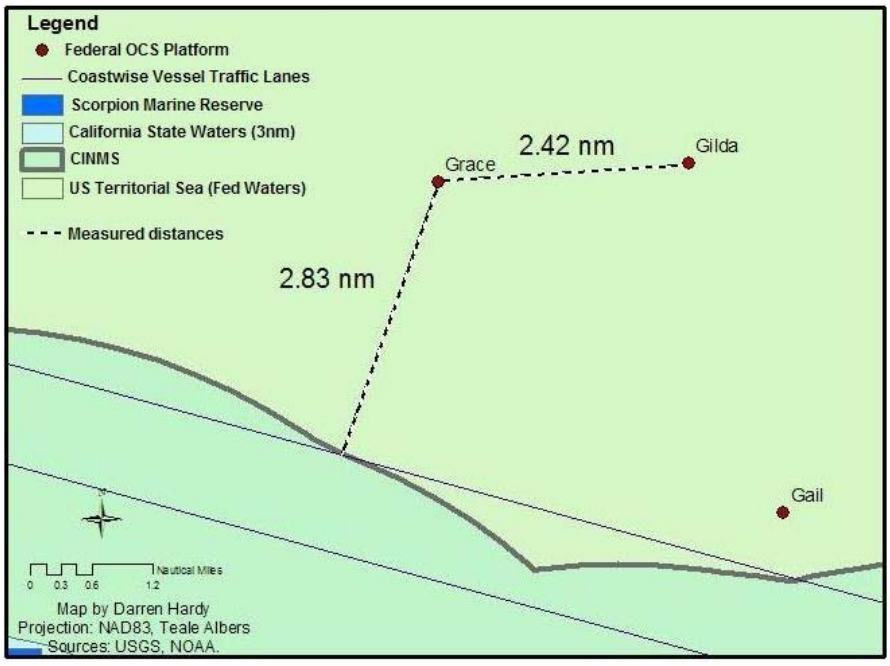


Figure 2.2.1: Estimated proximity of Platform Grace to CINMS

[42] CINMS. 2005. "2005 Sanctuary Advisory Council Work Plan." Goal 11 of this work plan stated: "Increase knowledge about offshore aquaculture and the proposed Grace Mariculture Project." Available at http://channelislands.noaa.gov/sac/report_doc.html (Viewed 7/9/07).
[43] Marine Research Specialists (MRS). December 2003. "Grace Mariculture Project: Final Report." Report to Hubbs-Sea World Research Institute. Marine Research Specialists, Ventura, California.
[44] Staff Writer. February 14, 2004. "Fish farm proposed for old platform." Newspaper article, Santa Barbara News-Press.

according to a promotional brochure for the project.[45] HSWRI planned to direct and manage the Grace Mariculture Project in collaboration with NOAA Fisheries Services and other governmental agencies, with direct support from Chevron's Environmental Management Division, and Venoco, Inc.[46]

Platform Grace is located in federal waters about 330 feet deep and approximately 3 NM from the CINMS boundary[47] (see *figure 2.2.1*, above). The Grace Mariculture plan includes use of about 2.4 square kilometers (about 593 acres) of surface area around the facility, including two submerged "semi-rigid" cages, two "gravity cages" (pens suspended from circular floats) (see *figures 2.2.2* and *2.2.3*, below), and approximately 19 "culture pools" on the main platform deck for hatchery and nursery operations.[48] The project would involve farming shellfish and fin fish, specifically mussels, abalone, striped bass (non-native), white sea bass, rockfish, California halibut, California yellowtail, and bluefin tuna.[49] A consultant report expected that the project would "produce approximately 100-300 metric tons (MT) of marketable seafood product annually … and … test critical components of a commercial scale operation." The pilot scale phase of the project was expected to last three years and, if proven feasible, the applicant planned

Figure 2.2.2: Submerged, "semi-rigid" fin fish enclosure at a pilot OOA facility offshore Puerto Rico. Photo: NOAA

[45] The Grace Mariculture Project Brochure. See http://gracemariculturepro ject.org/downloads/GMP_Brochure.pdf (Viewed 6/16/06). Given the promotional character of this reference, the actual character of the arrangement between HSWRI and Venoco may have been more nuanced than a simple "lease." A Venoco representative contacted to clarify the arrangement was unable to recall the exact nature of the deal contemplated by these two parties (personal communication, Mike Edwards, Venoco vice president for government affairs and public relations, May 11, 2007).
[46] Hubbs-Sea World Research Institute: 2005 Annual Report. See http://www.hswri.org/files/annualreport/HSWRIAR2005final650454.pdf (Viewed 6/16/06).
[47] Hardy, Darren. Unpublished GIS analysis, September 2006. Data sources: USGS, NOAA.
[48] MRS. December 2003. "Grace Mariculture Project: Final Report."
[49] Hubbs-Sea World Research Institute: Annual Report: 2003-2004. See: http://www.hswri.org/files/annualreport/annualreportpdfcopy586957.pdf (Viewed 7/09/07). Unfortunately, the specific rockfish species that were to be cultured were not identified in HSWRI promotional materials.

to apply to continue operations.[50] HSWRI's contracted consultants completed a preliminary analysis of the Grace OOA proposal and issued *The Grace Mariculture Project: Final Report* for HSWRI in December 2003. The report was intended to provide the necessary information to US Army Corps of Engineers (ACE) and the California Coastal Commission (CCC) for evaluation of potential environmental impacts and consistency with existing coastal and marine uses. It should be noted that the report was only a preliminary consultant assessment,[51] no EIS or environmental assessment (EA) process was ever initiated by federal permitting authorities.

In January 2004, HSWRI filed a Section 10 permit application with USACE and Forms 1 (General Application) and 2B NPDES (Application for Permit to Discharge Wastewater – Concentrated Animal Feeding and Aquatic Animal Production Facilities) with the EPA. Permits were never issued. The contractual agreement between HSWRI and Venoco, Inc. regarding aquaculture at or near Platform Grace expired in 2004 and was not renewed.[52] Venoco, Inc. is now working with MMS to resume hydrocarbon production at Platform Grace,[53] which thereby precludes fin fish farming activities from occurring at the platform.

The fate of the Grace Mariculture project resembles that of SeaFish Mariculture, which, at 34 miles offshore Texas, was the first aquaculture facility associated with a commercial offshore oil industry. After securing permits, in 1998 SeaFish actually commenced production of red drum, but ended only a year later in 1999 because Shell Oil decided to reactivate the platform for development of a nearby gas well.[54]

Figure 2.2.3: "Gravity cage" type fin fish enclosure. Photo: NOAA.

[50] MRS. December 2003. "Grace Mariculture Project: Final Report."
[51] A summary table of impacts identified by MRS is included here as *Appendix C*: *Potential Environmental and Socioeconomic Impacts of the Grace Mariculture Project.*
[52] Rogers, Terry. January 9, 2007. "Aquaculture report urges growth, better regulation." Newspaper article, San Diego Union Tribune.
[53] Letter (December 14, 2005) Re: Updated [Development and Production Plan] Information and Application for Permit to Drill – Venoco, Inc. Platform Grace Resumption of Production. Minerals Management Service, from Stephen Greig, Government Relations Manager, Venoco, Inc., to Rishi Tyagi, Chief Officer of District Operations, Pacific Outer Continental Shelf Region of Minerals Management Service, U.S. Department of Interior.
[54] Cicin-Sain, B., S. M. Bunsick, R. DeVoe, T. Eichenberg, J. Ewart, H. Halvorson, R. W. Knecht, and R. Rheault. 2001. *Development of a Policy Framework for Offshore Marine Aquaculture in the 3-200 Mile U.S. Ocean Zone*. Center for the Study of Marine Policy, University of Delaware, Newark, DE.

Both the Grace and SeaFish Mariculture projects appeared to have been proposed and withdrawn based solely on the economic dynamics faced by the sponsoring oil companies. A quantitative investi-gation into how market prices for oil and gas influence OOA proposals is beyond the scope of this report; however, the resumption of production at these two hydrocarbon facilities obviously reveals that sufficient incentive emerged to do so. What is important to consider in the context of SBC and CINMS is the opportunity for deferment of rig decommissioning and removal that OOA may present to oil platform owners. That is, whether OOA operations will be conducted at deactivated platforms only long enough for hydrocarbon prices to climb high enough for production to again make economic sense. In the case of SeaFish aquaculture, the OOA facility "provided an interim use of a platform and delayed the need for the oil company to make a decision on abandonment"[55]; many CINMS stakeholders rightfully have an acute sensitivity to that decision making process with respect to the abandonment of SBC platforms, so understanding how OOA may come to influence it could be important.

2.3 Hydrocarbon Development and Open Ocean Aquaculture

Figure 2.2.d: Industrial symbiosis? Oil platform and fish farm in the Gulf of Mexico. Photo: NOAA

President Bush signed the Energy Policy Act of 2005[56] on August 8, 2005. Section 388 of the Energy Policy Act amends Section 8 of the Offshore Continental Shelf Lands Act (OCSLA)[57], authorizing the Secretary of the Interior to grant leases, easements, or rights-of-way on the OCS for the development and support of alternative energy resources such as wind, solar and currents, and also to allow for "alternate uses" of existing facilities on the OCS, including OOA.[58] The DOI delegated authority to MMS, who, as lead agency for the permitting of alternative uses, is developing its OCS "Alternative Energy and Alternate Use program", to develop a framework for permitting, revenue sharing and siting.[59]

MMS issued a draft EIS for this program in March 2007, which, while focused on alternative energy projects, also includes discussion of OCS oil and gas infrastructure conversion to offshore aquaculture facilities.[60] MMS summarizes its current assessment of OOA in the DEIS, stating,

> *Offshore aquaculture is expected to have impacts similar to those experienced from coastal aquaculture operations. Impacts related to waste generation, native and non-*

[55] Id.
[56] U.S. Public Law 109-58. 109th Congress. 8 August 2005. Energy Policy Act of 2005. Section 388. Alternative Energy-Related Uses on the Outer Continental Shelf.
[57] 43 U.S.C. 1337 et seq.
[58] Federal Register / Vol. 70, No. 250 / Friday, December 30, 2005 / Proposed Rules.
[59] Hunter, Cheri (April 25, 2006). Presentation: Implementing the Energy Policy Act of 2005. See http://www.mms.gov/awards/Presentations2006/EPAct-April2006Hunter.pps (Viewed 6/18/06).
[60] Minerals Management Service (MMS). March, 2007, Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf. Available at: http://ocsenergy.anl.gov/eis/guide/index.cfm (Viewed 5/9/07).

> *native species, fisheries, and predators need to be recognized and addressed. With proper design and management, impacts to the environment would be negligible to moderate.*[61]

Unfortunately, the DEIS provides only superficial coverage of what appropriate "design and management" would comprise; the proposed mitigation measures for aquaculture at retired OCS facilities are presented in the following statement:

> *A number of mitigative actions can be taken to avoid adverse impacts from aquaculture operations on the OCS. Native species should be cultured. Feed, animal waste, antibiotics, and chemicals used for operations should be monitored to avoid pollution of the surroundings by excess material. Humane methods should be used for discouraging the approach of predators, and facility siting should avoid essential fish habitat and traditional fishing grounds.*[62]

This Alternate Use Program portends significant implications for CINMS: Seventeen of California's 33 offshore oil facilities are located in the SBC[63], and many if not all of them could be potential sites for OOA projects upon facility retirement. Donald Kent, President of HSWRI and prominent offshore aquaculture proponent, considers oil platforms "ideal for offshore fish production," [64] and states that, "as a general matter, we consider all existing OCS facilities as potential sites for offshore aquaculture projects."[65] Importantly, platform owners and liability holders such as Venoco and Chevron have significant incentive to extend the life of decommissioned platforms through establishment of alternative uses such as OOA; deferring the substantial expenses of removing the oil platform completely as currently required by MMS regulation results in significant savings.[66]

For example, the Offshore Facility Decommissioning Cost Team (OFDC) of MMS estimated the decommissioning cost for Platform Grace to be $27,405,000 in 2004 dollars.[67] According to OFGC Team's report, the estimated decommissioning costs in the Pacific OCS Region range (in 2004 dollars) from $10,291,000 at Platform Gina to a remarkable $129,842,000 at Platform Harmony (total decommissioning costs for the Pacific OCS region are estimated at about $1 billion, with an average of $43,813,000 per facility).[68] Grace Mariculture Project promotional materials explain that "[Chevron] is interested in conducting research within the operating life of

---

[61] Id.
[62] Id.
[63] California State Lands Commission: MMS Division Rigs to Reefs Workshop. See http://www.slc.ca.gov/Division_Pages/MRM/Paper.htm (Viewed 2/3/06).
[64] Kent, Donald, President, HSWRI. June 2003. "Development of Offshore Mariculture in California for Fisheries Replenishment and Commercial Farming." Presentation to Congressional staff. Available at http://www.lib.noaa.gov/docaqua/presentations.html (Viewed 8/31/06).
[65] Kent, Donald. President, HSWRI. February 28, 2006. Letter to MMS Rules Processing Team, Re: Alternate Energy-Related Uses on the Outer Continental Shelf RIN 1010-AD30.
[66] 30 C.F.R 250.1725. Also, other provisions of 30 C.F.R. 250 mandate full removal of well conductors and platform jackets to 15 feet below the mudline; decommissioning and full removal of platform decks; decommissioning and removal of pipelines and power cables as appropriate; and site clearance.
[67] Department of the Interior (September 17, 2004). *Offshore Facility Decommissioning Costs: Pacific OCS Region*. See http://www.mms.gov/omm/pacific/lease/2004_final_decommissioning_cost_report_rev_1.pdf (Viewed 6/18/06). The OFDC also projected that Grace would be removed between 2015 and 2020, implying that costs for facility decommissioning and removal will run much higher due to inflation.
[68] Id.

the platforms so that any beneficial alternate uses can be identified before the platforms are removed."

While Platform Grace would have continued in its pipeline-relay capacity with Platform Gail during the initial pilot phase of the Grace Mariculture project, the resulting technical understanding of platform-based OOA and the precedent of allowing for conversion of an OCS facility into a fish farm operation would likely have advanced the cause of establishing OOA as an alternate use, in turn advancing efforts by OCS facility owners to defer expensive removal for as long as possible. Consequently, the "subsidy" of Grace Mariculture by Chevron and Venoco (whether through direct charitable payments to HSWRI or the transfer of pre-existing infrastructure) has a potentially profitable "upside" for these and other members of the Pacific hydrocarbon industry.

Discussion in the following sections details the environmental and socioeconomic implications of fish farming, and what data from existing fish farms may portend for OOA in the SBC. However, it should also be noted that significant literature exists on the environmental effects caused by OCS oil and gas facilities themselves, some of which may continue occurring beyond what would be allowed without the establishment of OOA as an alternate use for these facilities. In addition, because OOA may help "free" the OCS developers from long-standing, traditional, economic and social obligations to remove their facilities and reclaim or restore the surrounding environment, OOA in the SBC region could effectively reduce the cost— and encourage the expansion— of Pacific OCS hydrocarbon development.

At a minimum, platform-based OOA will defer cleanup and restoration of the ocean environment that is required once production ceases, a scenario that alone could impact CINMS resources. Deferring removal results in inflated costs for removal, and longer "residence time" i.e. greater deterioration of the facility with the consequence of adding greater amounts of metals and other toxic residues to the surrounding ecosystem. Incidentally, evidence discussed below suggests that open ocean fin fish production at retired OCS facilities could cause significant adverse impacts to the biological assemblages that are known to form on and around subsurface components of oil and gas platforms,[69] assemblages that are often argued as a basis for leaving rigs in place.

While the extent of practical effects from the OOA/hydrocarbon linkage remains only theoretical, the fact of the interconnection seems undeniable. Consequently, CINMS stakeholders and resource managers should become and remain well-informed on the implications of these industries for Sanctuary resources, and engage actively in dialog concerning the future of both hydrocarbon development and aquaculture in the Sanctuary region.

[69] Holbrook, S., R. F. Ambrose, L. Botsford, M. H. Carr, P. T. Raimondi, M. J. Tegner. *Ecological Issues Related to Decommissioning of California's Offshore Production Platforms*. Report to the University of California Marine Council by The Select Scientific Advisory Committee on Decommissioning, University of California. November 8, 2000. Holbrook et al. summarize findings by Dr. Milton Love et al. on the different biological assemblages, some remarkably rich, that have formed on Santa Barbara Channel OCS facilities.

3. Environmental Implications

Open ocean aquaculture— the controlled rearing of marine organisms in the marine environment of the US Exclusive Economic Zone— is a form of aquaculture that currently remains experimental and has yet to mature into a self-sufficient industry in the United States.[70] Thus, little data exists to directly examine how a commercial OOA facility may impact the physical environment and biological communities of CINMS and the SBC region. However, documented research on the environmental impacts caused by the cultivation of predatory fish species in nearshore farms provides a great deal of information that may be applicable to OOA facilities in the SBC—many experts believe open ocean fish farms will closely resemble existing nearshore operations in scale and intensity. Thus, a review of the existing data helps outline the major environmental threats these facilities could pose to the SBC and CINMS.

In recent years, several excellent overviews of the environmental implications of aquaculture have been released by experts in biology, fisheries ecology, and economics (in addition to the overviews of aquaculture released in the Pew and US Ocean Commission on Ocean Policy reports), including articles in the 2005 *Annual Review of Environment and Resources*, the February 2005 *Frontiers in Ecology*, and May 2005 *BioScience*. This report draws from these works and others to provide summary information tailored for CINMS stakeholders, staff, and the public.

Overall, the array of environmental threats posed by aquaculture identified by researchers that may be pertinent to OOA facilities in the SBC region can be organized into the following four categories:

- Food web impacts: the economics of US aquaculture lead to fishing "down the food web" to farm higher trophic level species[71]
- Biological pollution: escape of farmed fish; spreading pathogens and parasites
- Discharges: organic, inorganic, pharmaceutical
- Degradation or conversion of marine habitat: noise and entanglements

Each of these categories is reviewed below. However, it is important to initially establish that aquaculture "is a diverse activity,"[72] one that can be and is practiced successfully in many different ways including some that cause minimal environmental impact. For example, the rearing of filter-feeding mollusks and herbivorous fishes like carp and tilapia result "in a net contribution to global fish supplies and food security" that, according to fisheries economists, "is great".[73] Herbivorous fin fish species are often raised in ponds "integrated within agricultural ecosystems," recycling nutrients in semi-closed systems. Other systems (such as the US onshore catfish industry) cultivate these species more intensely, relying on modern, formulated feeds with high percentages of plant-based protein. Bivalves, such as mussels, scallops and oysters, can be

---

[70] Cicin-Sain et al. 2001. *Development of a Policy Framework for Offshore Marine Aquaculture in the 3-200 Mile U.S. Ocean Zone*. According to Cicin-Sain's team, as of 2001 there were "no fully commercial aquaculture facilities operating in open waters of the [US] EEZ under federal government control." P. 62.l

[71] NOAA's Coastal Protection and Restoration Division provides the following definition of the concept of a food web: "The network of trophic relationships in an ecosystem, based on the food chain principle, but more accurately reflecting the complexities of branching energy transfer among various species at different trophic levels." Available at: http://mapping.orr.noaa.gov/website/portal/calcasieu/calc_html/resources/glossary.html (Viewed 7/9/07).

[72] Naylor, et al. 2000. "Effect of aquaculture on world fish supplies." *Nature* 405: 1017-1024.

[73] Id.

reared relying "entirely on ambient supplies of plankton and organic particles for food,"[74] and thus actually improve ocean water quality as they grow. Locally, Santa Barbara Mariculture, Inc. raises oysters, mussels, Manila clams, and rock scallops on suspended longlines offshore Hope Ranch. According to the company, the cultivated organisms simply extract ambient nutrients from the water column— "no chemicals or feeds are added."[75] One fundamental characteristic of these types of aquaculture is that they essentially provide for the growing domestic and international demand for fish and seafood with minimal or no associated reduction in global supplies of wild fish.

Unfortunately, these benign and beneficial forms of aquaculture contrast starkly with commercial fin fish production, the type of aquaculture that evidence suggests is likely to be practiced in the open ocean waters of the EEZ. Aquaculture experts generally agree that future open ocean facilities will focus production effort on predatory fin fish species of highest value to American consumers, in order to maximize return on the significant capital costs associated with developing commercial ventures in the challenging open-ocean environment.[76,77] For example, according to the Pew Oceans Commission report,

> *The higher costs associated with more durable offshore cage systems and their maintenance will likely necessitate that high-value species be raised in large quantities to make* [OOA] *operations financially feasible... An emphasis on high-value carnivorous marine fish is driving much of the current investigation into new species for United States aquaculture production.*[78]

As a result, the production of predatory marine fin fish species at densities and volumes similar to or greater than currently successful commercial salmon farms (300,000 to one million fish per facility) would be the likely model for OOA facilities in the SBC. With respect to the species of stock selected, the Grace Mariculture proposal seemed to largely corroborate this argument; besides mussel and abalone, HSWRI proposed to raise striped bass, white sea bass, California halibut, California yellowtail and bluefin tunas at Platform Grace[79]-- all of which are high value, predatory fin fishes.

3.1 Food web impacts: raising predators causes a net loss of fish

While some marine aquaculture proponents argue that expansion of the fish farming in US federal waters will help reduce pressure on wild fisheries, data from existing fin fish aquaculture suggests that something closer to the opposite may actually be true.

---

[74] Id.
[75] Santa Barbara Mariculture, Inc. "About the Company." http://www.sbmariculture.com/aboutpage.html (Viewed 9/4/06).
[76] Naylor, R.. Spring, 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology*.
[77] Goldburg, R.J., M. S. Elliot, R. L. Naylor. 2003. "Marine Aquaculture in the United States: Environmental Impacts and Policy Options." In: Pew Oceans Commission. 2003. *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. May 2003. Pew Oceans Commission, Arlington, Virginia.
[78] Id.
[79] Hubbs-SeaWorld Research Institute: Annual Report: 2003-2004. See: http://www.hswri.org/files/annualreport/annualreportpdfcopy586957.pdf (Viewed 7/9/07).

Despite ongoing research into vegetable protein substitution in feeds for cost reduction, the production of predatory fin fish still tends to require net inputs of wild-caught fish for food, either whole, or in formulated feeds comprising fish oil and fishmeal, in order to produce farmed product with the characteristics demanded by consumers (e.g. rich omega-3 fatty acid content).[80,81,82] For example, modern "compound" salmon feeds tend to consist of about 45% fishmeal and 25% fish oil.[83] A comprehensive synthesis of data on feed ratios in a 2000 study determined that an estimated average input of about 3.16 weight units (e.g. kg or tons) of wild caught fish was required for every 1 unit of salmon produced.[84] The ratio for strictly marine (non-diadromous) cultivated species (including flounder, halibut, sole, cod, hake, haddock, redfish, seabass, marine eels, tuna, bonito and billfish) was determined to be even more inefficient— about 5.16 units of wild-caught fish per produced unit of these predatory ocean fishes on average.[85]

Though offshore farming of predatory fin fish may help increase fish availability for human consumption for the short or middle term[86], over the longer term the projected trends for industry growth, and proportional growth in fishmeal and fish oil demands, appear to be problematic. For example, Naylor and Burke note that while the efficiency of wild fish inputs in the industry does show signs of increasing, (e.g. the quantity of wild fish required to produce 1 unit of farmed salmon fell by 25% between 1997 and 2001), the 60% global growth in the salmon industry over the same period "overshadowed" these efficiency gains due to the increase in "the aggregate number of farmed carnivorous fish produced."[87] In another study, Delgado et al. (2003), modeled future global fish markets, and found that:

> *Fish are highly likely to continue becoming more expensive to consumers compared with other food products over the next two decades… Prices for food fish, fishmeal, and fish oil are likely to rise under nearly all scenarios… This situation has raised concerns that demand for fishmeal and fish oil from the burgeoning aquaculture sector will raise prices for these commodities and place increasingly heavy pressure on wild fisheries to produce fish for feed.*[88]

---

[80] Goldburg, R. and R. Naylor. 2005. "Future seascapes, fishing and fish farming." *Frontiers in Ecology and the Environment*. 3(1): 21-28.

[81] Scottish Association for Marine Science and Napier University (SAMS). 2002. *Review and synthesis of the environmental impacts of aquaculture*. Scottish Executive Research Unit. Available at: www.scotland.gov.uk/cru/kd01/green/reia-00.asp (Viewed 9/8/06). The SAMS researchers state: "Fishmeal and fish oil are key constituents of pelleted diets for the intensive production of carnivorous species."

[82] Some reports claim that the feeding of vegetable protein and oil to predatory fish reduces growth, reduces fish amino acid content, compromises immune system function in young fish, making them more susceptible to disease, reduces the fish meat quality and the concentration of long chain omega-3 fatty acids, a valued human nutrient. Source: International Fishmeal and Fish Oil Organization. 2005. "A note on substitution of fish meal and fish oil." Available at: http://www.iffo.net/intranet/content/benefits/23(2).htm (Viewed 9/7/06).

[83] Naylor, et al. "Effect of aquaculture on world fish supplies." *Nature* 405: 1017-1024.

[84] Id.

[85] Id.

[86] Id.

[87] Naylor, R. and M. Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.

[88] Delgado, C. L.; N. Wada, M. W. Rosegrant, S. Meijer and M. Ahmed. 2003. *The Future of Fish: Issues and Trends to 2020*. World Fish Centre and International Food Policy Research Institute, Penang, Malaysia, and International Food Policy Research Institutue, Washington D.C. Available at: http://www.ifpri.org/pubs/ib/ib15.pdf (Viewed 9/8/06).

That is, until the average input/output ratio drops below 1, a net increase in global fishing effort will result per unit of fish consumed.

At present, the two known feeding methods of farmed predator fish, i.e. the provision of either whole dead fish, or formulated fishmeal- and fish oil-based feeds, depends on the species being raised in the facility. These two methods have similar but distinct implications for local and global marine resource conservation, and are examined separately below.

3.1.1 Feeding whole fish

The "ranching" of bluefin tuna, in which schools of the fish are live-caught and then fattened in captivity before being killed, frozen and sold, typifies the first of the two methods. Growth in this form of fin fish aquaculture is relevant to CINMS for several reasons. As mentioned above (page 13), tuna ranching was to be one component of the Grace Mariculture project; an unsurprising feature given the extremely high value of bluefin meat on the global market (reported by Dalton (2004) as $400-$700 per fish[89]), and the technological gains and revenue growth in offshore tuna ranching by aquaculturists worldwide.[90] Burke and Naylor (2005) summarize the global expansion:

> *Australia has ranched southern bluefin tuna since the early 1990s with great economic success; the value and volume of its industry grew by an astonishing 40% and 16% per annum, respectively, between 1992 and 2002. Atlantic and Pacific bluefin tuna ranching has emerged more recently in Mediterranean countries, such as Spain and Croatia, as well as in Mexico.*[91]

Dalton summarizes the activity as practiced offshore Mexico, just south of the US border:

> *To stock the Mexican* [tuna] *ranch, boats travel some 600 km down the coast to catch migrating bluefin tuna. The 35-kg fish are herded into a circular net, then slowly towed north to be anchored in deep water near Ensenada. The tow can take up to a month, during which time about 10% of the wild fish die or are lost from the nets. Once the nets are anchored in the Pacific, farmers bring in food to fatten the tuna by about 25% before selling them, typically to Japan.*[92]

Unfortunately, because the species is both a highly selective forager, known only to eat whole fish like sardines, anchovy and mackerel when in captivity, and is extraordinary among fishes by being endothermic,[93] successful fattening of captive bluefin is remarkably inefficient from a feed standpoint. By some estimates, feed conversion rates for ranched bluefin are as high as 20 kg of wild fish per unit of bluefin produced,[94] a ratio attributed to both the quantity of wasted feed and because of the high metabolic demands of these warm-blooded animals.

---

[89] Dalton, R. 2004. "Fishing for Trouble." *Nature* 431: 502-4.
[90] Montaigne, Fen. 2007. "Still Waters: The Global Fish Crisis." *National Geographic*, April 2007.
[91] Naylor, R. and M. Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.
[92] Dalton, R. 2004. "Fishing for Trouble." *Nature* 431: 502-4.
[93] Id.
[94] Naylor, R. and M. Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.

Should bluefin ranching be initiated in the Santa Barbara Channel, CINMS resources could be affected both by live capture of bluefin in the Southern California region, and through increased catch of regional coastal pelagic species (CPS) like sardine and anchovy. According to the California Department of Fish and Game, the "majority" of the coastal pelagic fish landed in California is already used for aquaculture, exported in blocks of frozen whole fish, which are then fed to predatory species farmed abroad, specifically bluefin tuna in Australia.[95,96]

Importantly, West Coast coastal pelagic stocks appear to sustain current levels of harvest,[97] and remain robust.[98] For example, according to NOAA Fisheries 2007 Pacific sardine stock assessment:

> *Based on the sardine biomass estimate from this assessment (1,319,072 mt* [metric tons]*) and current environmental conditions, the PFMC control rule suggests a 2007 HG* [harvest guideline] *of 152,564 mt for the U.S. fisheries. This HG recommendation is 28% higher than the HG adopted for calendar year 2006, and 51,197 mt higher than the largest recent harvest by the U.S. fisheries.*[99]

Similarly, the California Department of Fish and Game (CDFG) reports that managed coastal pelagic species in California, including Pacific sardine, "have been underutilized for the past five or six years," suggesting that increased demand from open ocean fish farming could be accommodated.[100]

However, adverse impacts to Sanctuary area resources could occur. The rising demand for sardine feeder fish by proliferating Mexican tuna ranches has reportedly begun to pressure the existing Mexican sardine fishery.[101] Perhaps more importantly, coastal pelagic species like Pacific sardine are highly variable, responding dramatically both to levels of fishing effort and changes in ocean climate, such as El Niño. According to the CDFG, coastal pelagic species are documented to undergo "highly dynamic" "boom or bust" population cycles in population numbers, even though the other environmental factors that influence the robustness of these ecologically important species remain poorly understood.[102] According to the CDFG, "fishery scientists are just beginning to understand the mechanisms that determine success or failure of coastal pelagic populations," which the agency identifies as a management liability given future economic trends:

---

[95] Vojkovich, M. February 2007. Personal communication: "The majority of the CPS caught in California is exported and used as feed for predatory fish in other parts of the world."
[96] Wolf, P., P. E. Smith, and D.R. Bergen. December 2001. "Pacific Sardine," in: *California's Living Marine Resources: A Status Report*. The California Resources Agency (CRA)/California Department of Fish and Game (CDFG). Edited by Leet, W.S., C. M. Dewees, R. Klingbeil, and E. J. Larson. Available at: http://www.dfg.ca.gov/mrd/status/status2001.html (Viewed 9/5/06).
[97] Hill, K. T., and R. Klingbeil, CDFG. December 2001. "Coastal Pelagic Species: Overview", in *California's Living Marine Resources: A Status Report*. Leet et al., eds. 2001.
[98] NOAA National NMFS. November 2006. *Assessment of the Pacific Sardine (*Sardinops sagax caerulea*) Population for U.S. Management in 2007*. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-396.
[99] Id.
[100] Vojkovich, M. February 2007. Personal communication via email.
[101] Dalton, R. 2004. "Fishing for Trouble." *Nature* 431: 502-4.
[102] Hill, K. T., and R. Klingbeil, CDFG. December 2001. "Coastal Pelagic Species: Overview", in *California's Living Marine Resources: A Status Report*. Leet et al., eds. 2001.

> *Hopefully, resource managers will continue to use the growing knowledge base of how these species respond to the environment, implementing harvest policies accounting for this uncertainty. Future utilization of the west coast CPS will depend not only on resource health and availability, but also upon basic economics and events in world export markets.*[103]

More specifically, the agency believes that, because "CPS stocks are highly variable, there are no guarantees that high abundances will persist or will be able to support increased demand."[104]

Should commercial fish farms that rely on whole feeder fish like Pacific sardine become established in the Santa Barbara Channel area, it seems plausible that facility operators would pursue cost savings in feed acquisition by sourcing feed fish locally or regionally, both because this approach seems to be practiced successfully in nearby Baja waters, and because catch and processing of feed fish for this type of aquaculture specifically already occurs in Southern California. However, because coastal pelagic species like sardine are a key food source for almost all wild marine predators, including fish, birds and mammals,[105] such increased demand could have adverse impacts on Sanctuary ecosystems. This may be worthy of heightened concern given the sensitivity of coastal pelagic fishes to climactic fluctuations, within the context of anthropogenic global climate change[106] and ocean acidification.[107] As a result, additional fishing pressure on California coastal pelagic fish populations for new open ocean fish farms could have meaningful implications for the natural resources of CINMS and the SBC area.

3.1.2 Fishmeal and fish oil based feeds

As of 2000, the global aquaculture industry appropriated approximately 35% of the world's produced fishmeal and 57% of its fish oil, the two key ingredients in many commercial compound fish feeds (the remaining portions were largely used for terrestrial livestock feed).[108]

To produce these two ingredients, fish scraps and whole, wild-caught fish are "reduced" or processed to remove the water and separate the oil and the remaining protein-rich matter.[109] According to one estimate, approximately 4.7 weight units (e.g. kg or tons) of wild fish are required to make one unit of dry fish meal, while 8.3 units of wild fish are required per unit of

---

[103] Id.
[104] Vojkovich, M. February 2007. Personal communication via email.
[105] Wolf, P., P. E. Smith, and D.R. Bergen.. December 2001. "Pacific Sardine", in *California's Living Marine Resources: A Status Report*. Leet et al., eds. 2001.
[106] Intergovernmental Panel on Climate Change (IPCC). 2001. *Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Integovernmental Panel on Climate Change*. Watson, R.T. and the Core Writing Team, eds. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp. Available at: http://www.ipcc.ch/pub/syreng.htm (Viewed 7/9/07). According to the report, "Carbon dioxide concentrations, globally averaged surface temperature,and sea level are projected to increase under all IPCC emissions scenarios during the 21st century." They go on to predict that projected rising anthropogenic greenhouse gas emissions "could set in motion largescale, high-impact, non-linear, and potentially abrupt changes in physical and biological systems over the coming decades to millennia, with a wide range of associated likelihoods."
[107] Kleypas, J.A, R.A. Feely, V.J. Fabry, C. Langdon, C.L. Sabine and L.L. Robbins. 2006. *Impacts of Ocean Acidification on Coral Reefs and Other Marine Calcifiers. A Guide for Future Research*, Report of a workshop sponsored by NSF, NOAA and the US Geological Survey. 88pp.
[108] SAMS. 2002. *Review and synthesis of the environmental impacts of aquaculture*.
[109] Wikipedia. "Fish meal." http://en.wikipedia.org/wiki/Fishmeal (Viewed 5/9/07).

fish oil.[110] Reduction fisheries largely comprise small coastal pelagic species such as sardines, anchovies, mackerel, capelin and sandeel.[111,112] Most of the global fishing effort for fishmeal and fish oil stock occurs offshore South America, for export around the world.[113].

While coastal pelagic species collectively represent one of California's largest and most lucrative fisheries,[114] and reduction of coastal pelagic fisheries is reported to occur in Mexico,[115] *no reduction fisheries currently occur in California*. According to CDFG, "Although they are not banned outright, the regulations in place are designed to discourage the utilization of the State's fisheries resources for reduction purposes;" essentially, new regulations would need to be promulgated before California fish could be landed for reduction[116]

Production in the Channel-region of most cultivated marine fish species (other than those like bluefin tuna, which require whole food fish) would represent an increase in the an already rapidly growing global demand for the fish reduction-based feed. Because of prohibitive California regulations, such feeds would probably be imported, or formulated from imported fishmeal and fish oil. Accordingly, it is not suggested that increased fishing effort in the Sanctuary area would result from initiation of aquaculture in the Channel that relies on fishmeal and fish oil based feeds.

However, because Sanctuary stakeholders are also stakeholders in the world ocean, awareness of the global dynamics and effects of increasing fishmeal and fish oil demand are warranted even if associated impacts are not foreseen to occur immediately around the Channel Islands.

As mentioned earlier, aquaculture production and thus demand for fish-based feed ingredients are growing rapidly. Naylor and Burke summarize the emerging predicament:

> *In 2002 the aquaculture industry used roughly 40% of the world's supply of fish meal,* [and] *is expected to consume well over 50% of global fish meal supplies by 2010. The fish oil market has a similar trend; aquaculture feed already consumes over half of the world's fish oil and by 2010 is expected to use 97% of total supply. Unlike livestock systems, which can readily substitute vegetable proteins when fish meal prices rise, carnivorous aquaculture species require a certain amount of fish meal and fish oil for energy, health, and palatability. If the farming of carnivorous fish continues to grow at*

---

[110] Tyedmers, P.H. 2000. *Salmon and Sustainability: The Biophysical Cost of Producing Salmon Through the Commercial Salmon Fishery and the Intensive Salmon Culture Industry*. Ph.D. dissertation. University of British Columbia, Department of Resource Management and Environmental Studies. Page 77.

[111] Goldburg, et al. 2003 "Marine Aquaculture in the United States: Environmental Impacts and Policy Options." In: *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. Pew Oceans Commission.

[112] Esmark, M., and S. Cripps. July 2003. World Wildlife Fund Position Paper: Intensive Marine Fish Aquaculture. Available at: http://assets.panda.org/downloads/wwfaquaculturepolicyfinaljuly2003.doc (viewed 9/5/06).

[113] Id.

[114] Hill, K. T., and R. Klingbeil, CDFG. December 2001. "Coastal Pelagic Species: Overview", in *California's Living Marine Resources: A Status Report*. Leet et al., eds. 2001. According to Hill and Klingbeil, "Coastal pelagic species (CPS) collectively comprise one of the largest marine fisheries in California with respect to biomass, landed volume, and revenue."

[115] NOAA National NMFS. November 2006. *Assessment of the Pacific Sardine (*Sardinops sagax caerulea*) Population for U.S. Management in 2007*. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-396.

[116] Vojkovich, M. February 2007. Personal communication via email.

> *its current rate, the demand for fish oil is expected to outstrip supply within a decade, with a similar result for fish meal by 2050. Such an outcome could jeopardize the industry's economic sustainability.*[117]

It's important to emphasize that Naylor and Burke refer to the supply of reduction-based products on the market, and the implications for *economic* sustainability, rather than the "supply" of fish in the ocean and the question of ecological sustainability. In other words, by "outstripping supply," the authors are pointing out that global aquaculture demand could appropriate 100% of reduction fish product commodities on the global market, despite the potential for other industries to also demand fish oil and fish meal. Nonetheless, such steeply-rising demand would inevitably put upward pressure on commodity prices, an economic scenario that would appear to encourage increased fishing effort in global reduction fisheries.

Essentially, expansion of fin fish aquaculture portends a growing and focusing of global fishing effort on coastal pelagic species. Unfortunately, the *ecological* sustainability of this harvest is also questionable should fishmeal and -oil demand grow as projected. For example, according to Naylor at al. (2000), the overfishing of capelin, sandeel and Norway pout stocks in the North Sea— all catches largely used for reduction— "has been implicated in the declines of certain stocks of other wild fish such as cod, and changes in the distribution, population sizes and reproductive success of seals and seabirds."[118]

Like the geographically dispersed feed supply chains for other intensive animal production (e.g. the international markets for soybeans and grain used in production of feedlot beef cattle[119]), fishing effort, fish reduction, and compound feed production would probably occur far from future Santa Barbara Channel fish farms themselves.[120] While this "outsourcing" of the natural resource management challenges associated with the aquaculture supply chain would distribute impacts away from the Sanctuary area in which Channel fish farms would occur, CINMS stakeholders would rightfully remain concerned about the degradation of marine ecosystems beyond the Advisory Council's immediate purview. For example, marine ecosystems offshore coastal nations with poor fishing management could be heavily impacted.

Whether relying on locally caught, whole sardines for ranched bluefin, or advanced, fishmeal based compound feeds for farmed striped bass and halibut, the wild fish inputs required for marine fin fish production sustain and appear to boost fishing pressure on wild fish rather than reduce it. Ironically, the global trade in fishmeal and fish oil, the two ingredients that remain essential to most marine fin fish aquaculture, also appears to undermine NOAA's goal of raising predatory fin fish in US waters to reduce the US trade deficit in seafood. If fish farmers offshore California come to rely on feeds made from *imported* fishmeal and fish oil, the metabolic inefficiency of their stocks may result in even greater levels of fish biomass importation than already occurs from the importation of foreign-caught seafood for human consumption.

---

[117] Naylor, R. and M. Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.

[118] Naylor, et al. "Effect of aquaculture on world fish supplies." *Nature* 405: 1017-1024.

[119] Researchers have documented a global trend of a geographic uncoupling of terrestrial livestock production and feed production, stating "Feed is sourced on a least cost basis from international markets, and the composition of feed is moving up the chain from agricultural by-products to grain, oil-meal, and fish-meal products that have higher nutritional and commercial value." Naylor, R., H. Steinfeld, W. Falcon, J. Galloway, V. Smith, E. Bradford, J. Alder, H. Mooney. 2005. "Losing the Links Between Livestock and Land." *Science* 310: 16-17. 9 December 2005.

[120] Naylor and Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources*.

RECOMMENDATION 1: If or when a predatory fin fish aquaculture facility is proposed for the Channel region, CINMS staff and stakeholders should support the ensuring of ecologically, economically and socially sustainable use of wild fish inputs for fish farm operations, whether as whole fish, or feed comprising fishmeal and fish oil ingredients. If fish-based feeds are to be used, CINMS resource managers and stakeholders must ensure that the origin of fish feed that the operator intends to use is publicly disclosed and that if local coastal pelagic fisheries are be exploited, the ecological and economic impacts of doing so are exhaustively assessed and disclosed in advance.

Because coastal pelagic stocks are of primary importance to such a broad range of CINMS species, and exhibit sensitivity to climatological variation, any additional local harvest for fin fish production must also include rigorous monitoring to prevent pelagic species stock decline or collapse. In the meantime, CINMS staff should both encourage their resource management partners at the PFMC to establish meaningful catch limits for the "monitored" members of the coastal pelagics management unit, and also facilitate the scientific research needed to ensure that these ecologically crucial stocks are well protected from collapse.

3.2 Biological pollution: escape, pathogens and parasites

Another concern raised by the prospect of OOA in the CINMS region is that of "biological pollution," or the introduction or dispersion of organisms or genetic material into the SBC environment that negatively impacts indigenous species. Researchers have documented three major sources of biological pollution from existing farms raising predatory species in the ocean: 1) escape of cultured fish, 2) incubation and dispersion of harmful parasites, and 3) incubation and dispersion of pathogens. Individually and collectively, these three pollution sources can have significant impacts on local fisheries and ecosystems.

3.2.1 Escapees

Almost all farmed aquatic species in the U.S. are either non-native or farmed outside their native range.[121] While certain indicators suggest a growing effort to rear native species, this existing pattern, and its consequences to native species and fisheries, could easily be replicated in future OOA operations.

The history of Atlantic salmon farming in both the Atlantic and the Pacific— an activity that grew by 468% between 1989 and 1998— provides important clues to the state of aquaculture confinement technology, the potential for escape of farmed species, and the potential ecological consequences. As set forth in the excerpt comprising figure 3.2.1 (below), the Pew Oceans Commission Report of 2003 provides a concise overview of the likelihood of escape of farmed fish, and some of the issues associated with what seems to be an inevitability of the industry.

For stakeholders and resource managers of CINMS, escape of farmed species could represent an acute threat to the unique assemblage of natural resources of the Sanctuary. The resident and transient fish communities of the Channel Islands area are both world class in their collective

[121] US Geologic Survey (USGS). 2000 "Non-indigenous Aquatic Species Database." http://nas.er.usgs.gov. Cited in Goldburg, et al. 2003 "Marine Aquaculture in the United States: Environmental Impacts and Policy Options." *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. May 2003. Pew Oceans Commission, May 2003.

biodiversity[122] and, in many cases, significantly depleted relative to historical abundance.[123] To protect these stocks and the ecosystems of which they are part, several marine zones for fisheries conservation and restoration have been established in the Sanctuary and surrounding region at significant expense in time, resources and human effort.[124] Existing data suggests that escape from OOA facilities in the SBC would be nearly inevitable, and that the introduction of non-native or genetically modified (through manual selection or genetic engineering) fin fish species could result in significant additional pressure on wild stocks— whether through genetic dilution and reduction of fitness in wild stocks or competition for resources. Both scenarios should be simply unacceptable to CINMS stakeholders and managers given the array of existing protections that have been arduously implemented for the Channel Islands fishes and marine ecosystems. Accordingly, future proposals for the rearing of non-indigenous or genetically modified stocks that could jeopardize these conservation endeavors should be rejected, and aquaculture project proponents should be required to demonstrate conclusively that their efforts will not cause such jeopardy before a siting or operations permit is issued.

While Atlantic salmon farming continues— and grows— around the world, some progressive aquaculture proponents are now pursuing culture of indigenous species to eliminate the impacts described above. For example, Johnson Sea Farms in Scotland, though traditionally an Atlantic salmon farming company, has now diversified operations to include the grow-out and commercial sale of cod juveniles captured in the waters around the Shetland Islands, where the company is based.[125] This endeavor apparently precludes the threats posed to wild stocks by the potential escape of non-indigenous or genetically modified species. Similarly, Hubbs-Sea World Research Institute continues to study whether native California species such as California halibut and yellowtail can be hatched and reared at commercial scale[126]; indeed, such research represented a significant component of the HSWRI proposal for aquaculture at Platform Grace.[127] In fact, the species planned for cultivation in the Grace Mariculture proposal were all species indigenous to the SBC area (with the exception of striped bass, which was introduced in California waters from New Jersey in 1879 and 1882[128]).

---

[122] NOAA National Centers for Coastal Ocean Science (NCCOS) 2005. A Biogeographic Assessment of the Channel Islands National Marine Sanctuary: A Review of Boundary Expansion Concepts for NOAA's National Marine Sanctuary Program. Prepared by NCCOS's Biogeography Team in cooperation with the National Marine Sanctuary Program. Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 21. 215 pp.

[123] CINMS. August 2006. *Draft Environmental Impact Statement for the Consideration of Marine Reserves and Marine Conservation Areas*. Available at: http://www.cinms.nos.noaa.gov/marineres/PDF/DEIS.pdf (Viewed 9/14/06). E.g., "CDFG data show decreases in landings for several categories of commercial and recreational fisheries (Leet et al. 2001; CDFG 2002)" in the Southern California Bight (page 5); Appendix G lists an array of fish species in the Sanctuary area that are described as "requiring some restoration / exhibiting long term of rapid decline" (page 203).

[124] Id.

[125] Johnson Sea Farms. "Johnson Organic Cod." http://www.johnsonseafarms.com/johnson-cod.htm (Viewed 9/11/06).

[126] Lebowitz, Paul. "Hubbs-Sea World Research Institute Scientists Find Cowcod Matchmaking a Tough Game." Magazine article published in *Western Outdoor News*, April 14, 2006. Available at: http://www.outdoorscribe.com/WONHubbs.htm (Viewed 1/3/07).

[127] Marine Research Specialists (MRS). 2003. *Hubbs-Sea World Research Institute Platform Grace Mariculture Project, Final Report*. Report to Hubbs-Sea World Research Institute, San Diego, CA. According to the report, one of the primary project goals was to "pragmatically evaluate the culture feasibility of several commercially important fish… species in California."

[128] Stevens, D.E., and D.W. Kohlhorst, CDFG. "Striped Bass." In: *California's Living Marine Resources: A Status Report*. Leet et al., eds. 2001.

Similar to Johnson Sea Farms, HSWRI intended to live capture 50-100 metric tons of native wild bluefin tuna (1400-2800 fish of 35kg weight average), and an unspecified number of "small juvenile" wild California yellowtail, for confined grow out of both species during the "pilot" phase of Grace Mariculture operations.[129]

While these interesting efforts to mitigate the risk of current fish farming practices represent potentially important efforts to eliminate the dangers posed by stock escape, they do not necessarily preclude fish farms from causing other environmental effects. For example, the implications for wild stocks from which Johnson Sea Farms captures its live cod juveniles, specifically the impact to recruitment, is poorly addressed. Similarly, other potential implications for local environments and wild fisheries must also be better understood and disclosed, for example bycatch of non-target species during larvae capture, mortality of wild fish during capture, and, longer term, ecosystem impacts from fish farm discharges, and the harvest of wild fish used for food in concentrated predator fish production.

Should regional OOA proliferate to include more, and/or larger facilities conducting ongoing capture of wild, indigenous juvenile fish, or even hatchery-based production of currently unfarmed marine species, the cumulative impacts to wild stocks and the Sanctuary-area's food web and environment could still be serious.

[129] MRS. 2003. *Hubbs-Sea World Research Institute Platform Grace Mariculture Project, Final Report*. Page 12.

Figure 3.2.1: Excerpt from Pew Oceans Commission Summary on Fish Farm Escape[130] [see Appendix B for list of works cited in this excerpt].

[E]scapes occur through normal operational "leakage," where only a few fish are lost; large-scale escapes can occur when storms, marine mammals, vandalism, or human error damage the netpens. Between 1987 and 1996, scientists documented at least a quarter million Atlantic salmon escapes on the West Coast (McKinnell and Thomson 1997), with another 350,000 escapes in 1997 alone (Fuller 2000).

Although farmed escapees have lower survival rates than wild salmon (McKinnell and Thomson 1997), they still compete with wild Pacific salmon stocks for food, habitat, and spawning grounds. As a result of continuing introductions, the number of Atlantic salmon seen returning to rivers and streams on the West Coast is increasing, and Atlantic salmon are now successfully reproducing in British Columbia rivers (Volpe et al. 2000).

Native Species

Escapes of native species of farmed fish can also harm wild stocks, particularly when substantial genetic differences exist between the farmed and wild populations. Genetic differences often occur when farmed fish are specifically bred for aquaculture or are moved from one area to another.

Farmed fish that have been selectively bred for particular traits can be markedly different from wild fish. Highly selected strains often have smaller fins, larger bodies, and more aggressive feeding behavior (Fleming and Einum 1997). Compounding these differences due to selective breeding, the genetic makeup of some fish, such as wild Atlantic salmon, varies significantly between regions due to evolved local adaptations (Hindar 2001; Johnson 2000). When farmed salmon escape, they can interbreed with wild salmon frequently enough to change the genetic makeup of some wild stocks (Hindar 2001; McGinnity et al. 1997). This interbreeding can decrease the fitness of wild populations through the loss of adaptations and the breakup of beneficial gene combinations (HSRG 2000), and wild stocks may be unable to readapt if escapes continue (Hindar 2001).

In Maine, escaped farmed Atlantic salmon may threaten the survival of endangered wild stocks by flooding the wild salmon gene pool (FWS/NOAA, 2000). Maine salmon populations are particularly susceptible to genetic perturbations because of their very low abundance levels. For example, a December 2000 storm resulted in the escape of 100,000 salmon from a single farm in Maine, more than 1,000 times the number of documented wild adult salmon (Daley, 2001). Similarly, in the Magaguadavic River in neighboring New Brunswick, 82 percent of the young salmon (smolts) leaving the river in 1998 were of farmed origin (FWS/NOAA, 2000). Aquaculturists' use of European milt (sperm) exacerbates the risk of genetic consequences. The genetic makeup of farmed Atlantic salmon in Maine is now about 30 to 50 percent European (NMFS/FWS 2000).

Transgenics

Transgenic organisms have genes from other species inserted into their DNA via genetic engineering techniques, usually to introduce or to amplify an economically valuable trait such as faster growth. Farming of transgenic fish will likely heighten concerns about escapes of farmed fish. Scientists have genetically engineered at least 35 species of fish worldwide (Reichhardt 2000), although no transgenic fish products are yet commercially available (FAO, 2000b).

In the United States, the company Aqua Bounty Farms™ has applied to the FDA for permission to market genetically engineered Atlantic salmon (Reichhardt 2000; Zitner 2001). These fish have an added growth-hormone gene from chinook salmon that may cause them to grow significantly faster than nontransgenic fish (CEQ 2000).

[130] Goldburg, et al. 2003 "Marine Aquaculture in the United States: Environmental Impacts and Policy Options." In: *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. Pew Oceans Commission.

RECOMMENDATION 2: Given the apparent inevitability of farmed stock escape, proposed farming of non-indigenous or genetically modified (GM) aquatic plant and animal species (including specimens of non-local genetic stock) in the Santa Barbara Channel region should be rejected by CINMS resource managers and stakeholders, in line with the Sanctuary's proposed prohibition on the introduction of species. While certain theoretical genetic modifications could be considered precautionary (such as engineered infertility or disease resistance), tremendous uncertainty surrounds such technology and the potential impacts from genetically modified escapees interbreeding with Sanctuary-area wild stocks. Until more certainty exists, disallowing non-native GM stocks remains the most precautionary and appropriate approach to protect Sanctuary resources and existing uses.

3.2.2 Pathogens and parasites

Transmission of harmful diseases and infectious parasites from marine aquaculture facilities to wild stocks has begun to be documented in the marine aquaculture assessments,[131] and represents another potential threat to CINMS and the surrounding marine environment should OOA be established in the SBC region. According to Naylor (2006), large-scale intensive aquaculture

> *...provides opportunities for the emergence of an expanding array of diseases. It removes fish from their natural environment, exposes them to pathogens that they may not naturally encounter, imposes stresses that compromise their ability to resist infection, and provides ideal conditions for the rapid transmission of infectious agents.*[132]

Such transmissions are documented to impact both invertebrate and fish stocks. Naylor et al. (2000) report two important examples:

> *In Europe… serious epidemics of furunculosis and* Gyrodactylus salaris *in stocks of Atlantic salmon have been linked to movements of fish for aquaculture and re-stocking. Since the early 1990s, Whitespot and Yellowhead viruses have caused catastrophic, multimillion-dollar crop losses in shrimp farms across Asia. Both pathogens have recently appeared in farmed and wild shrimp populations in the United States, and the Whitespot virus has been reported in several countries in Central and South America. The Whitespot virus has caused high mortalities in Texas shrimp farms and may cause mortality of wild crustaceans.*

Meanwhile, salmonid pathogens and parasites originating from imported Atlantic salmon have emerged in recent years as severely problematic for both cultivated animals and wild stocks. For example, in January of 2001, the viral and lethal salmonid disease infectious salmon anemia (ISA) was detected for the first time in the US at a Maine salmon farm, after original detection in Norway in 1984 and progressive spread among farmed salmon stocks in New Brunswick, Nova

---

[131] See for example: Naylor, R. 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology.* Spring 2006 53-58; Goldburg, et al. 2003 "Marine Aquaculture in the United States: Environmental Impacts and Policy Options." *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. Pew Oceans Commission, May 2003; U.S. Commission on Ocean Policy. 2004. *An Ocean Blueprint for the 21st Century. Final Report*. Washington, DC.

[132] Naylor, R. 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology.* Spring 2006 53-58.

Scotia, Scotland, Chile and the Faroe Islands.[133] Since 2001, ISA was detected at two more Maine aquaculture facilities, and is now detected in both escaped farm stock and in wild fish in New England.[134] According to the USDA, the disease is spread through fish by contact with contaminated fish handlers and aquaculture equipment, and by the transfer of parasitic sea lice from infected to uninfected fish; mortality ranges from 2-50%.[135] Though the disease is only documented to affect Atlantic salmon, other wild fish are susceptible to infection from the virus, including sea run brown trout (*Salmo trutta)*, rainbow trout (*Onchorhyncus mykiss)*, and herring (*Clupea spp.)*; in addition, the virus is known to mutate, evolve and change rapidly through genetic recombination[136].

Infectious hematopoietic necrosis (IHN), another serious salmonid disease, is documented to be transferred in both directions among farmed and wild salmonids in the Pacific Northwest.[137]

In addition to disease, fish-borne parasites also appear to be fostered and spread by fish farms, with dramatic implications for wild stocks. Krkošek et al. (2005) investigated the documented correlation between Atlantic salmon farms and parasitic sea lice infestations and concurrent populations declines among wild salmonids in British Columbia. Sea lice that specialize on parasitizing salmonids attach themselves to the bodies of the fish and "feed on the mucus, scales and blood of the host fish, leading to osmotic stress and emaciation of sufficiently infected hosts."[138] By studying sea lice infections of juvenile pink salmon and chum salmon before, during and after they passed a high-output (approximately one million fish) salmon farm on their way to the ocean after hatching, Krkošek and his team were able to establish to what degree the salmon farm was causing sea lice infection among wild fish.[139] Their findings offer a troubling example of how fin fish aquaculture facilities can essentially represent parasite incubators of sufficient magnitude to limit entire salmonid populations.

> *Our calculations suggest the infection pressure imposed by the farm was four orders of magnitude greater than ambient levels, resulting in a maximum infection pressure near the farm that was 73 times greater than ambient levels and exceeded ambient levels for 30 km along the two wild salmon migration corridors. The farm-produced cohort of lice parasitizing the wild juvenile hosts reached reproductive maturity and produced a second generation of lice that re-infected the juvenile salmon. This raises the infection pressure from the farm by an additional order of magnitude, with a composite infection pressure that exceeds ambient levels for 75 km of the two migration routes. Amplified sea lice infestations due to salmon farms are a potential limiting factor to wild salmonid conservation.*[140]

---

[133] United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Veterinarian Services. 2002. "Infectious Salmon Anemia: Technical Note." Riverdale, MD. Available at: http://www.aphis.usda.gov/lpa/pubs/tnisa.html (Viewed 10/9/06).

[134] Goldburg, et al. 2003 "Marine Aquaculture in the United States: Environmental Impacts and Policy Options." *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. Pew Oceans Commission, May 2003.

[135] USDA. 2002. "Infectious Salmon Anemia: Technical Note." Riverdale, MD.

[136] Id.

[137] Naylor and Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.

[138] Krkošek, M., M.A. Lewis and J.P. Volpe. 2005. "Transmission dynamics of parasitic sea lice from farm to wild salmon." *Proceedings of the Royal Society B: Biological Sciences* 272: 689–696.

[139] Id.

[140] Id.

After their findings were published, Krkošek and his research team publicly advocated for regulations that disallowed large open-net aquaculture in wild-salmon habitats.[141] According to a news report on their statement, the researchers cautioned that "There is a clear potential for severe and irreversible damages to be inflicted upon wild salmon populations and their dependent cultures, ecosystems, and economies."[142]

No other predatory marine fin fish species are yet farmed in the magnitude or density of Atlantic salmon, nor are there commercial scale OOA facilities from which pathogen or parasite proliferation can be quantified, so uncertainty may remain as to whether cultivation of non-diadromous species in the SBC could cause the same level of impact to wild stocks as the salmon farms in Europe, New England and the Pacific Northwest. However, as noted above, aquaculture experts have already made general conclusions about how the intensive confinement of fish in farm settings leads to pathogen and parasite outbreaks.[143]

RECOMMENDATION 3: Some experts recommend that aquaculture facilities stock "pathogen-free" fish[144]; however data demonstrates that fish farms can easily pick up naturally occurring pathogens and then incubate, amplify and spread them. Cultivation of indigenous stocks, use of enclosures and maintenance of fish densities that minimize animal stress, and siting of fish farms well-removed from important wild stock spawning or recruitment areas are principles suggested by the literature as important for controlling disease and parasites in fish farms. CINMS staff and stakeholders should apply these standards when considering an emergent OOA proposal, toward reducing its potential to act as a parasite or pathogen source that could impact the Sanctuary's wild fishes. In addition, development of comprehensive operations standards to keep cultivated fish in the EEZ healthy and relatively free of pathogens and parasites without the use of chemicals and antibiotics should be supported, to protect both the farmed fish and Sanctuary resources.

[141] Monastersky, Richard. April 22, 2005. "The Hidden Cost of Farming Fish: Will environmental problems deep six efforts to raise salmon and other fish?" *The Chronicle of Higher Education*. Available at: http://chronicle.com/free/v51/i33/33a01801.htm (Viewed 7/9/07).
[142] Id.
[143] Naylor and Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.
[144] See, for example: Cicin-Sain et al. 2001. *Development of a Policy Framework for Offshore Marine Aquaculture in the 3-200 Mile U.S. Ocean Zone*; Pew Oceans Commission. 2003. *America's Living Oceans: Charting a Course for Sea Change*; Naylor, R. and M. Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea."

3.3 Discharges

As mentioned in the opening sections, the deep waters and steady currents of open-ocean (EEZ) settings are attractive to aquaculture proponents such as the Bush administration in part because of the increased dilution power of this environment for the diverse and potentially toxic discharges and concentrated waste streams originating at commercial fish farms. Data demonstrate that these pollutants can cause harsh local environmental impacts; unfortunately, while open ocean settings may reduce the acuity of a given fish farm's pollution stream, other factors suggest that OOA discharges could cause similar problems in their environmental setting to those of fish farms situated in coastal settings.

Figure 3.3 Benthic community members at Santa Cruz Island: bat star and giant spined sea star. (*©2006 Jaimi Kercher*)

Fish feces and uneaten food constitute the majority of existing intensive fish farm discharges, resulting in varying levels of nutrient enrichment in the surrounding waters; according to NOAA, "Some… enrichment of benthic sediments should be expected in nearly all forms of intensive aquatic animal production, but the response by the benthic invertebrates differs widely."[145] For example, at low levels, artificial nutrient enrichment can encourage productivity among the existing (indigenous) ecological community.[146,147] However, an excess of these biological wastes can lead to eutrophication, low-oxygen or anoxic (oxygen-free) sediment layers below and down-

[145] Nash, C.E., P.R. Burbridge, and J.K. Volkman (editors). 2005. *Guidelines for ecological risk assessment of marine fish aquaculture*. U.S. Dept. of Commerce, NOAA Technical Memo. NMFS-NWFSC-71, 90 p.
[146] Id.
[147] Pacific Fishery Management Council (PFMC). December 1998. "Coastal Pelagics Species Management Plan [Amendment 8 to the Northern Anchovy Fishery Management Plan]." Available at: http://swr.nmfs.noaa.gov/hcd/cpsefh.PDF (Viewed 9/12/06).

current from the facilities, and even complete burial of benthic organisms under the fish farm waste.[148] In turn, the waste "can cause dramatic changes to the sediments biologically by attracting different species and eliminating others," according to NOAA scientists; they continue: "when enrichment becomes too great, sensitive species may be excluded and opportunistic species proliferate, thus changing benthic communities."[149] Because these communities form "the base of aquatic food webs," impacts they experience due to fish farm feces and feed ripple up through local populations of "benthic fish and pelagic fish, together with diving birds and other piscivores."[150] And unfortunately, while nutrient loading in general does not necessitate serious impacts, current data suggests that commercial fish farms generally tend to discharge fecal matter and uneaten food at such a rate that ecologically-significant levels of nutrient enrichment occur quite quickly. Naylor and Burke report that "large changes in sediment chemistry and in the benthic community can occur even with relatively low salmon stocking and feeding rates in the early stages of production."[151] While in other cases, "where there is little flushing by tides and currents, net-pen wastes can create a dead zone on the ocean floor that can extend from 100 to 500 feet in diameter."[152]

In addition to biological wastes and nutrient loading, researchers have documented a remarkable array of additional environmental pollutants from fish farms, including: antibiotic pharmaceuticals, vitamins, pigments for coloration of fish flesh, chemicals for facility maintenance such as antifouling compounds for paint[153], and even potentially toxic heavy metals and other bioaccumulative compounds in the feeds and feces of the stock fish.[154] According to Naylor and Burke (2005), at some fish farm sites, "nitrogen wastes (e.g., ammonia and nitrite) exceed the assimilative capacity of the local marine ecosystem and lead to degenerated water quality that can be toxic to fish and shellfish."[155]

With respect to this discussion on the potential impacts of open ocean aquaculture, two main questions on this data arise: 1) Would potential cultivation species for OOA in the Channel region result in rates of waste discharge comparable to the salmon farms for which most of the discharge impacts data exists? and 2) To what extent will the open ocean setting mitigate the ecological impacts of fish farm discharges?

At present, comparatively little data exists on discharge rates for non-salmonid cultivars. However, the data that has been gathered does not bode well for areas such as the SBC that may host the farming of non-diadromous predatory marine species. For example, in a comprehensive aquaculture siting study conducted by Scotland's Fisheries Research Services, the Scottish researchers determined that, compared with farmed Atlantic salmon, halibut (one of the species

[148] Nash et al. 2005. *Guidelines for ecological risk assessment of marine fish aquaculture*. NOAA Technical Memo.
[149] Id.
[150] Id.
[151] Naylor and Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.
[152] Id.
[153] Iwama, G.K. 1991. "Interactions between Aquaculture and the Environment." *Critical Reviews in Environmental Control* 21 (No. 2): 177-216.
[154] Nash et al. 2005. *Guidelines for ecological risk assessment of marine fish aquaculture*. NOAA Technical Memo.
[155] Naylor and Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.

proposed for Grace Mariculture) discharge 1.4 times the nutrient nitrogen waste.[156] They also found that cod and haddock discharge about 1.5 times the nutrient nitrogen as Atlantic salmon, while turbot, a north Atlantic predatory flatfish farmed in Europe and Chile[157], discharges the same chemical at 1.8 times that of salmon.[158]

Given the aforementioned extreme inefficiency of feed conversion of farmed tuna (up to 20:1, compared to approximately 3:1 for salmon), suggesting both high rates of feeding (i.e. feed waste) and fecal discharge, it does not seem unreasonable to predict that cultivating these top predators in the SBC could result in high rates of organic pollution and nutrient loading.

Fortunately, aquaculturists have a stake in maintaining minimum water quality standards around their facilities, because, as Naylor et al. (2000) state: "poor water quality and high stocking densities often promote outbreaks of pathogens and subsequent declines in farm productivity."[159] On the other hand, as discussed above, pathogen and parasite outbreaks in fish farms have become a significant problem for both farmed and wild stocks, suggesting that many fish farmers have failed to implement practices that maintain healthful water quality. Should this reflect simply a crude level of aquacultural understanding or poorly refined husbandry practices, operations at future OOA facilities may include techniques that better reflect the operator's stake in reducing pollution. Then again, should such industrial "symptoms" simply reflect an insensitivity among certain members of the aquaculture sector, or ongoing practical difficulties in avoiding the release of pollutants, such environmental problems from fish farms may very well plague the SBC marine ecosystem in the continued absence of a comprehensive regulatory framework to eliminate such harm to public trust resources.

With respect to the second question, in comparison to the shallower, nearshore locations where most fish farms occur today, the open ocean provides what OOA proponents apparently consider to be a much greater capacity to absorb and dilute pollutants and thus neutralize any ill-effects that these pollutants may cause. At presently-operating, small-scale OOA or OOA-type facilities, this seems to be the case: the marine environment surrounding the University of New Hampshire's experimental open ocean fish farm appears to have accumulated very low levels of pollutants from the aquaculture activities.

Unfortunately, these-subsidized, experimental facilities probably do not represent the scale of future commercial fin fish facilities, which will likely seek to achieve economies of scale in their capital investments just like current nearshore operations. For example, existing commercial salmon facilities tend to stock ten times the fish of current experimental offshore enterprises.[160] Not only are total quantities of discharge proportionally greater at this scale, but the local concentration of polluting discharges are also much higher.

Based on its recent 10-Year Plan for the NOAA Aquaculture Program, NOAA and other aquaculture proponents appear to presume that the marine environment of the US EEZ could

---

[156] Gillibrand P, Gubbins M, Greathead C, Davies I. 2002. *Scottish executive locational guidelines for fish farming: predicted levels of nutrient enhancement and benthic impact*. Scottish Fisheries Research Report No. 63. Fisheries Research Services, Marine Laboratory, Aberdeen Scotland. Available at: http://www.govdocs.aquake.org/cgi/reprint/2004/524/5240210.pdf (Viewed 9/12/06).
[157] "Turbot." Wikipedia. http://en.wikipedia.org/wiki/Turbot (Viewed 9/12/06).
[158] Gillibrand et al. 2002. *Scottish executive locational guidelines for fish farming: predicted levels of nutrient enhancement and benthic impact*.
[159] Naylor, et al. 2000. "Effect of aquaculture on world fish supplies."
[160] Naylor, R. 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology*.

sustain a nearly 600-fold increase by weight in marine fin fish production between now and 2025[161], including the corresponding quantity of untreated discharge of feces, waste, and chemicals. NOAA policies are discussed in greater detail in the following section. However, offshore aquaculture proponents within NOAA and elsewhere appear to be targeting this dramatic increase despite a distinct lack of data on how waste from targeted levels of production would affect the environment in open ocean sites or an understanding of how it will be controlled, choosing to defer development of specific standards or technologies until later on.[162] Unfortunately, this approach seems slightly reminiscent of historical marine resource management failures, in which the productive or assimilative capacity of the ocean was wrongly assumed to be unlimited.

Naylor (2006) succinctly summarizes the actual challenge at hand:

> *The claim that open-ocean aquaculture provides a "dilution solution" to effluent discharge may be disputed as the scale of aquaculture operations expands to meet economic profitability criteria… The ability of offshore aquaculture to reduce nutrient pollution and benthic effects will depend on flushing rates and patterns, the depth of cage submersion, the scale and intensity of the farming operations, and the feed efficiency for species under cultivation.*[163]

With particular relevance to the California scenario, Naylor concludes:

> *It is not a stretch to imagine a pattern similar to that of the U.S. industrial* [terrestrial] *livestock sector, with large animal operations concentrated near processing facilities and transportation infrastructure, and in states with more lenient environmental standards.*[164]

In the case of OOA, emerging federal policy and legislation threatens to establish the offshore federal waters of the EEZ as the marine analogy to the "lenient state," with less rigorous, more lax environmental standards relative to California state law on aquaculture, and which allow fish farm operators to externalize more of their costs to the public trust commons (see Section 4, below, for a review of the respective legal frameworks).

The analogy is relevant to the SBC region, and illuminating with respect to future trends. In their analysis, Goldburg and Naylor further elaborate the terrestrial feedlot analogy, stating:

> *Most marine aquaculture is modeled after terrestrial feedlots or "industrial" farms used to raise most hogs and poultry in the US and elsewhere. Large numbers of animals are confined in a small area, and their feed imported, often from distant sources. Industrial animal facilities typically cluster geographically to benefit from economies of scale and favorable politics… One consequence is water pollution, since a substantial fraction of nutrients in animal feeds ends up in animal wastes, which often cannot all be assimilated*

---

[161] Interim Final 10-Year Plan for the NOAA Aquaculture Program, November 2006. NOAA Aquaculture Program Office, Silver Spring, MD. On pages 4 and 5 of the Plan, it states that NOAA staff believe it would be possible to increase domestic, non-anadromous, marine fin fish production from the current <1000 metric tons per year to 590,000 metric tons per year by 2025. Later (page 8), the Plan states that environmental impact analysis for OOA growth has yet to occur, but is part of the plan's goal to develop a regulatory program.

[162] Id.

[163] Naylor, R. 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology*.

[164] Id.

by local croplands… Water pollution from animal wastes is a major environmental issue in coastal North Carolina and other areas where animal production has concentrated.[165]

The scenario of "clustering" or "concentration" of OOA facilities in the Channel region gains further plausibility given the intuitive interest of the owners of all 17 of the Channel's oil platforms (all "excellent" settings for OOA, according to HSWRI president Donald Kent) to establish an alternative use for their facilities that either defers or eliminates liability for platform removal. Economies of scale in future platform-based OOA could likely be realized in both the maximization of productivity at each individual platform, and by consolidated ownership and operation of multiple platform-based fish farming facilities.

While the prospect of one "pilot" OOA facility at one platform such as Grace does not immediately seem to warrant concern from the standpoint of water quality or benthic ecosystems, the confluence of federal macroeconomic goals and policies, the ever-growing costs for OCS platform removal that oil corporations are loathe to bear, and the ever growing human demand for fin fish collectively suggest that aquaculture proponents have a much grander vision for the future of their industry.

The growing collection of information on the environmental impacts of fish farming available now presents CINMS resource managers and stakeholders with an opportunity to consider, and perhaps proactively act, years in advance of the targeted five-fold increase in aquaculture production. The arguably fortuitous emergence and withdrawal of the Grace Mariculture project proposal gives these parties the advantage of time to consider not just the merits or threats of one suddenly emergent proposal in isolation, but the implications of a significant, perhaps widespread marine economic activity for the ecology and character of the Santa Barbara Channel Region.

Naylor and Burke (2005) succinctly summarize the factors that influence the extent of pollution discharged from a given fish farm, as follows: "feed ingredients and uptake efficiency, fish density in net pens, and location and design of pen facilities."[166] Additionally, they offer evidence "that nutrient discharge from net pens is significantly lower when plant-based feed ingredients are substituted for fish meal–based feeds."[167] In addition, the rearing of filterfeeding mollusks such as mussels in conjunction with fin fish (i.e. aquatic polyculture) has shown promise of both reducing water quality impacts from fish farms and increasing returns for fish farmers.[168] With respect to evaluating, mitigating or preventing the environmental impact of pollution from a given OOA proposal, these identified variables provide a straightforward set of criteria, as well as facility design principles for CINMS resource managers and stakeholders to apply.

---

[165] Goldburg, R. and R. Naylor. 2005. "Future seascapes, fishing and fish farming." *Frontiers in Ecology and the Environment*. 3(1): 21-28.

[166] Naylor and Burke. 2005. "Aquaculture and Ocean Resources: Raising Tigers of the Sea." *Annual Review of Environment and Resources* 30: 185-218.

[167] Id. In addition to discharging less pollution, it's worth re-emphasizing that the cultivation of herbivorous fishes greatly reduces impacts to wild fish stocks, and actually results in net fish production compared to rearing predators.

[168] Naylor, et al. "Effect of aquaculture on world fish supplies." *Nature* 405: 1017-1024.

RECOMMENDATION 4:

a) To mitigate or prevent impacts to Sanctuary resources and qualities from Santa Barbara aquaculture discharges, Sanctuary staff should support current and potential future aquaculture approaches that minimize water quality degradation from untreated discharges often associated with fish farming. These may include:

- Abstaining from the application of chemicals and pharmaceuticals,
- Employing advanced systems that minimize or eliminate overfeeding,
- Use of plant based, rather than fish or animal-byproduct based feeds, and the cultivation of fish that can efficiently convert plant-based feeds,
- Use of closed confinement systems that can capture wastes for treatment
- Focusing on cultivation of shellfish, plants, and integrated polycultures rather than fin fish,
- Siting OOA facilities in locations with the highest assimilative capacities, where adverse impacts to existing biological communities and water quality from facility discharges will be minimized (rather than sited opportunistically based on preexisting infrastructure),
- Identifying appropriate fish densities for a given facility based on site-specific analysis of receiving water quality and dispersion characteristics *in advance* of facility construction and operation, as a component of a proposal's environmental review process.

b) In addition, as part of preliminary environmental review, CINMS staff should require potential fish farm operators to:

- Demonstrate that fish farm discharges will not reduce CINMS water quality.
- Analyze and disclose potential cumulative impacts to the SBC and Sanctuary resources from multiple commercial scale fish farms, concurrent with other large scale oceanographic trends, including global warming and global ocean acidification, that may exacerbate impacts or impair the dilution of pollutants and absorption of nutrients.

3.4 Degradation of marine habitat: noise and entanglements

Fish farms generally represent the conversion of marine habitat into an industrial environment that is unsuitable or purposefully inhospitable (even openly hostile) to local wildlife that traditionally inhabited the area. In addition to the potentially serious global food web impacts and the environmental threats of nutrient loading, biological and chemical pollution, data suggests that the incidental and intended acoustic emissions from fish farms, their potential to serve as "attractive nuisances", and the emplacement of new physical obstacles to the free passage of marine wildlife represent additional threats to local or migrating marine wildlife. Collectively, these forms of habitat conversion may impact CINMS populations by reducing the suitability of the waters surrounding future OOA facilities in the Santa Barbara Channel as habitat.

3.4.1 Alteration of the acoustic environment

Fish farms appear to attract fish-eating seals and sea lions, which have been reported to cause damage to salmon pen enclosures in order to access the prey fish within.[169] In addition to inflicting the cost of facility repair on operators, such incidents can result in the escape of stock fish. As a result, in the early 1980s, salmon farmers began to deploy acoustic harassment devices (AHDs), underwater modules that emit sound to frighten or repel these pinnipeds from the

[169] Goldburg, et al. 2003 "Marine Aquaculture in the United States: Environmental Impacts and Policy Options." *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. Pew Oceans Commission, May 2003.

salmon pens; unfortunately, within weeks the seals and sea lions became accustomed to the early AHDs and returned en masse to cause further damage and depredation to the salmon farms.[170]

As a result, new AHDs were developed and deployed at fish farms that emit sound at a much higher intensity, specifically designed to cause physical pain to marine mammals that swim within range. For example, AHDs in Canadian waters can emit mid- to high frequency underwater sound at more than 190 decibels,[171] well above the levels marine mammal experts consider to cause harassment and physical harm.[172] While scientific studies on the impacts of these sounds on wild marine mammals are limited, data from two key behavioral studies on toothed whale interactions with AHDs in the Pacific Northwest should be of concern with respect to the potential deployment of such deterrent devices in the Santa Barbara Channel.

Olesiuk et al. (2002) investigated the impact of AHD deployment on harbor porpoise (*Phocoena phocoena*) in an area of traditional *phocoena* inhabitation and found that, once one AHD was turned on, observed presence of the animals plummeted, from between 99.8% between 200 and 399 meters (m) from the sound source, to 91.1% at the outermost range of their observation, 2.5-3.5 kilometers (km).[173] Because of these figures, the researchers concluded that the harbor porpoise habitat abandonment caused by the AHD probably "extended beyond our maximum sighting range of 3.5 km."[174] Essentially, the local surroundings became almost completely uninhabitable to the harbor porpoise (who do not predate on fish farms) as soon as the AHD emissions commenced.

Morton and Symonds (2002) conducted a longer-term, more robust investigation on the incidental impacts to killer whales (which, like harbor porpoise, are not known to vandalize fish farms) from the noise pollution caused by AHDs.[175] Their findings illustrate with conclusiveness the impacts from fish farm AHDs.

> *Two independent studies on the natural history of killer whales (*Orcinus orca*) monitored frequency of whale occurrence from January 1985 through December 2000 in two adjacent areas: Johnstone Strait and the Broughton Archipelago. Four high-amplitude, acoustic harassment devices (AHDs) were installed throughout 1993 on already existing salmon farms in the Broughton Archipelago, in attempts to deter predation on fish pens by harbour seals (*Phoca vitulina*). While whale occurrence was relatively stable in both areas until 1993, it then increased slightly in the Johnstone Strait area and declined significantly in the Broughton Archipelago while AHDs were in use… Acoustic*

---

[170] Jasny, M., J. Reynolds, C. Horowitz, and A. Wetzler. 2005. *Sounding the Depths II: The Rising Toll of Sonar, Shipping, and Industrial Ocean Noise on Marine Life*. Natural Resources Defense Council, November 2005. Available at: http://www.nrdc.org/wildlife/marine/sound/contents.asp (Viewed 7/9/07).
[171] Id.
[172] The steady, piercing pulses of AHD sound measure around 190 decibels underwater, which is roughly equivalent in intensity to a 164 decibel airborne sound (airborne and waterborne sound are measured differently). The source level for a commercial jet engine is about 174 decibels (see Jasny et al. 2005, for further explanation).
[173] Olesiuk, P.F., L.M. Nichol, P.J. Sowden, and J.K.B. Ford, 2002. "Effect of the Sound Generated by an Acoustic Harassment Device on the Relative Abundance and Distribution of Harbor Porpoises (*Phocoena phocoena*) in Retreat Passage, British Columbia," *Marine Mammal Science*, vol. 18: pp. 843–62.
[174] Id.
[175] Morton, A. B. and H. K. Symonds. 2002. "Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia, Canada." *ICES Journal of Marine Science* 59: 71–80.

harassment ended in the Broughton Archipelago in May 1999 and whale occurrence re-established to baseline levels.[176]

Intuitively, both sets of results are unsurprising given our understanding of odontocetes (toothed whales), like bottlenose dolphins, harbor porpoise and killer whales, as hearing specialists. These species rely heavily on hearing for foraging, predator evasion, and navigation;[177] in addition, many species (such as bottlenose dolphins, killer whales, common dolphins, and others) exist in complex, often tight-knit social groups that exhibit dependence on successful vocal communication among group members.[178] Thus, beyond simply fleeing from what was likely first experienced by these animals as physical pain, the extremely intense noise "pollution" from the experimental AHD resulted in a profound alteration to a fundamental aspect of their physical environment. The "flood" of high intensity noise from the AHDs impinged on an entire suite of behaviors critical to the animals, and whether due to the masking of vital acoustic signals from the environment or conspecifics, the displacement of prey animals driven away from the noise, or some other unknown mechanism (or most likely, the collusion of all these factors and others), the continued inhabitation of an area kilometers beyond the defended fish farms became simply untenable.

The Santa Barbara Channel harbors a globally unique assemblage of marine mammals— toothed whales, baleen whales, pinnipeds and sea otters— with respect to both the diversity of species and simple population numbers.[179] Accordingly, the threat of habitat conversion as a byproduct of Channel aquaculture is pertinent to stakeholders in the continued healthful inhabitation of these animals in the bio-geographic setting of CINMS. Specifically, it seems quite plausible (even inevitable, by some accounts) that the harbor seals and sea lions of Santa Barbara Channel would become attracted to the net pens and submerged cages of future OOA facilities, just as they have in the Pacific Northwest and around the tuna ranches off Baja California.[180] As these indigenous species become nuisances or even significant liabilities for vandalism and stock escape to open-ocean fish farm operators, the deployment of AHDs or other wildlife repellent technologies around fish farms in Channel waters also would become quite likely.

Because AHD deployment is documented to eliminate habitat for marine mammals so effectively, Sanctuary stakeholders and resource managers should include rigorous review of marine predator deterrent tactics associated with any future OOA proposal, and even explore consultation with Wildlife Services[181] to ensure that predator control tactics are highly focused and do not cause peripheral impact to species. Given the world-class character of CINMS and much of the rest of Santa Barbara Channel with respect to marine mammal habitat, these same parties should also

---

[176] Id.
[177] Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA. 576 pp.
[178] Simmonds, M.P. 2006 "Into the brains of whales." *Applied Animal Behaviour Science* 100: 103-116.
[179] U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Sanctuary Program. 2006. *Channel Islands National Marine Sanctuary Draft Management Plan / Draft Environmental Impact Statement*. Silver Spring, MD.
[180] Dalton, R. 2004. "Fishing for Trouble." *Nature* 431: 502-4.
[181] The USDA's department of Wildlife Services has well-established programs, technologies and research teams targeting the reduction of depredation of farmed fish stocks. At present, these services are provided largely to catfish farmers in the Southeast. (See the USDA's fact sheet: "USDA Wildlife Services Protects American Agriculture" (2004), available at: http://www.aphis.usda.gov/ws/introreports/agriculture.pdf). However, should marine fish farming grow as dramatically as the federal government currently aims for (see the review of federal aquaculture policy in the following section), such federally funded, systematic wildlife damage control efforts could be applied to marine settings like the Santa Barbara Channel.

consider the fundamental question of whether AHD use— the purposeful emission of painful noise—is appropriate at all in this area.

3.4.2 Spatial intrusion and entanglements

In addition to the wide-ranging alteration of the acoustic environment that fish farms can cause, the addition of their basic physical presence— including the attendant enclosures, mooring lines, and other general infrastructure— also represents an alteration of the marine habitat that reduces its suitability for indigenous species.

For example, the NOAA Fisheries Service (aka NMFS) identifies poorly sited aquaculture facilities as an entanglement hazard for marine mammals and sea turtles, one that can cause "significant negative impacts."[182] Based on the results of a 1999 workshop, the agency summarized the fish farm threat to marine wildlife:

> *There are documented cases of interactions between nearshore aquaculture operations and pinnipeds on both the US east and west coasts. These interactions include injury and mortality to marine mammals from entanglements as well as economic losses to the aquaculture industry… Interactions can also occur offshore… offshore facilities in New Zealand have documented marine mammal entanglements. Marine turtles are also at risk of entanglement from offshore aquaculture operations… [which] may entangle, capture, or disrupt migratory movements of post-hatching or pelagic-state marine turtles.*[183]

In addition, the National Marine Sanctuary Program itself has identified whale entanglement in aquaculture gear as a threat to resource conservation at Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHNMS), where aquaculture is currently an allowable use within the site's boundaries.[184] Reinforcing this perspective, HIHWNMS stakeholders have expressed similar concern with aquaculture entanglements in comments submitted during the site's recent management planning process[185], and the State of Hawaii has echoed these concerns in its "Comprehensive Wildlife Management Plan."[186]

Given what we know of the economic and policy trends for the aquaculture industry, NOAA Fisheries concluded from its collaborative aquaculture, whales and turtles workshop that further entanglements and other impacts to marine wildlife from fish farms are more or less inevitable, and likely to grow worse: "As marine aquaculture operations expand in the nearshore and

---

[182] National Marine Fisheries Service, Office of Protected Resources (NMFS OPR). 1999. *Marine Aquaculture, Marine Mammals, and Marine Turtles Interactions Workshop: Silver Spring Maryland 12-13 January, 1999.* K. Moore and D. Wieting (in collaboration with the Workshop Participants), eds. NOAA Technical Memorandum NMFS-OPR-16. November 1999.

[183] Id.

[184] Personal Communication, Sean Hastings, Channel Islands National Marine Sanctuary. June 21, 2006.

[185] National Marine Sanctuary Program (NMSP). August 2002. *Hawaiian Islands Humpback Whale National Marine Sanctuary Management Plan.* Available at: http://www.hihwnms.nos.noaa.gov/planreview/pdfs/HIHWNMS_FMP.pdf

[186] Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. October 2005. *Hawaii's Comprehensive Wildlife Conservation Strategy*. State of Hawaii Department of Land and Natural Resources. Honolulu, Hawai'i. 722 pp. (see chapter 5), available at: http://www.state.hi.us/dlnr/dofaw/cwcs/files/NAAT%20final%20CWCS/Chapters/CHAPTER%205%20NAAT%20final%20!.pdf

offshore marine environment, it is likely that interactions with marine mammals and marine turtles will increase."[187]

RECOMMENDATION 5: To best conserve and protect CINMS resources, stakeholders and managers must insist that potential fish farm operators demonstrate that their pest-control practices will not cause habitat abandonment or other adverse impacts to untargeted species, or serve as a navigational hazard that threatens marine wildlife with injury or death from entanglement. Useful facility design guidelines exist for reducing entanglement impacts, such as siting in areas not frequented by whales, dolphins, and turtles, as well as employing appropriate technology such as taut mesh cages and limited numbers of tensioned mooring lines for enclosures and floating storage facilities. OOA applicants in the SBC region should be held to the highest standards in these areas to protect the Sanctuary's unique assemblage of biodiversity.

3.5 Conclusion

The Woods Hole Marine Aquaculture Task Force, a panel of marine scientists, aquaculturists and policy experts, convened repeatedly over 18 months in 2005 and 2006, with a goal "to develop a series of protective, science-based standards to ensure that aquaculture development poses minimal threats to the ocean environment."[188] Their resulting January, 2007 report, entitled *Sustainable Marine Aquaculture: Fulfilling the Promise, Managing the Risks*, comes to many of the same conclusions as the CWG report at hand, for example:

- that the dramatic growth in marine fin fish aquaculture warrants the development of comprehensive measures to reduce and eliminate environmental impacts from the industry and protect existing ocean uses,
- that "if done carelessly, aquaculture can add substantial pollution to the marine environment, damage wildlife habitat, disrupt fisheries, introduce nonnative species and impact the genetic integrity of wild stocks in already-stressed ecosystems," and
- that a conservative, precautionary approach should be taken to permitting offshore marine aquaculture.[189]

However, perhaps the most compelling and germane recommendation from the WHOI task force with respect to the consideration of fin fish aquaculture in the Santa Barbara Channel region pertains to future siting of fish production facilities. Prospective fish producers may be tempted to view existing OCS oil and gas infrastructure as "low hanging fruit" for aquaculture, despite the immense uncertainty as to whether such locations are optimal or even appropriate relative to potential impacts to the resources and existing uses of the Channel and Sanctuary. Furthermore, because fin fish aquaculture requires significant quantities of its own space for operations, poorly- or opportunistically-sited facilities could result in long term exclusion of existing uses, such as fishing, research, and non-consumptive recreation, in addition to resource impacts, exacerbating adverse impacts to CINMS stakeholders.

---

[187] NMFS OPR. 1999. *Marine Aquaculture, Marine Mammals, and Marine Turtles Interactions Workshop: Silver Spring Maryland 12-13 January, 1999*

[188] Woods Hole Oceanographic Institute Marine Aquaculture Task Force. January 2007. *Sustainable Marine Aquaculture: Fulfilling the Promise: Managing the Risks*. Rear Adm. (ret.) Richard F. Pittenger, Chair. Available at: http://www.whoi.edu/sbl/liteSite.do?litesiteid=2790&articleId=4439 (Viewed 5/10/07).

[189] Id.

The WHOI panel directly addresses this unfolding predicament in a conclusion that applies directly to the question of open ocean aquaculture and CINMS conservation:

> *For marine aquaculture to develop in a sustainable manner it is clear that criteria and guidelines are needed for where to proceed with aquaculture development and, possibly more importantly, where not to move forward.*
>
> *Whether this occurs as a part of broader regional efforts to manage ocean uses on an ecosystem basis, as has been called for by the U.S. Commission on Ocean Policy and the Pew Oceans Commission, or for aquaculture on its own, developing criteria to guide siting and density of aquaculture facilities will be crucial in avoiding environmental damage and user conflicts.*

RECOMMENDATION 6: In line with the recommendations outlined by the WHOI Marine Aquaculture Task Force, CINMS stakeholders and staff should be resolved that any future aquaculture facilities in the Santa Barbara Channel region be sited deliberately, based on specific, science-based criteria, and robust data demonstrating that the chosen location is optimal for avoiding or minimizing adverse effects on Channel and Sanctuary resources and uses, rather than sited opportunistically based solely on the existence of useful infrastructure.

4. Regulatory Framework

State and federal permitting authorities differ greatly in their approach to overseeing and regulating aquaculture. Accordingly, the regulatory framework applied to a given aquaculture facility in the Santa Barbara Channel (SBC), and thus its potential impact on natural resources, depends on the distance from shore that the facility is sited. Under the Submerged Lands Act[190] states have title to the submerged lands extending three nautical miles (NM) from the low water mark and control over natural resources within that 3 NM reach. Figure 4.1 (page 47) delineates the various federal, state, local and CINMS jurisdictional boundaries in the SBC region that could affect how aquaculture would be permitted and regulated.

In general, the current federal regulatory framework for open ocean aquaculture (i.e. aquaculture sited in the US Exclusive Economic Zone (EEZ), or the waters beyond the 3NM limit of state jurisdiction) is deficient, lacking both a designated lead agency and a clear, comprehensive permitting process. This deficiency is exemplified by the fact that the Army Corps of Engineers, an agency with a purview centered on national security and navigation, presently has primary permitting authority over OOA, even though impacts to fisheries and the environment are perhaps the most significant factors with respect to permitting decisions.

In contrast, California's current regulatory framework for aquaculture within the state's waters includes targeted legislation and a designated lead agency, which both streamlines the permitting process for aquaculture development and ensures certain standards of environmental protection. While the topical focus of this report is on OOA, comparison with California's aquaculture framework is instructive relative to future protection of Sanctuary resources and when considering the emerging federal legislation and rulemaking on OOA.

The CINMS regulatory framework prohibits almost all types of discharge typically associated with fish farms, as well as the alteration of, or construction on, the seabed, typically a necessity for most aquaculture facilities. Consequently, fish farms are unlikely to be proposed within CINMS boundaries. However, neither the physical or biological resources of CINMS, nor the pollutants that can impact them, respect these delineations. Consequently, Sanctuary resource managers and stakeholders must be aware of the existing management and regulatory tools available outside CINMS jurisdiction that are available to best address the potential impacts of Channel OOA operations, and be aware of the gaps in these regulatory networks that may result in harm to CINMS resources.

The following sections detail these frameworks and their gaps.

4.1 The Federal Regulatory Framework

By definition, OOA is aquaculture sited in the EEZ, from 3 – 200 NM from shore, and is therefore permitted and regulated by federal agencies and federal law. The U.S. has not yet developed a coherent regulatory framework for OOA, despite the complex array of variables involved in the siting, permitting, leasing, operating, and monitoring of OOA facilities. Additionally, inherent conflicts with the public trust doctrine represented by operation of OOA facilities, with respect to the effective "privatization" of the marine environment caused by fish farms, are far from resolved. Nor has a lead agency been designated, which causes problems both

[190] 43 U.S.C. § 1301 et seq.

for applicants trying to win project approval, and for the public and ocean stakeholders concerned with the protection of the surrounding marine environment. The limited federal legislation and policy that does exist for aquaculture is essentially promotional in nature, and largely outdated relative to contemporary scientific data on fish farming.

4.1.1 Federal Aquaculture Legislation

In the National Aquaculture Act of 1980 (P.L. 96-362), as amended (16 U.S.C. 2801 *et seq*.), Congress found that aquaculture promises many benefits to the US economy and to fisheries conservation, but is impeded by scientific, economic, legal, and production factors. The Aquaculture Act established aquaculture as a national interest, and clearly states its purpose as the promotion of aquaculture through planning, policy making, and encouraging aquaculture activities in both the public and private sectors of the economy. This legislation and its promotional approach have, in general, defined the character of federal policy, actions and goals for the industry since the Act's signing by President Carter in 1980.

A central feature of the National Aquaculture Act is a mandate for the establishment of the Federal Joint Subcommittee on Aquaculture (JSA) to facilitate aquaculture promotion and "the coordination and dissemination of national aquaculture information" to the private sector.[191] The JSA is composed of the heads of a diverse array of federal agencies and departments; its executive committee comprises the Secretary of Agriculture (the JSA's permanent chair), and the U.S. secretaries of Commerce, and the Interior, because their departments bear most aquaculture-related regulatory responsibilities based on existing resource laws.[192] Notably, despite the designation of at least 13 seats on the JSA, only three of them are held by administrators with some level of responsibility for environmental protection or critical assessment of impacts, specifically the Interior Secretary, the director of the Environmental Protection Agency, and the Director of the National Science Foundation.[193]

Given that the Aquaculture Act's purpose is simply to "encourage the development of aquaculture," this administrative bias is not surprising. However, it does represent a structural challenge to certain ocean stakeholders, as well as other federal agencies or programs with natural resource conservation mandates, desirous of a regulatory framework for the industry that comprehensively protects the public trust of the ocean and addresses natural resources impacts.

4.1.2 Federal Aquaculture Policy

a) National Aquaculture Development Plan (1983, 1996)

The Aquaculture Act in turn mandated that the JSA produce a National Aquaculture Development Plan to provide more specific guidance to federal agencies on their role in facilitating growth of the industry. The plan was first completed in 1983 as mandated by the Aquaculture Act, then revised and updated in 1996. The 1996 plan outlined its "vision" and purpose as follows:

(*continued on page 49*)

[191] 16 U.S.C. §2805.
[192] United States Joint Subcommittee on Aquaculture. "Background and Description." http://aquanic.org/jsa/mission.htm (Viewed 12/15/06).
[193] Id.

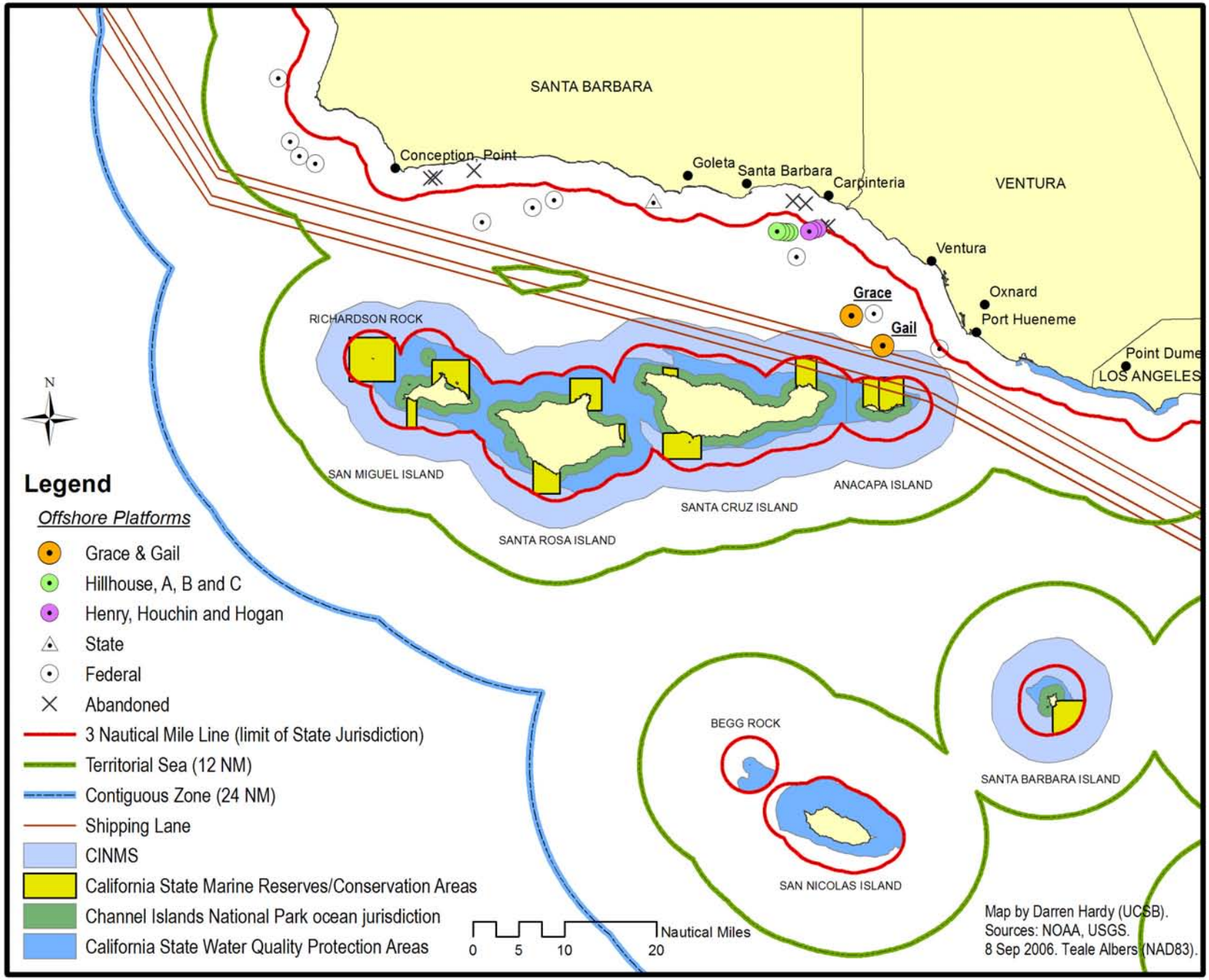


Figure 4.1: Selected jurisdictional authorities and features of the Channel Islands National Marine Sanctuary and Santa Barbara Channel Region.

(*continued from page 46*)

> *1.1 Vision for U.S. Aquaculture: To develop a highly competitive, sustainable aquaculture industry in the United States to meet consumer demand for cultivated aquatic foods and products that are of high quality, safe, competitively priced, and nutritious and are produced in an environmentally responsible manner with maximum opportunity for profitability in all sectors of the industry.*
> *1.2 Purpose of the Plan: To identify high priority Federal government actions, over the next 3-5 years, to support a sustainable, internationally competitive U.S. aquaculture industry, and to lay out a realistic, achievable strategy for undertaking these actions.*

About a dozen specific areas of action for the federal government are outlined, mostly focusing on business development. These include transfer of technology and production techniques, research and development, information systems, marketing, financial services, etc.

Two of these components are particularly noteworthy with respect to recent regulatory developments and the contemporary challenges that may be faced by CINMS area stakeholders.

First, the middle of the Development Plan, Section 4.4.5, "Sustainability and Environmental Compatibility," states:

> *We need substantially better knowledge about possible interactions between aquaculture and natural environments to minimize the potential for habitat degradation, disease transmission, genetic dilution of wild stocks through interbreeding with cultivated strains, introduction of non-indigenous species into natural waters, and discharges of wastes, toxins, and excess nutrients…*
> *The Federal government should encourage and support programs that improve management of water resources and aquaculture wastes, increase understanding of environmental risks associated with aquaculture, and foster development of environmentally sound design and operating guidelines.*[194]

Identification of these environmental challenges and conflicts represents a welcome acknowledgment of the ecological degradation caused by commercial marine fish farms on nearshore marine environments and wild stocks. As previously discussed, these issues are known to be significantly consequential, so any attempt to bring them to light and address them is considered positive.

As is often discussed by reviewers of US aquaculture, the Development Plan next calls for a streamlining of the fish farm permitting process:

> *4.4.8 Federal Regulatory Framework.*
> *Challenges. The complex, fragmented, and uncertain regulatory environment affecting aquaculture is a deterrent to the development of a profitable and competitive U.S. aquaculture industry. Because aquaculture involves land and water use as well as the production, processing, and distribution of food for human consumption, a number of Federal, State, and local government agencies are involved in regulating the industry (8). As a result, aquatic farmers may either be required to comply with a daunting and*

[194] "Draft National Aquaculture Development Plan of 1996." Joint Subcommittee on Aquaculture, National Science and Technology Council. Available at: http://aquanic.org/publicat/govagen/usda/dnadp.htm (Viewed 12/29/06).

expensive array of regulations or, as exemplified by offshore marine aquaculture initiatives, be forced to operate in a highly uncertain regulatory framework.

Opportunities. The Federal government has a responsibility and opportunity to develop alternative, rational approaches to the Federal permitting, licensing, and regulatory requirements now in place. This can include clarification, streamlining, and consolidation, wherever possible, of the regulatory process, while simultaneously ensuring protection of the health and well-being of the population and environment.

The web of laws and regulations in place to protect the marine environment and marine wildlife is identified as "daunting," "expensive," and a "deterrent" to be overcome through policy reform. In the same breath, the Development Plan calls for ensuring environmental protection, revealing something of an un-reconciled duality in the federal approach to aquaculture. While comprehensive protection of public trust marine resources and existing ocean users is not necessarily incompatible with a streamlined regulatory framework optimized for profitability and competitiveness, the analysis that follows demonstrates that subsequent federal policy developments have not necessarily achieved the targeted balance.

b) National Oceanic and Atmospheric Administration (NOAA) Aquaculture Policy (1998)

NOAA drafted its 1998 policy[195] with aims to organize the agency's array of aquaculture related activities and initiatives, formalize its goals, and also state the agency's case for primacy in federal jurisdiction and permitting for aquaculture. In accordance with the Aquaculture Act and the 1996 Development Plan, the 1998 policy reinforces the agency's promotional approach to the industry, arguing that a strong need for aquaculture exists in order to meet market demand for seafood, reduce the national trade imbalance, and reduce pressure on wild fish stocks (though little evidence is given to support this last assertion).

The Policy identifies four areas for the agency to focus on in order to achieve a "successful" aquaculture program:

1) Research, development, and technology transfer;
2) Financial assistance to businesses;
3) Environmental safeguards including regulatory and permit procedures; and
4) Coordination. NMFS, National Ocean Service (NOS), and National Sea Grant College Program in the Office of Oceanic and Atmosphere Research (OAR) will incorporate these priorities into their aquaculture-related activities.

Like earlier federal law and policy, potential environmental effects from fish farming appear to be acknowledged to a very limited extent at best (as does the need for a regulatory and permit-based safeguards). Three of the areas mandate facilitation of industry growth. Importantly, the Research and Development component specifically directs the agency to focus on development of open ocean aquaculture technology for transfer to the private sector.

Furthermore, the "Environmental Safeguards" component of the policy, comprising subsections on permitting and "Environmental Research and Planning", also appears to dictate a directly promotional approach for the agency. The discussion begins by stating: "A primary objective of a Federal aquaculture policy is to develop… more efficient Federal and state permit processes to

[195] The full text of NOAA's Aquaculture Policy is available at: http://www.nmfs.noaa.gov/mediacenter/aquaculture/docs/16_NOAA%20Aq%20Policy.pdf

promote industry development." To help accomplish this stated objective while upholding some unarticulated "environmental safeguards", the policy proposes that NOAA identify potential areas for aquaculture within the EEZ that would "reduce user conflicts with vessel transit lanes, traditional fishing grounds and protected species habitat, as well as minimize the potential for negative impacts on the environment." Once identified, permits for conducting aquaculture in these areas "would receive rapid responses because the areas would already have been designated as approved for aquaculture."

Though potentially obviated by federal OOA legislation in 2007 or 2008 (see below), this aspect of the 1998 policy is interesting to consider relative to the discussion at hand for three reasons. First, it embodies a persistent pattern within federal aquaculture policy whereby unresolved environmental implications are superficially acknowledged, but then "addressed" simply by emphasizing development of open ocean fish farming, as if the expanded pollution absorption capacity of deep water fish farm sites will mitigate all the potential impacts of expanded fish farm activity. As discussed in the previous section, open ocean sites are expected by many experts to cause environmental problems including conversion of marine habitat, escape of poorly adapted, non-indigenous, or genetically modified stocks, depletion of wild fisheries for fishmeal and fish oil, and cause significant or cumulative local impacts in the event that future OOA facilities are installed in clusters or at large scale in the manner of contemporary salmon farms. To achieve sustainability, OOA policy will require a management framework that explicitly acknowledges the environmental implications and challenges associated with open ocean fish farms, and the need for a comprehensive regulatory framework to mitigate or preclude them.

Second, the policy suggests that while NOAA is strongly promotional of aquaculture, the agency appears to have articulated some criteria for whether a given ocean site is appropriate for a fish farm. Given the policy's identification of agency need to reduce conflicts with efforts to protect imperiled species and existing ocean uses, it appears to suggest that NOAA has identified significant unresolved environmental challenges associated with fish farming, of sufficient magnitude to impinge on other activities within the agency's management purview. More tenuously, the criteria would seem to suggest that NOAA would not consider fish farming appropriate near rockfish breeding or recruitment areas (such as those at Platform Grace and Platform Gail) or in areas that traditionally support a recreational fishery, or that lie near boundaries to a federally established marine protected area.

Third, in addition to incentivizing "appropriate" siting of aquaculture, the policy outlines the role that scientific data and environmental protection will play within Agency aquaculture decision making:

> *…it is important that the feedback derived from research is taken into account in the Federal and State regulatory and planning processes. The best scientific information available will be considered in guiding these processes, and where there is insufficient science a precautionary approach will be taken to adequately safeguard the environment and wild stocks.*

The 1998 NOAA policy also appears to present CINMS resource managers with something of a policy "opportunity" to influence fish farm siting in the Santa Barbara Channel to insure that such operations do not impact Sanctuary resources. As discussed in the previous section, significant scientific data already exists regarding the environmental impacts of raising predatory fishes, including the impacts to benthic communities, the spread of pathogens and parasites, and the impacts on coastal pelagic species; the policy appears to mandate that this data be incorporated into NOAA decision-making, including regulatory and management actions. Of equal importance, the policy mandates a precautionary approach to fish farm siting. This suggests that

CINMS managers can and should require that potential fish farm operators near the Sanctuary bear the burden of proof to demonstrate that their facilities and stocks will not negatively affect Sanctuary resources or qualities, and that in the absence of such evidence CINMS staff are empowered to argue against an open ocean fish farm.

c) U.S. Department of Commerce Aquaculture Policy (1999)

Repeating similar themes from earlier NOAA policy, the DOC aimed its 1999 policy at creation of "a business climate and technological base for industry to develop environmentally sound aquaculture."

This relatively short document (2 pages) includes several specific objectives, which DOC hopes to achieve by 2025:

A. *Increase the value of domestic aquaculture production from the present $900 million annually to $5 billion, which will help offset the $6-billion annual U.S. trade deficit in seafood.*
B. *Increase the number of jobs in aquaculture from the present estimate of 180,000 to 600,000.*
C. *Develop aquaculture technologies and methods both to improve production and safeguard the environment, emphasizing where possible those technologies that employ pollution prevention rather than pollution control techniques.*
D. *Develop a code of conduct for responsible aquaculture by the year 2002 and have 100% compliance with the code in Federal waters.*
E. *Double the value of non-food products and services produced by aquaculture in order to increase industry diversification.*
F. *Enhance depleted wild fish stocks through aquaculture, thereby increasing the value of both commercial and recreational landings and improving the health of our aquatic resources.*
G. *Increase exports of U.S. aquaculture goods and services from the present value of $500 million annually to $2.5 billion.*

Like the preceding NOAA plans and policies, the DOC policy bears a preponderance of stated objectives targeting significant industry growth, while failing to articulate in proportional detail the specific challenges that an enlarged aquaculture industry may engender. For example, as the previous section discussed, an expanded US aquaculture may have significant impact on global wild fish stocks harvested to provide fishmeal and fish oil to facilities raising high-value, predatory species. Yet the DOC policy avoids any mention of this ecological and economic conundrum, blithely recommending that aquaculture be used as a tool to address overfishing by "enhancing depleted wild fish stocks." How a massively increased aquaculture industry, including the intended export and restoration sub-sectors, will feed their captive stocks over the long term without undermining wild ecosystems is uncertain by many accounts, but apparently of no concern to the DOC.

Nevertheless, the DOC goals for specific levels of aquaculture industry growth, and the establishment of deadlines for achieving them, appear to have had a significant impact on the federal government's general approach to aquaculture. Though accruing data has lead many analysts to a much more cautious and critical perspective of the industry since the 1999 release of the DOC policy (perhaps best summarized in the 2003 Pew Oceans Commission Report), the subsequent federal plans and policies that have actually been promulgated, as well as the major

offshore aquaculture legislation introduced into Congress, have all essentially focused on streamlining and facilitating manifold growth of US aquaculture.

d) NOAA Fisheries Service Code of Conduct for Responsible Aquaculture Development in the U.S. Exclusive Economic Zone (2003)

In order to meet Objective D of the 1999 Aquaculture Policy statement, in 2003 NOAA Fisheries released its *Code of Conduct for Responsible Aquaculture Development in the U.S. Exclusive Economic Zone* ("the Code"). The Code, which adopted most of the policy recommendations for OOA published by Cicin-Sain et al. (2001)[196], was published to "address impediments to the development of a domestic marine aquaculture industry and the necessary safeguards associated with such development." The Code references DOC and NOAA plans to increase marine aquaculture, and explains the encouragement of OOA as a solution to growing competition for coastal resources including space and water quality.

However, the Code is unusually clear among federal policies and statements that aquaculture in the EEZ will encounter its own problems, and therefore aims to provide guidance for regulators. The Code's central guidelines include:

1. *Aquaculture development in the EEZ will be adequately regulated and protected by an integrated and effective legal framework to ensure its growth in a sustainable manner, and one consistent with comparable industries sharing the nation's offshore resources.*
2. *... be administered by an appropriate national infrastructure, with one agency designated the overall authority to ensure its efficient organization and management.*
3. *... have a policy environment to: (a) provide guidelines for development plans and management strategies; (b) encourage entrepreneurs to invest in projects without difficulty and adopt responsible production practices; and (c) promote the development of appropriate regulation and efficient enforcement.*
4. *... be the responsibility of the private sector, and assisted by appropriate federal policy instruments designed to encourage implementation of the Code, facilitate investment, and minimize the cost of compliance.*
5. *... adopt the guiding principle of the **precautionary approach** combined with **adaptive management** to achieve sustainable development in offshore waters* [emphasis added].
6. *... establish and enforce measures to ensure responsible management practices and attitudes at the farm level to minimize potential harm to the environment and ensure its sustainability.*
7. *... support an effective program for applied research by stakeholders and help achieve the goal of responsible development. It will encourage and facilitate cooperative research at the regional and sub-regional levels, and promote sharing of results to achieve industrial uniformity and efficiency.*
8. *... make a special effort to increase public awareness about the rationale for offshore aquaculture, and in particular to provide information addressing issues of concern to the public.*

[196] Cicin-Sain et al. 2001. *Development of a Policy Framework for Offshore Marine Aquaculture in the 3-200 Mile U.S. Ocean Zone*.

While many of the Code's recommendations are on point with respect to addressing the environmental threats associated with fish farming, gaps within the Code and the fact that implementation of its recommendations remains voluntary for operators and resources managers significantly undermines its effectiveness.

Polgar (2005)[197] provides an excellent overview of the Code's strengths and failings (figure 4.1.2 below excerpts her analysis).

Figure 4.1.2. Polgar (2005), excerpted analysis of NOAA's *Code of Conduct* for offshore aquaculture

> With respect to potentially adverse effects of offshore aquaculture, [the Code] adopts a precautionary approach combined with adaptive management as the guiding principle, and declares, "it is the responsibility of Government to ensure development compatible with responsible stewardship by means of clear and achievable development policies based on financial, social, and environmental sustainability". NOAA outlines overall methods for conducting various steps (e.g. planning, siting, permitting, monitoring) and addressing issues such as uncertainty with respect to potential adverse effects of offshore aquaculture. Although the Code addresses offshore aquaculture policies in general terms, it provides the first steps towards interpreting the recommended conceptual policies into management methodologies that can be implemented by an agency. Examples of concrete measures include creating a plan that "specifies management objectives, and how impacts of development are to be assessed, monitored, and addressed," developing a siting guide for projects, and assessing the benefits and costs of proposed offshore aquaculture projects relative to existing objectives for development and management of the resources and the environment (NOAA, 2002).
>
> NOAA's attempts to adhere to the precautionary approach and adaptive management suggest that offshore aquaculture will be implemented in a manner that is protective of the marine environment, and that projects will be assessed for their consistency with the public trust doctrine. However, NOAA omits the policy recommendation [from Cicin-Sain et al. 2001] stipulating that offshore aquaculture leaseholders provide "compensation to the public in return for the exclusive right" to use public waters. Furthermore, the only discussion of financial issues in the Code focuses on providing incentives to the aquaculture industry to further research and development of technologies and projects. NOAA avoids any mention of requiring firms to post a precautionary financial guarantee to prevent costs to taxpayers. Despite these gaps in the Code, incorporation of its policy framework into federal legislation would give weight to environmental reviews of offshore aquaculture.

That compliance with the Code is strictly voluntary is perhaps its most important characteristic; as Polgar points out, there are several components of the Code that would strengthen the OOA management framework with respect to environmental sustainability, if adopted as policy or regulation. Unfortunately, the recommendations of the Code are little more than that, requiring neither compliance nor enforcement. Since its release, neither the federal government nor the aquaculture industry has moved to adopt this recommended framework for management and regulation—and emerging federal legislation introduced to Congress by NOAA also appears to have ignored these basic guidelines.

e) NOAA draft Interim 10-Year Plan for Aquaculture (2006)

[197] Polgar, Sara. 2005. *Aquaculture in the U.S. federal offshore waters: Analyses of the legal issues for granting private use of federal waters and policy implications of proposed legislation for offshore aquaculture development.* Unpublished research paper, advised by Gail Osherenko, research scientist, Marine Science Institute, UCSB.

In response to a request from the Department of Commerce's Marine Fisheries Advisory Committee (MAFAC[198]), NOAA's Aquaculture Program drafted a "10-year plan" to frame the Program's plans for future marine aquaculture development in the US. MAFAC approved the 10-year plan in July of 2006 and made it available for public comment the following November; as of January 2007 the NOAA Aquaculture Program was reviewing submitted comments.

In accordance with the promotional tradition of NOAA and the DOC, the 10-year plan "builds a case for a broad, national marine aquaculture development initiative" (p.2). However, the specificity and scale of development alluded to in the 10-year plan is unprecedented in preceding policy documents.

In its introductory statements, the 10-year plan states that "a preliminary analysis by NOAA staff shows that it would be possible to increase domestic aquaculture production (freshwater and marine) by 1 million metric tons per year by 2025… Of the 760,000 tons of [additional] fin fish aquaculture, 590,000 tons could come from marine fin fish aquaculture" (p.4). This is a particularly important position to be aware of with respect to the discussion at hand, as the current domestic marine fin fish industry produces less than 1000 metric tons of marine fin fish per year (not including production of anadromous fish).[199] Incidentally, this would shift marine fin fish production in the US from less than 1% of total domestic aquaculture production, to more than a third of total industry output in 2025.[200] While the 10-year plan does offer the disclaimer that these figures "are not specific agency targets for production of seafood from aquaculture," they do provide an eye-opening suggestion of the scale of marine fin fish production NOAA is envisioning and considering (if not directly targeting). Given what we know about the effects of fish farms on both wild fisheries and local environments, the suggestion in NOAA policy of this scale of industry growth is cause for concern among coast and ocean stakeholders throughout the US EEZ, and in the Santa Barbara Channel where alternative uses including fish farms are being considered for existing offshore oil and gas facilities. Additionally, the possibility of this scale of growth in marine fin fish aquaculture raises the stakes for implementation of a comprehensive, functional permitting and regulatory framework for open ocean aquaculture.

NOAA's Aquaculture Program structures the substance of its 10-year plan around four major goals, namely to:

1. *Establish a comprehensive regulatory program for marine aquaculture.*
2. *Develop appropriate technologies to support commercial marine aquaculture and enhancement of wild stocks.*
3. *Improve public understanding of marine aquaculture.*
4. *Influence the development and international adoption of sustainable practices and standards for marine aquaculture.*

To accomplish the first goal of establishing a comprehensive regulatory framework, NOAA proposes several significant actions: Development of regulations for aquaculture under existing laws (e.g. the Clean Water Act, Marine Mammal Protection Act, and National Marine Sanctuaries Act), securing passage of the proposed National Offshore Aquaculture Act of 2005 (reviewed

---

[198] MAFAC advises the Secretary of Commerce on all living marine resource matters that are the responsibility of the DOC, and functions solely as an advisory body that reports to the Commerce Secretary. The Under Secretary for Oceans and Atmosphere—Vice Adm. Conrad C. Lautenbacher, Jr., as of January 2007— is the designated chair of the Committee.

[199] Nash, Colin. 2004. "Achieving policy objectives to increase the value of the seafood industry in the United States: the technical feasibility and associated constraints." *Food Policy* 29: 621-641.

[200] Id.

below), and development of a programmatic Environmental Impact Statement (EIS) and regional siting plans (discussed in previous policy).

The passage of the proposed OOA legislation likely represents the functional core of these actions, which, given the array of flaws and gaps it contains in current form, does not bode well for establishing a truly comprehensive framework of sufficient robustness to protect fisheries and the environment from potential harm from fish farming (see analysis of this pending legislation below). However, should the 10-year plan be approved and followed, the public participation processes associated with these actions may well be some of the best opportunities for CINMS staff, stakeholders and the National Marine Sanctuary Program to influence further policy and regulatory development. For example, the CINMS Advisory Council will likely have the opportunity to submit comments on regulatory rulemaking for aquaculture under the National Marine Sanctuaries Act, on scoping and drafting of a programmatic EIS for offshore aquaculture, and on the development of any regional fish farm siting plans. The information compiled in this report, and the NOAA Code of Conduct for Offshore Aquaculture discussed above, provide many useful criteria against which to analyze these future policy developments. One intent of this report is to help Sanctuary stakeholders and staff prepare for these administrative processes, which may well determine if and how fish farming is practiced in the Santa Barbara Channel.

RECOMMENDATION 7: Because the proximity of many OCS oil and gas facilities represents an unusual level of exposure to open ocean aquaculture development, CINMS staff and stakeholders should commit to active involvement in public consultation processes associated with federal rulemakings and policy development on aquaculture. These review processes may represent important opportunities to protect the natural resources, systems and existing uses of the Sanctuary and the Channel from externalized costs associated with open ocean fish farms. Published resources such as the Pew Oceans Commission Report and NOAA's Code of Conduct for Responsible Aquaculture provide an array of innovative policy recommendations to guide such participation, which in turn may help better align federal management of aquaculture with the goals and responsibilities of the National Marine Sanctuary Program and its individual sites.

4.1.3 Federal Agencies with Implicit Authority over OOA

Currently, there is no specific federal framework, nor a designated lead agency to comprehensively regulate OOA or protect the ocean commons of the EEZ from future commercial OOA operations. At present, the Department of Agriculture is considered the "lead" coordinating agency under the National Aquaculture Act of 1980. The U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (EPA) are considered "lead" permitting agencies. Each permit is considered individually by the issuing agency, usually with no provision for examining cumulative impacts.[201] Several other federal agencies in several administrative departments may also assert authority over various aspects of OOA operations. Overall, aquaculture permitting decisions, and thus aquaculture policy, appear to be made on a case-by-case basis.[202]

Many researchers have analyzed and criticized this jurisdictional morass; Firestone et al. (2005) succinctly summarized the bureaucratic disorganization facing an entrepreneur hoping to raise fish in federal waters, who

[201] deFur, P.L. and D.N. Rader (1995). "Aquaculture in Estuaries: Feast or famine?" *Estuaries* 18(1A): 2-9.
[202] Rubino, M. and C. Wilson (1993). "Issues in Aquaculture Regulation." Bluewaters, Inc., Bethesda, MD.

> *…must obtain a U.S. Army Corps of Engineers permit to place a structure in U.S. navigable waters, the U.S. Environmental Protection Agency (EPA) regulates the discharge of effluents from the aquaculture facility, and the National Oceanic and Atmospheric Administration (NOAA) asserts jurisdiction over aquaculture based on the premise that aquaculture operations may negatively impact wild fish stocks.*[203]

Meanwhile, unlike the production of offshore oil and gas in federal waters, which is overseen and organized by the Minerals Management Service, "no agency has the authority to lease ocean space for the purposes of aquaculture."[204]

This fragmentation has undoubtedly been a factor in the forestalling of commercial OOA in the US, and on one hand this could be considered beneficial because of the additional scientific and policy research that has occurred in the meantime. The accrued knowledge could lead to more sophisticated and effective regulation and management when legislation is finally passed. Conversely, the disorganization of such a hodge-podge also represents a management structure that is simply inadequate for overseeing an industry that impacts, and depends on resources held in the public trust. The current framework of agency jurisdiction thus represents untenable risk economically and ecologically,

The following review of agencies with implicit authority based on statutory interpretation of environmental and food safety law (and the remainder of Section 4.1.3), is adapted from the excellent and comprehensive University of Delaware/Cicin-Sain et al. (2005) report: *Recommendations for an Operational Framework for Offshore Aquaculture in U.S. Federal Waters*.[205]

US Department of Defense: Army Corps of Engineers (USACE)

> USACE has authority over the navigable waters of the United States, and since OOA by definition is located in these waters, all projects (including those in state waters) are subject to review and approval by USACE.
>
> The Rivers and Harbors Act of 1899 (33 U.S.C. §403) requires a Section 10 permit for activities in or affecting the navigable waters of the U.S., including installations or other devices permanently or temporarily attached to the seabed, erected for the purpose of exploring, for developing, or producing resources from the Outer Continental Shelf (OCS).
>
> The National Environmental Policy Act (NEPA: 42 U.S.C. §4332) requires a determination on environmental impacts prior to the issuance of a permit. As part of its review process, USACE decides whether a full Environmental Impact Statement (EIS) is needed for a particular project, or whether a less extensive Environmental Assessment (EA) is sufficient.

---

[203] Firestone, J., W. Kempton, A. Krueger C. E. Loper. 2005. "Regulating Offshore Wing Power and Aquaculture: Messages from Land and Sea." *Cornell Journal of Law and Public Policy* 14:71.
[204] Id.
[205] Cicin-Sain, B., S. Bunsick, J. Corbin, R. DeVoe, T. Eichenberg, J. Ewart, H. J. Firestone, K. Fletcher, H. Halvorson, T. MacDonald, R. Rayburn, R. Rheault, B. Thorne-Miller. *Recommendations for an Operational Framework for Offshore Aquaculture in the U.S. Federal Waters.* Center for the Study of Marine Policy, University of Delaware. October 2005.

The Marine Protection, Research and Sanctuaries Act (MPRSA: 16 U.S.C. §1431 *et seq*.) requires a permit under Title I, also known as the Ocean Dumping Act, for dumping dredged materials.

US Environmental Protection Agency (EPA)

EPA is responsible for protecting U.S. natural resources through authority established by several federal environmental laws.

The Clean Water Act (33 U.S.C.§1251 *et seq*.) requires a National Pollutant Discharge Elimination System (NPDES) permit to regulate point sources that discharge pollutants directly to surface waters (Section 402). Based on this law, EPA has determined it has the authority to set ocean disposal criteria and review environmental effects of aquaculture projects (Section 403(c)). In 2004, EPA issued effluent limitation guidelines (ELGs) and new source performance standards for concentrated aquatic animal production (CAAP) facilities, also known as fish farms. EPA implements these guidelines and standards through NPDES general permits[206] for facilities with:

1. Flow-through, re-circulating, or net-pen systems,
2. Direct wastewater discharge, and
3. At least 100,000 pounds of fish production a year.[207]

However, the guidelines and standards only require "best management practices to control the discharge of pollutants in the wastewater from these facilities,"[208] such as the use of active feed monitoring strategies to minimize the uneaten food that accumulates beneath the net and prevention of the discharge of dead animals in the wastewater. The guidelines and standards do not set numeric limits on pollutants or specific limits on species cultivated.

Like USACE, EPA must determine and assess environmental impacts prior to the issuance of a permit, as required by NEPA.

Like USACE, the Ocean Dumping Act requires the EPA to issue permits for dumping, in this case, of material other than dredged material. It also requires the EPA to designate appropriate dumpsites.

US Department of Agriculture: Animal and Plant Health Inspection Service (APHIS)

21 U.S.C. §111 *et seq*. requires APHIS to enforce regulations on the spread of contagious, infectious, or communicable disease of animals from a foreign country or between U.S. states.

As described in the previous section, fish farms are known to spread diseases among farmed and wild fish stocks. Disease is thus an ongoing threat to sustainable aquaculture; APHIS is responsible for managing this threat. For

[206] U.S. Environmental Protection Agency: View NPDES Individual and General Permits. See http://cfpub.epa.gov/npdes/permitissuance/genpermits.cfm (Viewed 5/13/06).
[207] U.S. Environmental Protection Agency: Aquatic Animal Production Industry Effluent Guidelines. See http://www.epa.gov/guide/aquaculture/ (Viewed 3/19/06).
[208] Effluent Guidelines: Final Rule Fact Sheet. See http://www.epa.gov/guide/aquaculture/fs-final.htm#impacts (Viewed 3/19/06).

example, in 2001 APHIS identified infectious salmon anemia (ISA) (a salmonid disease of European origin afflicting farmed and wild salmon in Maine and Southeast Canada) as a *foreign animal disease* posing a threat to animal health and the U.S. economy. In response, APHIS established its ISA Program based on surveillance, monitoring and indemnification, to eradicate the disease.[209] In 2002, as the spread of ISA worsened, APHIS determined that federal assistance was necessary and secured federal money for "depopulation" of fish farms and disposal, clean up and disinfection.[210] The APHIS ISA protocol was "universally" implemented in Maine salmonid farms, leading to an apparent lull in the epidemic.[211] Unfortunately, a significant new outbreak of ISA occurred in 2003 and early 2004, when the pathogen was detected in several salmon farms around Cobscook Bay, Canada; by some reports, the outbreak may have been caused by a disparity between U.S. and Canadian disease management protocols.[212] After initially causing tens of millions of dollars of loss in stock among US salmon farmers, it appears based on recent ISA occurrence data[213] that the APHIS efforts have successfully controlled the disease.

In addition, APHIS is currently developing a National Aquatic Animal Health Plan (NAAHP) to guide the three federal agencies with primary authority for aquatic animal health (APHIS, the US Fish and Wildlife Service, and NOAA Fisheries Service).[214] A completed draft is expected in the spring of 2007. While the NAAHP is not a regulation, it may be related to regulations by means of species and disease program recommendations such as import protocols, indemnity, and eradication, control, and management programs.[215] Such recommendations may be applicable in the SBC.

US Department of Homeland Security: US Coast Guard (USCG)

14 U.S.C. §83 *et seq*. requires USCG to ensure that aquaculture-related structures located in navigable waters be marked with lights and signals for safe passage of vessels.

The Merchant Marine Act (46 U.S.C.§12101 *et seq*.) requires USCG certification for vessels (including barges) of 5 or more tons, which would likely include service vessels for any OOA operations initiated in the SBC region.

---

[209] Personal communication with J. Rolland (Robert Hulbrock (Aquaculture Specialist, USDA/APHIS/VS/ASEP) on April 10, 2006.
[210] U.S. Animal Health Association, Resolution 12 (October 27, 2004). See http://www.usaha.org/committees/resolutions/2004/resolution12-2004.pdf (Viewed 6/14/06).
[211] Id.
[212] Id.
[213] USDA Veterinary Services, National Aquaculture Program. "Monthly Report for November 2006: Infectious Salmon Anemia (ISA Program)." Available at: http://www.aphis.usda.gov/vs/aqua/reports/rpt_nov06.html (Viewed 01/04/07). The document reports that, between January and November of 2006, only one salmon cage tested positive for ISA, during the month of February.
[214] USDA Veterinary Services: National Aquatic Animal Health Plan. Available at: http://www.aphis.usda.gov/vs/aqua/naah_plan.html (Viewed 4/21/06).
[215] Rolland, J., G. Ergie, K. Amos, and G. Blair. 2005. "The National Aquatic Animal Health Plan Presentation." Available at: aquanic.org/publicat/org/ustfa/USTFA%20Sep%202005.ppt (Viewed 6/14/06).

US Department of the Interior: US Fish and Wildlife Service (FWS)

The Endangered Species Act (ESA: 16 U.S.C.§1531 *et seq*.) provides for the consultation and review of aquaculture siting permits to assure that no conflicts arise with protection and recovery programs for ESA-listed species under the jurisdiction of the FWS. Generally speaking, this includes terrestrial species as well as the Southern sea otter (and, incidentally, the walrus and the polar bear).

The Lacey Act (16 U.S.C. §§3371-3378) prohibits the introduction of injurious species of wildlife into the U.S. It also prohibits commerce in wildlife taken in violation of state, tribal, federal, or foreign government law. For example, FWS published a proposed rule in the Federal Register in February 2000 to list all forms of live black carp as an injurious species. The issue has not yet been resolved since the comment period was reopened on August 30, 2005 due to the release of the Draft Environmental Assessment and Draft Economic Analysis (50 CFR Part 16).

US Department of Commerce: NOAA Fisheries Service

The Magnuson-Stevens Fishery Conservation and Management Act (MSA: 16 U.S.C. §1801-1882), as amended by the Sustainable Fisheries Act (Public Law 104-297, 110 Stat. 3559), establishes federal management of commercial fishing operations and protection of essential fish habitat (EFH) by the NOAA Fisheries Service (NOAA Fisheries). It also requires development of fishery management plans by Regional Fishery Management Councils. NOAA Fisheries approves and enforces these management plans, which may be amended to accommodate aquaculture activities.

The Marine Mammal Protection Act (MMPA: 16 U.S.C. §1361-1421) requires NOAA Fisheries to review and approve any facility whose activities, despite utilizing the required mitigation measures, may result in "take"[216] of marine mammals (excluding sea otters), or impinge on their established critical habitat or known migratory paths. If approved, the NOAA Fisheries Office of Protected Resources may issue either an Incidental Harassment Authorization (IHA) for activities that do not result in injury or death, or an Incidental Take Authorization (also known as a Letter of Authorization (LOA)) for activities that may result in injury or death.

Additionally, NOAA Fisheries, in collaboration with other Federal and state authorities, is organizing information and developing practices for "deterring pinnipeds that have an effect on human activities and property."[217] As discussed in Section 3, this service could be of potentially significant relevance to OOA in the Sanctuary-area.

Finally, the Endangered Species Act (ESA) mandates protections for threatened and endangered marine life. NOAA Fisheries' Office of Protected Resources also

[216] As defined in the MMPA, "take means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." 16 U.S.C. §1362 (13).
[217] NOAA Fisheries Office of Protected Resources. "U.S. and International Programs." Available at: http://www.nmfs.noaa.gov/pr/programs.htm (Viewed 1/4/07).

carries out those mandates by cooperating with partners to conserve, protect, and recover protected marine life. Generally, USFWS manages land and freshwater species, while NOAA Fisheries manages marine and anadromous species, including cetaceans, sea turtles, marine and anadromous fishes, and one marine plant species.

The ESA requires NOAA Fisheries to designate critical habitat and to develop and implement recovery plans for threatened and endangered species under its jurisdiction. NOAA Fisheries also reviews applications and issues permits and authorizations for any parties conducting activities that may result in take of protected species. NOAA Fisheries reviews proposed federal actions and provides consultation for actions which may impact or result in "take" of ESA-listed species under the agency's jurisdiction.[218] NOAA Fisheries manages the protection and recovery programs of an array of marine mammal and ESA-listed species that inhabit the Sanctuary area and that may be affected by aquaculture, e.g. the Southern California steelhead trout, the leatherback sea turtle, the white abalone, and the blue whale.[219]

US Department of the Interior: Minerals Management Service (MMS)

The Outer Continental Shelf Lands Act (OCSLA: 43 U.S.C.§1331-1356) provides DOI with jurisdictional authority to oversee permitting the development of oil, gas and mineral resources in the offshore outer continental shelf (OCS), the collection of royalties from OCS leases, oversight of environmental and human health impacts, and abandonment and removal of platforms and other OCS mineral development facilities.

Additionally, according to MMS, Section 388 of the Energy Policy Act of 2005:
:

> *…clarifies the Secretary [of the Interior]'s authority to allow an offshore oil and gas structure, previously permitted under the OCSLA, to remain in place after oil and gas activities have ceased in order to allow the use of the structure for other energy and marine-related activities… such as research, renewable energy production, aquaculture, etc., before being removed*[220]. [Also see Section 2.3, above.]

In March of 2007, MMS released its draft programmatic EIS for the alternate use program. Though focused on alternative energy projects, the PEIS also includes discussion of OCS oil and gas infrastructure conversion to offshore aquaculture facilities, including a basic identification of potential environmental impacts and general mitigation measures.[221]

---

[218] Under the ESA, take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." 16 U.S.C. §1532 (19).
[219] Id.
[220] "Renewable Energy and Alternate Uses of Federal OCS Lands." MMS press release. Contact: Maureen Bornholdt, Program Manager, OCS Renewable Energy and Alternate Use Program. Available at: http://www.mms.gov/offshore/RenewableEnergy/RenewableEnergyAndAlternateUses.pdf (Viewed 1/4/07).
[221] MMS. 2007, PEIS for Alternative Energy Development and Production and Alternate Use of Facilities on the OCS. Available at: http://ocsenergy.anl.gov/eis/guide/index.cfm (Viewed 5/9/07).

US Department of Health and Human Services: Food and Drug Administration (FDA)

The Federal Food, Drug, and Cosmetics Act (FFDCA: 21 U.S.C. §301 *et seq*.) requires FDA to ensure that seafood shipped or received in interstate commerce is "safe, wholesome, and not misbranded or deceptively packaged." FDA also must approve animal drugs, feeds, and genetically modified organisms (GMOs) before use, all of which could apply to an OOA operation in the SBC.

Department of Commerce: Office of Ocean and Coastal Resource Management (OCRM)

The Coastal Zone Management Act ("CZMA," 16 U.S.C. §1451-1464) allows states with federally certified coastal management programs ("CMP") to review federal activities and permits that affect the land, water, or natural resources of the state's coastal zone. OCRM implements the CZMA, under which it reviews and approves state CMPs.

Federal agency activities that may affect a state's coastal resources must ensure that such activities are "carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved State management programs." (16 U.S.C. §1456(c)(1)(A).) Each federal agency carrying out such an activity must prepare a "consistency determination" that explains how the activity is consistent with the applicable CMP and submit such determination to the state. (16 U.S.C. §1456(c)(1)(C).) The state will either concur with, or object to, the determination. Even if the state objects to the determination, the federal agency may elect to proceed with the activity. The state must then file an action in federal court to prevent the federal agency from proceeding with the activity. If the court rules in favor of the state, the federal agency shall not carry out the activity unless the President, at the request of the Secretary of Commerce, exempts the activity from the consistency requirements of the CZMA on the grounds that the activity is in the "paramount interest of the United States." (16 U.S.C. §1456(c)(1)(B).)

Private activities that require federal approval are also subject to the consistency requirements of the CZMA. (16 U.S.C. §1456(c)(3)(A).) If the activity is listed in a CMP as requiring state review, the applicant must submit a consistency certification to the state, demonstrating that the proposed activity "complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program." If the activity is not listed in the state's CMP, but the state believes that the activity may affect its coastal resources, the state may request that OCRM grant it the authority to review the proposal. Once a state is presented with a consistency certification from the applicant, the state will either concur with the certification, or object on the grounds that the project does not comply with the CMP. If the state objects, the federal agency with permitting authority may not approve the project. A state's objection may be overturned on appeal by the Secretary of Commerce, based on a finding that the activity is consistent with the CZMA or is "otherwise necessary in the interest of national security." (16 U.S.C. §1456(c)(3)(A).)

California's CMP was certified in 1977. The California Coastal Commission is the state agency endowed with the responsibility for implementing the CZMA in California and has been delegated the authority to review federal and private

proposals for consistency with the state's CMP. As of December of 2006, OOA activities were not listed in the state's CMP, meaning that the Coastal Commission must request permission to review any privately-proposed projects.

4.1.4 Limitations of Federal Agencies with Implicit Authority over OOA

Very few of the authorities described above arise from legislation with explicit reference to aquaculture. Consequently, no agencies comprehensively address the specific issues associated with OOA described in previous sections. The National Aquaculture Act of 1980 remains the only explicit federal legislation on aquaculture and, as discussed, is promotional rather than regulatory. This patchwork of federal agencies asserting authority based on statutory interpretation is common for new commercial activities, but, as discussed above, represents unsustainable deficiency in the safe development of aquaculture, and in protecting marine resources and systems from fish farm impacts.

The University of Delaware report on which NOAA based its "Code of Conduct" for open ocean aquaculture[222] outlined the primary limitations of the existing regulatory framework as a starting point for its recommendations.

1. *An agency may have insufficient resources to fulfill the responsibilities it initially assumes or has assigned. For example, in recent years EPA has had to invest significantly to develop sufficient expertise in the various types of aquaculture operations and their associated environmental impacts, so that the agency can begin to develop adequate pollution standards for the industry.*
2. *Conflict between different regulatory agencies is inevitable and may compromise environmental standards. For example, NEPA requires the lead federal regulatory agencies to assess the environmental impacts of proposed projects and determine the need for the preparation for an EIS. It is conceivable that USACE could determine that an EA is sufficient based on its analysis of the potential for interference with navigation and recreational use of the particular project. At the same time, however, EPA could conclude that the project's level of nutrient waste discharges requires a full EIS.*
3. *Regulatory framework that has already been stretched to include aquaculture at all may create gaps, allowing some types of OOA to "fall through the cracks." For example, future practices may include mobile operations not tethered to the bottom in a single location. If such an operation is not deemed a potential threat to navigation, it may not even require a Section 10 permit from USACE.*[223]

These limitations reveal the gaps in the existing federal regulatory framework– the absence of a designated lead agency and the absence of a well-defined policy for siting, permitting, leasing, and monitoring environmentally sustainable OOA, in addition to inhibiting potential operators of OOA. Future federal legislation must address these gaps so that federal agencies can assert authority over OOA based on explicit statutory authority.

4.1.5 Emerging Federal Legislation – The National Offshore Aquaculture Act of 2007

[222] Cicin-Sain, B., S. Bunsick, R. DeVoe, T. Eichenberg, J. Ewart, H. Halvorson, R. Knecht, and R. Rheault. *Development of a Policy Framework for Offshore Marine Aquaculture in the 3-200 Mile U.S. Ocean Zone.* Center for the Study of Marine Policy, University of Delaware. July 2001.
[223] Id.

With the conclusion of the 109th Congress at the end of 2006, the Bush administration's National Offshore Aquaculture (NOA) Act of 2005 (what was known as S.B. 1195) expired. The NOA Act of 2005 targeted establishment of a streamlined permitting framework for siting and operation of aquaculture facilities in the federal waters of the EEZ, from 3-200 NM offshore. This bill was criticized by both environmental and fishing organizations for its lack of provisions for protection of marine habitats and wild fish stocks (such protection was left to the discretion of the Commerce secretary), lack of transparency with respect to permitting and environmental review, and lack of overall balance, ignoring as it did, data indicating that significant costs could be associated with the bill's strongly promotional approach.[224,225]

In March of 2007 a revised version of the bill, known as the NOA Act of 2007, was introduced in to the House of Representatives as H.R. 2010 by Congressman Rahall D-West Virginia. As of May 10, 2007, the last action on the bill was its referral to the House Committee on Foreign Affairs on April 24.

The NOAA Aquaculture Program, from which the 2007 bill originated, made a noticeable attempt to respond to critics of the 2005 version. The Aquaculture Program's own summary of the new bill, including its major differences from the 2005 version, are included below as Figure 4.1.5a. (*text continues on page 66*).

Figure 4.1.5: "Highlights of the 2007 NOA Act," excerpted from NOAA (2007).[226]

Environmental Requirements
Permit decisions must take into account environmental requirements and compatibility with other uses - The Secretary of Commerce would be required to consult with other federal agencies and coastal states to identify the environmental requirements that already apply under the current law and to develop additional requirements through rulemaking. - The permit process specifically requires public notification and comment and an analysis under the National Environmental Policy Act (NEPA). - Environmental requirements specifically address risks to and impacts (including cumulative impacts) on natural fish stocks and fisheries, marine ecosystems, water quality, habitat, and marine life. - Environmental requirements specifically include monitoring, record systems to track inventory and movement of cultured fish, and a provision that operators must grow species native to the geographic region unless a scientific risk analysis shows that the risk of harm is negligible or can be effectively mitigated.
Existing laws and regulations would continue to apply - Implementation of the Act would require compliance with the Coastal Zone Management Act. - To the extent practicable, the Secretary of Commerce would ensure that offshore aquaculture does not interfere with fisheries conservation and management or other uses of the EEZ.
Operations would be required to be monitored and permit terms and conditions enforced - The Secretary of Commerce would be required to collect information to evaluate the suitability of sites for aquaculture and monitor the effects of aquaculture, in cooperation with other federal agencies, and take appropriate measures to protect the environment. - The Secretary of Commerce would have the authority to suspend, modify, or revoke permits. (*continued, following page*)

[224] Shapson, Mitchell. "Analyzing the Administration's Ocean Fish Farming Legislation." Fishermen's News, July 2005. Available at http://www.environmentalobservatory.org/library.cfm?refid=78573 (Viewed 6/24/06).
[225] Naylor, R.. 2006. "Environmental Safeguards for Open-Ocean Aquaculture." *Issues in Science and Technology*.
[226] NOAA Aquaculture Program. Legislation fact sheet: "The National Offshore Aquaculture Act of 2007 At a Glance." March 12, 2007. Available at http://www.nmfs.noaa.gov/mediacenter/aquaculture/docs/03_Highlights_2007%20Offshore%20Act%20At%20A%20Glance.pdf

Figure 4.1.5 (continued): "Highlights of the 2007 NOA Act."[227]

[continued from previous page]

In addition to abiding by all permit terms and conditions, permit holders would be required to:

- Post bonds or other financial guarantees,
- Remove structures, gear, and property and restore the site when the permit expires or is terminated.

Permits

Permits would specify the location of the offshore aquaculture operation, the species to be grown, and the type of production system. Most permits would be for 20 years, renewable in increments up to 20 years.

- The Secretary of Commerce would set fees and establish permit terms and conditions.
- Permits would be transferable.
- Anyone could apply for a permit. Foreign persons or entities would be required to maintain a U.S. presence or agent so as to be subject to U.S. law.
- Once all permit requirements are met, the Secretary of Commerce must issue or deny the permit within 120 days, or provide written notification to the applicant with an explanation and timeline for decision.

The Secretary of Commerce would be required to consult with federal agencies, Fishery Management Council, and coastal states before issuing a permit.

- If a state submits written notification that it opposes offshore aquaculture, the Secretary of Commerce may not issue new permits within 12 miles of that state. The notice is revocable, and would not apply to applications received prior to the notice.
- If a site is in a location where other uses are already authorized, planned or permitted under the Outer Continental Shelf Lands Act (OCSLA), or within 1 mile of an OCSLA-permitted facility, concurrence from the Secretary of the Interior is required, and the Secretary of the Interior could impose and enforce additional requirements. The addition of an aquaculture facility would not extend the timeline for decommissioning and removal of OCSLA facilities. *[Note, however, that OCSLA facilities may soon be allowed to be permitted for "alternate uses" such as open ocean aquaculture, under the emerging MMS permitting framework authorized by the Energy Policy Act of 2005 (described above, in Section 2.3, and at page 61).]*

Research

The Secretary would be authorized to establish a research and development program to further marine aquaculture technologies compatible with marine ecosystems, in consultation with other federal agencies.

- The Secretary would be authorized to enter research partnerships with permit holders.
- The Secretary would be required to collaborate with the Secretary of Agriculture to conduct research to reduce the use of wild fish in aquaculture feeds.

What Changed from the 2005 Version of the Act?

Environmental Requirements

- Added an explicit requirement for Secretary of Commerce to establish environmental requirements and monitoring procedures and data requirements (by changing "may" to "shall" in relevant provisions).
- Added more specific language with respect to impacts on natural fish stocks, disease escapes, water quality, cumulative impacts, monitoring, non-native species, and identification of farmed fish.
- Added an explicit requirement for the permit process to be established through rulemaking and consultations with coastal States and regional fishery management councils, including public notice and comment and preparation of an analysis under NEPA.

Permits

- Calls for a single permit (instead of separate site and operating permits) for 20 years (instead of 10 years), renewable in increments of up to 20 years (instead of 5 years).

Role of States

- Added a new provision that would allow any coastal state to opt out of offshore aquaculture within 12 miles of its coastline.

Research

- The provision includes research for all marine aquaculture, not just offshore.
- Added a new provision requiring all collaborative research with the U.S. Department of Agriculture on alternative feed formulas to reduce the use of wild fish in aquaculture feeds.

[227] Id.

(continued from page 64)
Despite changes targeted at mollifying critics, numerous environmental and fishing groups[228] are opposing the 2007 NOA Act based on concerns that the bill would establish a streamlined permitting structure for large facilities without adequate safeguards. According to this unusual assemblage of associations:

> *We strongly oppose the bill because it appears to promote aquaculture, in particular ocean fish farming, at the expense of marine ecosystems and fishing communities. We believe that strong standards to eliminate or minimize the significant environmental and socioeconomic impacts of ocean fish farming must be provided in statutory criteria for issuing permits, and not merely addressed in a subsequent rulemaking process.*
>
> *NOAA's proposed legislation does not contain adequate standards to eliminate or minimize diseases and parasites transmitted from farmed to wild fin fish species; pollution of the marine environment with fish wastes and excess feed; contamination of humans and wildlife from feeds, drugs and chemicals; harm to marine mammals and other wildlife from predator controls; and the decimation of populations of important forage fish such as menhaden, herring and anchovies used to feed carnivorous farmed species. The proposed legislation also fails to develop a precautionary and transparent permitting and regulatory program, provide an adequate role for states and Fishery Management Councils, or protect essential fish habitat and other sensitive ocean sites.*[229]

4.2 CINMS Authority

4.2.1 Legislation and Regulations

The National Marine Sanctuaries Act, 16 U.S.C.§1431 et seq. (NMSA), authorizes the Department of Commerce to designate sanctuaries for "the primary purpose of resource protection" (16 U.S.C. 1431(b)). The Secretary of Commerce delegated the day-to-day management to the National Marine Sanctuary Program (NMSP). Program Regulations, codified at 15 CFR Part 922, describe and define the boundaries of the designated national marine sanctuaries, prohibit specific kinds of activities, and set up a system of permits to allow the conduct of certain types of activities. Each Sanctuary has specific regulations in place to safeguard marine resources within its boundaries, and technical and substantive changes to the regulations can be made at various times, including during the review process of a sanctuary management plan.

---

[228] Institute for Fisheries Resources, Ocean Conservancy, Environmental Defense, Alaska Independent Fishermen's Marketing Association, Alaska Marine Conservation Council. Alaska Trollers Association, Cape Cod Commercial Hook Fishermen's Association, Center For Food Safety, Clean Catch, Columbia River Crab Fishermen's Association, Environment Matters, Fishing Vessel Owners' Association, Food and Water Watch, Go Wild Campaign, Gulf Restoration Network, Kenai Peninsula Fishermen's Association, Mangrove Action Project, Monterey Bay Aquarium, National Coalition for Marine Conservation National Farmers Union, Northcoast Environmental Center, Oceana, Pacific Coast Federation of Fishermen's Associations Pacific Marine Conservation Council, Puget Sound Harvester's Association, Sierra Club, Small Boat Commercial Salmon Fishermen's Association, Southeast Alaska Regional Dive Fisheries Association, Southern Shrimp Alliance, United Fishermen of Alaska. April 24, 2007. Letter to The Honorable Madeline Z. Bordallo, Chairwoman, Subcommittee on Fisheries, Wildlife and Oceans Committee on Natural Resources. U.S. House of Representatives. Washington D.C.

[229] Id.

The CINMS regulations (CFR 15 Section 922.71) prohibit certain activities to protect the cultural and natural resources within its boundaries. Most, if not all, aquaculture projects would fail to conform to these regulations given current technological systems for the activity, effectively (though not explicitly) prohibiting aquaculture within Sanctuary waters. These regulations include:

Prohibition 3 (Discharge or Deposit)
Prohibited: Discharging or depositing any material or other matter except:

(i) Fish or fish parts and chumming materials (bait);

(ii) Water (including cooling water) and other biodegradable effluents incidental to vessel use of the Sanctuary generated by:

(A) Marine sanitation devices

(B) Routine vessel maintenance, e.g. deck wash down;

(C) Engine exhaust; or

(D) Meals on board vessels;

(iii) Effluents incidental to hydrocarbon exploration and allowed exploitation activities

Prohibition 4 (Altering the Seabed)
Prohibited: Except in connection with the laying of allowed pipeline, within 2 NM of any island:

(i) Constructing any structure other than a navigation aid,

(ii) Drilling through the seabed, or

(iii) Dredging or otherwise altering the seabed in any way, other than

(A) To anchor vessels, or

(B) To bottom trawl from a commercial fishing vessel.

The NMSP Director, and CINMS as the issuing body, may permit otherwise prohibited activities if they are "research related to the resources of the Sanctuary, to further the educational value of the Sanctuary; or for salvage or recovery operations."[230] However, the issuance criteria do not provide a clear mechanism to evaluate permit applications in light of whether the activities will, in fact, advance Sanctuary objectives.

4.2.2 Draft Management Plan/Draft Environmental Impact Statement

In accordance with NMSA amendments requiring site management plan updates every 5 years, and a growing body of scientific knowledge revealing the rapid antiquation of its 1983 Management Plan, CINMS began formal management plan review in 1999. Seven years later, CINMS staff overcame resource constraints and extensive bureaucratic hurdles and released a Draft Management Plan (DMP) and complementary Draft EIS (DEIS) to the public in May, 2006.

This section reviews these documents with respect to their applicability to future OOA activities. The DEIS analyzes the environmental impacts associated with regulations in the Proposed Action, Alternative One, and No-Action (Status Quo, see Section 4.2.1 for relevant prohibitions in the existing management plan).

The proposed regulatory actions within the DMP/DEIS would modify and strengthen existing Prohibitions 3 (Discharge or Deposit) and 4 (Altering the Seabed), which would reinforce the implicit prohibition on aquaculture within CINMS boundaries without a special CINMS-issued-

[230] U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Sanctuary Program May 2006. *Channel Islands National Marine Sanctuary Draft Management Plan/Draft Environmental Impact Statement*. Silver Spring, MD.

permit. For example, the DMP/DEIS proposes to replace the term "seabed" with "submerged lands of the Sanctuary" and prohibits altering any of the submerged lands in the Sanctuary rather than merely the first 2 NM from island shores as is currently specified.[231]

In addition, the proposed regulatory updates would prohibit discharging and depositing "from within *or into* the Sanctuary" [emphasis added], with few exceptions, so that "discharging or depositing from beyond the boundary of the Sanctuary any material that subsequently enters the Sanctuary and injures a Sanctuary resource or quality" would be a violation.[232] For example, if an OOA facility located outside the Sanctuary were to discharge excess feed, fish feces and chemicals that subsequently flowed into Sanctuary waters and impaired CINMS water quality, the fish farm could be subject to penalty under the NMSA.

The Sanctuary's Proposed Action also includes a new regulation relevant to OOA: "12. Releasing an Introduced Species." This provision would prohibit "introducing or otherwise releasing within or into the Sanctuary an introduced species, except striped bass (*Roccus saxatillis*) released during catch and release fishing activity."[233] Importantly, the proposed regulation defines "introduced species" as:

> *(1) a species (including but not limited to any of its biological matter capable of propagation) that is non-native to the ecosystems protected by the Sanctuary; or (2) any organism into which genetic matter from another species has been transferred in order that the host organism acquires the genetic traits of the transferred genes.*[234]

Prohibition 12 aims to "prevent injury to Sanctuary resources and qualities, and protect CINMS ecosystem biodiversity and function, all of which are put at risk by introduced species being released or otherwise introduced into the Sanctuary."[235] While neither the proposed regulation nor the discussion in the DEIS refer to fish farming specifically, the prohibition's clear language, and the inclusion of genetically modified organisms in the regulatory definition, indicate direct applicability to the activity. OOA projects outside Sanctuary boundaries would, under this prohibition, be held liable for non-native or genetically modified fish escaping and entering the Sanctuary. The proposed regulations aim to establish "a deterrent against intentional and unintentional releases… into the Sanctuary through civil penalty (up to $130,000 per incident, per day) under the NMSA."[236]

Should the Proposed Action and these regulatory updates be adopted by CINMS, CINMS staff will be authorized to take an active, influential role in the review and permitting process for OOA projects proposed outside but near Sanctuary boundaries. For example, Platforms Grace, Gilda, Gail and Gina all lie relatively short distances from CINMS boundaries, well within range of pollutant plumes or escaped fin fish stock. Enactment of the discharge update could help ensure that CINMS managers are properly consulted should new OOA proposals for these facilities

---

[231] U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Sanctuary Program May 2006. *Channel Islands National Marine Sanctuary Draft Management Plan/Draft Environmental Impact Statement*. Silver Spring, MD. Volume I: Draft Management Plan p.247.
[232] Id., p.246
[233] Id., p.250.
[234] Id.
[235] U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Sanctuary Program May 2006. *Channel Islands National Marine Sanctuary Draft Management Plan/Draft Environmental Impact Statement*. Silver Spring, MD. Volume II: Draft Environmental Impact Statement. p.2-15.
[236] Id.

emerge. Meanwhile, because existing data overwhelmingly demonstrates the inevitability of fish escape from marine fin fish farms, enactment of a prohibition on introducing species to CINMS waters could help ensure that non-native fish, and fish that have been genetically modified for "farm optimization" simply aren't included in future fish farm proposals for the CINMS area.

RECOMMENDATION 8: To protect resources under NMSP jurisdiction from potentially deleterious aquaculture practices in and around waters near CINMS boundaries, CINMS staff should adopt the following regulatory updates proposed in the DMP/DEIS:

- *Proposed Action 3. Discharging or Depositing*, especially the proposed prohibition on discharges that enter and injure Sanctuary waters (Proposed Action 3(F)(ii))
- *Proposed Action 4. Altering the Submerged Lands*
- *Proposed Action 12. Releasing an Introduced Species*

These Proposed Actions represent an opportunity to enhance the Sanctuary's authority to prevent harmful impacts to CINMS resources from future open ocean aquaculture. Accordingly, if the Proposed Actions are adopted, CINMS staff should proactively leverage this influence during permitting processes for any future Santa Barbara Channel fish farm proposals to ensure in advance that they conform to these requirements.

4.3 The California State Regulatory Framework for Aquaculture

Aquaculture conducted within 3 NM of shore falls under state jurisdiction, and is regulated by the laws of the adjacent coastal state. As stated in definitions earlier in the report, aquaculture in this ocean zone is not considered open ocean aquaculture for the purposes of the discussion at hand; existing Sanctuary regulations effectively prohibit fish farming throughout its waters including its area of state waters within three miles of the islands' shore. However, comparing and contrasting California's existing regulatory framework with existing and emerging federal law and policy sheds light on both the management challenges and opportunities that exist in preventing degradation of CINMS resources from future fish farming in the Santa Barbara Channel region

Unlike the federal government, California has a clearly established lead agency for aquaculture, the California Department of Fish and Game (DFG), which is mandated by legislation to enforce current laws and regulations and coordinate with other regulatory agencies including the State Lands Commission, the State Water Resources Control Board, and the California Coastal Commission. The recent Sustainable Oceans Act outlines specific environmental standards for aquaculture leases and regulations in state waters. The following sections describe California's regulatory framework for aquaculture within its realm of ocean jurisdiction.

4.3.1 State Legislation on Aquaculture

The California Aquaculture Development Act of 1979 (California Public Resource Code, Division 1, Chapter 4) stated that the DFG "shall be the lead agency for purposes of the California Environmental Quality Act … for any project involving issuance of a permit required pursuant to Division 12 … of the Fish and Game Code." Division 12 (Sections 15000-15008 of the Fish and Game Code) governs "the business of aquaculture" and touches on a wide array of issues related to the industry, including permitting, operations, environmental assessment, fee structures, security, etc.

The DFG's role in California's management of aquaculture was clarified by 1982 legislation that provided guidelines and authority for aquaculture regulations (California Code of Regulations, Title 14, Natural Resources: Division 1. Fish and Game Commission - Department of Fish and Game). This bill also established three committees to:

> *1) provide information on aquaculture to the industry and to the public,*
> *2) promote an understanding of aquaculture among government, industry, and public sectors, and*
> *3) propose methods of reducing the negative impact of public regulation on the aquaculture industry.*[237]

To facilitate these relations, the DFG created the position of Aquaculture Coordinator in 1987 (Fish and Game Code, Division 12, Chapter 2).

The California Aquaculture Promotion Act of 1995 restructured the three committees to form the current Aquaculture Development Committee and the Aquaculture Disease Committee (Fish and Game Code, Division 12, the Public Resource Code, Section 30411, and the Food and Agriculture Code Sections 23.5, 25.5, and Division 4). The Aquaculture Development Committee consists of at least twelve industry representatives, two representatives from the

[237] Interagency Committee for Aquaculture Development. 1994. *A Guide to California State Permits, Licenses, Laws, and Regulations affecting California's Aquaculture Industry*. State of California.

University of California (science and outreach), and one member each from and chosen by the Department of Food and Agriculture, the California Coastal Commission, the State Lands Commission, the State Water Resources Control Board, the State Department of Health Services, and the Joint Legislative Committee on Fisheries and Aquaculture.[238] The Aquaculture Disease Committee consists of six industry representatives (one of which is the chair), the DFG Fish Hatchery Director, the DFG Director of Pathology, two representatives from UC Davis (pathology and outreach), and the aquaculture advisor for the California Department of Food and Agriculture.[239]

This legislation also required DFG to prepare a programmatic environmental impact report (PEIR) for commercial marine aquaculture operations.[240] However, there were no established criteria for such environmental review, and the draft released for public comment in 2003 was deemed deficient by the DFG.[241] The original draft was funded by the aquaculture industry; the DFG initially lacked funds to complete the required redraft. However, the California Ocean Protection Council recently allocated $300,000 to the project to complete the PEIR (see Section 4.3.4).

Legislation in 2003 (S.B. 245, Chapter 871) established some environmental protections by prohibiting marine aquaculture of salmonids, non-native species of salmonids, and genetically altered or other species non-native to California waters.

On May 26, 2006, Governor Schwarzenegger signed the Sustainable Oceans Act (S.B. 201) authored by Senator Simitian (Palo Alto).[242] The major provisions of S.B. 201, outlined below, set California's aquaculture regulations in stark contrast to the disorganized, almost haphazard federal framework currently in place. The specificity in the standards for siting and operation of marine aquaculture facilities also contrast markedly with the pending federal NOA Act of 2007.

1. Programmatic Environmental Review: State law (Fish and Game Code 15008 (a)) requires the DFG, in consultation with the Aquaculture Development Committee, to prepare PEIRs for commercial aquaculture projects in both coastal and inland areas of the state. If they are approved under the California Environmental Quality Act (CEQA), the reports are to "provide a framework for managing marine finish aquaculture in a sustainable manner that adequately considers specified environmental factors." The arguably exhaustive factors identified in the legislation are listed in Figure 4.3a.
2. Standards of the Lease and Regulations: Leases issued and regulations adopted by the Fish and Game Commission must meet standards described in Fig. 4.3b. According to Fish and Game Code 15400(a), "the commission may lease state water bottoms or the water column to any person for aquaculture, including, but not limited to, marine fin fish aquaculture" as long as "the commission determines that the lease is in the public interest in a public hearing conducted in a fair and transparent manner, with notice and comment, in accordance with

[238] California Aquaculture: UC Davis. See http://aqua.ucdavis.edu/government/cdfgDevnf.html (Viewed 2/4/06).
[239] California Aquaculture: UC Davis. See http://aqua.ucdavis.edu/government/cdfgDiseasenf.html (Viewed 2/4/06).
[240] DFG: News Release. See http://www.dfg.ca.gov/news/news03/03019.html (Viewed 2/4/06).
[241] Bill Analysis: Assembly Committee on Appropriations, June 20, 2005. See http://info.sen.ca.gov/pub/bill/sen/sb_0751-0800/sb_768_cfa_20050628_161432_asm_comm.html (Viewed 2/4/06).
[242] Senate Bill No. 201: Chapter 36. Available at: http://www.leginfo.ca.gov/pub/bill/sen/sb_0201-0250/sb_201_bill_20060526_chaptered.pdf (Viewed 6/3/06).

commission procedures." 15400(b) states that a person shall not engage in marine fin fish aquaculture in ocean waters within the jurisdiction of the state without a lease from the commission. In addition, "leases and regulations adopted by the commission for marine fin fish aquaculture shall meet, but are not limited to, all" of the standards listed in Fig. 4.3b.

3. Terms of the Lease: The FGC may lease the state water bottom or the water column for marine fin fish aquaculture if, during a public hearing "conducted in a fair and transparent manner, with notice and comment," the FGC determines that the lease is in the public interest. The initial term of the lease is less than 10 years. The FGC decides if the lessee has the right to renew the lease or awards the lease to the highest responsible bidder. To terminate the lease, the lessee must remove all structures and return the area to its original condition. For this reason, the FGC requires financial assurances such as surety bonds, credit, or trust funds from each lessee to ensure that restoration is completed to the satisfaction of the FGC.

The full list of FGC standards for submerged lands leases are listed below, in Figure 4.3b.

Fig. 4.3a. Environmental Factors Considered in Marine Fin fish Aquaculture Management (S.B. 201)

(1) Appropriate areas for siting marine fin fish aquaculture operations to avoid adverse impacts, and minimize any unavoidable impacts, on user groups, public trust values, and the marine environment.
(2) The effects on sensitive ocean and coastal habitats.
(3) The effects on marine ecosystems, commercial and recreational fishing, and other important ocean uses.
(4) The effects on other plant and animal species, especially species protected or recovering under state and federal law.
(5) The effects of the use of chemical and biological products and pollutants and nutrient wastes on human health and the marine environment.
(6) The effects of interactions with marine mammals and birds.
(7) The cumulative effects of a number of similar fin fish aquaculture projects on the ability of the marine environment to support ecologically significant flora and fauna.
(8) The effects of feed, fish meal, and fish oil on marine ecosystems.
(9) The effects of escaped fish on wild fish stocks and the marine environment.
(10) The design of facilities and farming practices so as to avoid adverse environmental impacts, and to minimize any unavoidable impacts.

Fig.4.3b. Standards for Fish and Game Commission Leases and Regulations. (S.B. 201)

(1) The lease site is considered appropriate for marine fin fish aquaculture in the programmatic environmental impact report if prepared and approved by the commission pursuant to Section 15008.
(2) A lease shall not unreasonably interfere with fishing or other uses or public trust values, unreasonably disrupt wildlife and marine habitats, or unreasonably harm the ability of the marine environment to support ecologically significant flora and fauna. A lease shall not have significant adverse cumulative impacts.
(3) To reduce adverse effects on global ocean ecosystems, the use of fish meal and fish oil shall be minimized. Where feasible, alternatives to fish meal and fish oil, or fish meal and fish oil made from seafood harvesting byproducts, shall be utilized, taking into account factors that include, but need not be limited to, the nutritional needs of the fish being raised and the availability of alternative ingredients. *(continued, next page)*

(continued from previous page)

(4) Lessees shall establish best management practices, approved by the commission, for each lease site. Approved best management practices shall include a regular monitoring, reporting, and site inspection program that requires at least annual monitoring of lease sites to ensure that the operations are in compliance with best management practices related to fish disease, escapement, and environmental stewardship, and that operations are meeting the requirements of this section. The commission may remove fish stocks, close facilities, or terminate the lease if it finds that the lessee is not in compliance with best management practices, that the lessee's activities have damaged or are damaging the marine environment, or that the lessee is not in compliance with this section. The commission shall take immediate remedial action to avoid or eliminate significant damage, or the threat of significant damage, to the marine environment.

(5) Before issuance of the lease, the lessee shall provide baseline benthic habitat and community assessments of the proposed lease site to the applicable regional water quality control board or the State Water Resources Control Board, and shall monitor the benthic habitat and community during the operation of the lease in a manner determined by the regional board or the State Water Resources Control Board. The regional board and the State Water Resources Control Board may establish and impose reasonable permit fees to pay for the costs of administering and conducting the assessment and monitoring program.

(6) Fin fish numbers and density shall be limited to what can be safely raised while protecting the marine environment, as specified by the terms of the lease, subject to review and amendment by the commission.

(7) The use of all drugs, chemicals, and antibiotics, and amounts used and applied, shall be minimized. All drugs, therapeutic substances, and antibiotics shall be used and applied only as approved by the United States Food and Drug Administration for marine fin fish aquaculture. The lessee shall report that use and application to the commission on a regular schedule, as determined by the commission, but no less than annually, that shall be included in the terms of the lease. The commission shall review those reports on a regular basis and at least annually.

(8) The commission shall require all farmed fish to be marked, tagged, or otherwise identified as belonging to the lessee in a manner determined appropriate by the commission, unless the commission determines that identifying farmed fish is unnecessary for protecting wild fish stocks, the marine environment, or other ocean uses.

(9) All facilities and operations shall be designed to prevent the escape of farmed fish into the marine environment and to withstand severe weather conditions and marine accidents. The lessee shall maintain records on all escapes in a manner determined by the commission. In the event of more than *de minimis* escapement, the number of escaped fish and the circumstances surrounding the incident shall be reported immediately to the commission, and the lessee shall be responsible for damages to the marine environment caused by those escaped fish, as determined by the commission.

(10) The lessee shall, at a minimum, meet all applicable requirements imposed by the State Water Resources Control Board and the regional water quality control boards, and shall prevent discharges to the maximum extent possible. Monitoring and testing of water quality shall be required on a regular basis as deemed appropriate by the State Water Resources Control Board or the regional water quality control boards. All inspection and monitoring reports and other records, and all data on the discharge of chemical and biological pollutants shall be kept on file and available for public review.

4.3.2 Department of Fish and Game (DFG)

The DFG implements Fish and Game Commission (FGC) policies to manage the fish and wildlife resources of the state, and is California's lead agency on permitting aquaculture facilities. The DFG implements the following aquaculture procedures according to the Fish and Game Code and Title 14 of the California Code of Regulations.

1. Registration – The DFG reviews registration applications to ensure that the aquaculture operation would not have a detrimental effect on adjacent native wildlife (California Fish and Game Code Sections 15101-15102).
2. Leases – The DFG issues and administers leases at the direction of the FGC (California Fish and Game Code Section 15400).
3. Permits – The DFG issues permits for stocking and importation (California Fish and Game Code Chapters 3 and 7) (see Appendix B: Permit Track for Offshore Aquaculture).
4. Disease Control – The DFG is responsible for aquaculture disease detection, control, and eradication (not related to human health and safety) (California Fish and Game Code Chapter 6 and California Code of Regulations, Title 14, Section 245).

It is also the DFG's formal responsibility to promote cooperation and communication between other relevant state agencies, through the Interagency Committee for Aquaculture Development. This advisory group is required to comprise representatives of the Department of Food and Agriculture, the California Coastal Commission, the State Lands Commission, the State Water Resources Control Board, the State Department of Health Services, the University of California Cooperative Extension Service, the University of California aquaculture program, and the Joint Legislative Committee on Fisheries and Aquaculture (California Fish and Game Code Section 15800). Meeting at least twice a year, the Committee "shall be advisory to the [DFG] director on all matters pertaining to aquaculture and act in a coordinating role among agencies" (California Fish and Game Code Section 15803).

4.3.3 California State Lands Commission (SLC)

The SLC manages sovereign state tide and submerged lands, and reviews all permits and leases issued by the DFG for use of these lands for aquaculture to ensure that the lands are not being, or planned on being, otherwise used. In addition, the SLC grants permits or leases for exclusive use of state tidelands for improvements such as outfalls, pipelines, fish ladders, or other structures. In these cases, the SLC reviews the proposed project as a CEQA Responsible Agency[243] and uses the Lead Agency's document to make a decision on the project based on CEQA Guidelines §15096.[244]

4.3.4 California State Water Resources Control Board (SWRCB)

The State Board and its nine Regional Boards regulate water quality and resources according to the Porter-Cologne Act of 1969 and federal Clean Water Act. Proposed aquaculture operations

[243] 14 C.C.R. §15381. "Responsible Agency" means a public agency which proposes to carry out or approve a project, for which a Lead Agency is preparing or has prepared an EIR or Negative Declaration. For the purposes of CEQA, the term "Responsible Agency" includes all public agencies other than the Lead Agency which have discretionary approval power over the project.

[244] Personal communication with Robert Hulbrock (Aquaculture Coordinator, California Department of Fish and Game), June 5, 2006.

must be apply for a permit to discharge waste into California waters, and adhere to waste discharge requirements (WDRs), unless waste is discharged to a sewer. These state permits, issued by the jurisdictionally appropriate Regional Boards, can serve as a National Pollutant Discharge Elimination System (NPDES) permit for discharge to surface waters as required by the Clean Water Act.

4.3.5 California Coastal Commission

The California Coastal Commission (CCC) was established by the California Coastal Act of 1976, which mandates that the CCC protect and enhance the resources of the coastal zone. Therefore, the CCC has direct permitting authority in this zone, which extends "seaward to the state's outer limit of jurisdiction, including all offshore islands, and … inland generally 1,000 yards from the mean high tide line" (California Coastal Act. PRC Section 30103).

The Coastal Act encourages aquaculture. First, Section 30411 (c) provides that the DFG may identify coastal sites for aquaculture activities and forward this information to CCC. While "the DFG has not submitted a specific list of sites to the CCC, [it] has given testimony to the CCC in support of aquaculture developments."[245] Second, Section 30411(d) provides that any agency of the state owning or managing land shall make it available for aquaculture use when feasible and consistent with the provision of law. Third, Section 30222.5 protects ocean front land for use by coastal dependent aquaculture.

However, aquaculture facilities in the coastal zone require a coastal development permit from the CCC, or, if a local government has a certified local coastal program (LCP), it can issue coastal development permits within its onshore jurisdiction. Regardless, to receive a coastal development permit, marine aquaculture operations must conform to two key provisions of the Coastal Act. Sections 30320 requires that "Marine resources shall be maintained, enhanced, and where feasible, restored," and that uses of the marine environment are sustainable with respect to biological communities and "long-term commercial, recreational, scientific and educational purposes." Similarly, Section 30231 requires that adverse environmental effects from waste water discharge are minimized such that biological productivity and water quality are maintained, so that "populations of marine organisms" and human health are in turn maintained, and where feasible, restored. These environmental standards represent a vital control on marine aquaculture in State waters, ensuring that sustainable aquaculture practices are followed and facilities only approved in locations where they would be considered environmentally appropriate.

The CCC also has authority under the CZMA (discussed above) to review activities within federal jurisdiction that may affect the state's coastal resources. Since open ocean aquaculture remains an unlisted activity under the California Coastal Management Plan, the CCC must request permission from OCRM to invoke federal consistency review of a proposed open ocean fish farm (a facility beyond the 3NM limit). The CCC requested permission from OCRM to review the consistency of the Grace Mariculture project, but OCRM deferred decision-making until the conclusion of the NEPA process. This process was never completed, because the project's permits were suspended at the request of the applicant.[246] Accordingly, OCRM never approved CCC consistency review for open ocean aquaculture. However, given known potential impacts to marine resources from the activity, the CCC remains desirous of federal approval to

[245] Interagency Committee for Aquaculture Development. 1994. "A Guide to California State Permits, Licenses, Laws, and Regulations affecting California's Aquaculture Industry." State of California.
[246] Personal communication with Audrey McCombs, Specialist for Grace Mariculture Project, California Coastal Commission. June 22, 2006.

list OOA as an activity subject to consistency review, so that the Commission can determine (and potentially influence) whether future open ocean fish farm proposals are consistent with California's Coastal Management Plan.[247]

4.3.6 California Ocean Protection Council

The California Ocean Protection Council (the Council) was established by the California Oceans Protection Act (COPA) of 2004. COPA was a recommendation of *Protecting Our Ocean: California's Action Strategy*, or the Ocean Action Plan, which represents the official response from the California Resources Agency and California Environmental Protection Agency (CalEPA) to the findings of the Pew Oceans Commission and the U.S. Commission on Ocean Policy. The Council consists of the Secretary of the Resources Agency, Secretary of Environmental Protection, Chair of the State Lands Commission, and two nonvoting, ex officio members, one from the Senate and one from the Assembly, and exists to help protect and manage California's ocean and coastal resources and implement the Ocean Action Plan. The Council has recognized that "sustainable aquaculture" practices are far from mature from a technical standpoint, and thus require further study.[248]

On June 8, 2006, the Council authorized the use of $300,000 to complete a coastal aquaculture PEIR, which the DFG had been previously unable to complete because it lacked funding. Since the restoration of funding the DFG aims to complete the PEIR in accordance with the criteria established in the Sustainable Oceans Act (S.B. 201); the PEIR will identify and discuss potential environmental impacts, thresholds of significance, and mitigation strategies.[249]

The environmental review will serve many purposes. First, the FGC will likely use the PEIR "to provide background and support for drafting, discussion, and possible adoption of regulations"[250] to govern marine fin fish aquaculture leases. Second, CEQA Lead Agencies will use the PEIR as the first tier of CEQA review, which will likely result in greater consistency of review for proposed aquaculture operations. For example, as the CEQA Lead Agency for state aquaculture leases, the FGC will "rely heavily upon the PEIR in considering individual lease sites and lease terms and conditions."[251] Furthermore, potential aquaculture project sponsors will use the PEIR as a guidance document to bring their attention to potential environmental impacts and the need to mitigate those impacts.

The Council's decision to fund the PEIR is consistent both with its interim project selection criteria and guidelines, and California's Ocean Action Plan, Actions 10 and 13.[252] The PEIR,

---

[247] Caldwell, M., California Coastal Commission Chair September 15, 2005. "Aquaculture Off the California Coast: Law and Policy Issues." Luncheon Briefing on Science and Policy.
[248] Akins, Leah and Page Nelson. 2005. *California Ocean and Coastal Information, Research, and Outreach Strategy Needs Workshop: Final Summary.* Available at: http://www.calost.org/reports/NeedsWorkshopReportNov04FINAL.pdf (Viewed 6/14/06).
[249] California Ocean Protection Council: June 2006 Meeting. See http://resources.ca.gov/copc/6-8-06_meeting/0606_OPC_Book/0606COPC11D_Aquaculture_PEIR.pdf (Viewed 6/28/06).
[250] Id.
[251] Id.
[252] Actions 10 and 13 of the California Ocean Action Plan, respectively, call to "pursue, support, implement, and establish long-term funding for coordinated ecosystem management approaches at the federal, state, and local levels to guide and improve the stewardship of ocean and coastal resources" and "identify and prioritize issues that may benefit from additional coordination by the California Ocean Protection Council."

which could be completed by summer 2007,[253] will set environmental standards for aquaculture development in California and could serve as an example for similar legislation to other states as well as the federal government.

RECOMMENDATION 9: CINMS staff and stakeholders should formally acknowledge California's current leadership in marine fin fish aquaculture management, support and leverage the State's existing standards for aquaculture siting, operations, and reclamation, and, in the absence of a federal framework, generally encourage extension of the state's standards and policies as established by the Sustainable Oceans Act into the federal waters of the EEZ.

4.3.7 California Water Quality and Natural Resource Protection Areas

Specific state regulations guide the management of protected areas located with the CINMS. First, the State Water Control Resources Board has designated Areas of Special Biological Significance (ASBS) in the waters around San Miguel, Santa Rosa, and Santa Cruz Islands (ASBS No. 17) and in the waters around Santa Barbara and Anacapa Islands (ASBS No. 22).[254] Both ASBS extend from the mean high tide one nautical mile offshore, or to the 300-ft isobath, whichever is greatest.[255] In some cases, the 300-ft isobath extends to the 3 NM boundary, representing the limit of state jurisdiction (see *Figure 4.1*, map of selected features and ocean jurisdictions, on page 47).

Legislation effective January 1, 2003 (A.B. 2800 (Chapter 385, Statutes of 2000)) classified ASBS as subsets of State Water Quality Protected Areas (SWQPAs) and legislation effective January 1, 2005 (S.B. 512 (Chapter 864, Statutes of 2004)) clarified that ASBSs require special protection as determined by the State Water Board pursuant to the California Ocean Plan. The Ocean Plan[256] prohibits waste discharges to the ASBS, unless an exception is granted by the State Water Resources Control Board:

> *Waste shall not be discharged to areas designated as being of special biological significance. Discharges shall be located a sufficient distance from such designated areas to assure maintenance of natural water quality conditions in these areas.*

Within a SWQPA, on the other hand, "point source waste and thermal discharges shall be prohibited or limited by special conditions. Nonpoint source pollution shall be controlled to the extent practicable."[257] These SWQPA protections are less comprehensive than the absolute discharge prohibition for ASBS.[258] Therefore, OOA facilities in or near the Sanctuary would be prohibited from discharging into ASBS, unless, according to the COP, an exception "will not

---

[253] California Ocean Protection Council: June 2006 Meeting. See http://resources.ca.gov/copc/6-8-06_meeting/0606_OPC_Book/0606COPC11D_Aquaculture_PEIR.pdf (Viewed 6/28/06).
[254] Resolution No. 74-28 (March 21, 1974), Resolution 74-32 (April 18, 1974), and Resolution 75-61 (June 19, 1975).
[255] SWRCB 2003. *Areas of Special Biological Significance: California's Marine State Water Quality Protection Areas.* Pamphlet.
[256] SWRCB (2005). California Ocean Plan. See http://www.swrcb.ca.gov/plnspols/docs/oplans/oceanplan2005.pdf (Viewed 6/14/06).
[257] Id.
[258] Porter-Cologne Water Quality Control Act (Water Section Code 13000 *et seq*.) broadly defines waste in both ASBS and SWQPA, including sewage, among other things.

compromise protection of ocean waters for beneficial uses, and [t]he public interest will be served." The State Water Board would have to hold a public meeting, comply with CEQA, and get EPA approval prior to granting an exception.[259]

Second, the FGC adopted a network of Marine Protected Areas (MPAs) to preserve the Sanctuary's natural resources in November 2002. By April 2003, the DFG implemented, and now manages, 10 State Marine Reserves (SMRs), where no take of living, geological, or cultural resources is allowed except for permitted scientific collection, and 2 State Marine Conservation Areas (SMCAs), where limited commercial and/or recreational fisheries are allowed. The SMRs total approximately 132 square NM, or 19% of state waters within the Sanctuary, and the SMCAs contribute an additional 10 square NM of the Sanctuary.[260]

Areas of Special Biological Significance, Marine Reserves or Marine Conservation Areas would seem to be extremely unlikely sites for OOA project proposals, due to the stringent regulations of both these special areas, CINMS regulations, and public perception of the purpose of these places. However, given the current clues as to the future scale of commercial fish farming, it does not seem implausible that a waste plume (or escaped stock) from hypothetical aquaculture operations at Platforms Grace or Gail could penetrate Sanctuary boundaries and even the marine protected areas within the 3NM limit of state jurisdiction. Interestingly, ASBS prohibitions have the potential to control discharges outside ASBS boundaries in order to prevent discharge from entering into the area via ocean currents and subsequently degrading water quality, in a manner similar to the "enter and injure" regulatory provision being considered for adoption by CINMS staff.

4.4 Conclusion

RECOMMENDATION 10: In order to implement the recommendations of this report and future SAC advice, to ensure that CINMS regulations are upheld, and to best protect Sanctuary resources, qualities and existing uses, CINMS staff should participate, consult and comment *directly* in the permitting processes for any future Santa Barbara Channel region aquaculture facility proposals. Concurrently, the SAC should uphold its general mandate by reviewing application materials for future fin fish aquaculture proposals and formally advising CINMS staff on the Council members' findings and concerns.

[259] SWRCB (June 16, 2006). *Draft ASBS Special Protections to Address Storm Water and Nonpoint Source Waste Discharges*. See http://www.waterboards.ca.gov/plnspols/docs/asbs/special_protections_jun142006_draft.pdf (Viewed 7/8/06).

[260] CINMS Monitoring: Final Draft Monitoring Plan (Feb 2004). See http://www.dfg.ca.gov/mrd/channel_islands/monitoringplan0204.pdf (Viewed 3/19/06).

Appendix A -
Brief information on marine fin fish aquaculture in Hawaiian Islands Humpback Whale National Marine Sanctuary

Marine Fin fish Aquaculture in Hawaiian Islands Humpback Whale National Marine Sanctuary

The Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) is currently the only National Marine Sanctuary with marine fin fish aquaculture within its boundaries. Kona Blue Water Farms (KBWF), a division of Black Pearls, Inc., obtained an ocean lease in November 2003 for a 90 acre "hatch-to-harvest" Kona Kampachi® net cage operation located less than 1 NM offshore. KBWF also obtained the following permits: Section 10 permit from USACE in March 2004, Finding of No Significant Impact (FONSI) on their EA from the Department of Land and Natural Resources (DNLR) in June 2003, a NPDES permit in June 2004, and an approval for their Conservation District Use Application (CDUA) in August 2004.[261] Unlike all the other Sanctuaries, including CINMS, HIHWNMS does not issue permits for otherwise prohibited activities within their boundaries, but rather works within the existing permit processes of other federal and state authorities (15 CFR 922.187). HIHWNMS raised concerns about the loss of habitat, specifically for endangered humpback whales in the Sanctuary, but KBWF assured permitting agencies that, "Taut line moorings will eliminate risk of entanglement. Cages and moorings will not present significant obstruction to whale movements. Laws protecting threatened species will be followed."[262]

[261] Personal Communication with Sean Hastings, Channel Islands National Marine Sanctuary.
[262] Final Environmental Assessment for an Offshore Open Ocean Fish Farm Project off Unualoha Point, Kona, Hawaii (July 29, 2003). Prepared for Land Division, Department of Land and Natural Resources. Prepared by Kona Water Farms. See http://www.blackpearlsinc.com/3_4.shtml (Viewed 7/3/06).

Appendix B -
Bibliography for Pew Oceans Commission excerpt, Figure 3.2.1 on p. 24 (entries copied from Report bibliography).

CEQ. Council of Environmental Quality. Office of Science and Technology Policy, Executive Office of the President. 2000. CEQ/OSTP Assessment: Case studies of environmental regulation for biotechnology, case study one: salmon. 6 Apr. 2001. http://www.ostp.gov/html/ceq_ostp_study2.pdf

Daley, B. 2001. Escaped farm salmon raise alarm in Maine. Boston Globe 23 Feb. 2001.

FAO 2000b. The state of world fisheries and Aquaculture 2000. Rome, Italy.

Fleming, I.A., and S. Einum. 1997. Experimental tests of genetic divergence of farmed from wild Atlantic salmon due to domestication. ICES Journal of Marine Science 54:1051–1063.

Fuller, P. 2000. Salmo salar Linnaeus 1758. 4 Apr. 2000. Nonindigenous aquatic species program. Florida Caribbean Science Center, United States Geological Survey. 8 Apr. 2001. http://nas.er.usgs.gov/fishes/accounts/salmonid/sa_salar.html

FWS/NOAA. 2000. Fish and Wildlife Service/National Oceanic and Atmospheric Administration. Endangered and threatened species; final endangered status for a distinct population segment of anadromous Atlantic salmon (Salmon salar) in the Gulf of Maine. Federal Register 65(223):69459–69483.

Hindar, K. 2001. Interactions of cultured and wild species (draft). Marine aquaculture and the environment: a meeting for stakeholders in the Northeast. University of Massachusetts, Boston. 11–13 Jan. 2001.

HSRG. 2000. Puget Sound and Coastal Washington Hatchery Scientific Review Group. Dec. 2000. Scientific framework for artificial propagation of salmon and steelhead. 4 Apr. 2001.

Johnson, M.S. 2000. Measuring and interpreting genetic structure to minimize the genetic risks of translocations. Aquaculture Research 31:133–143.

McGinnity, P., C. Stone, J.B. Taggart, D. Cooke, D. Cotter, R. Hynes, C.McCamley, T. Cross, and A. Ferguson. 1997. Genetic impact of escaped farmed Atlantic salmon (Salmo salar L.) on native populations: use of DNA profiling to assess freshwater performance of wild, farmed, and hybrid progeny in a natural river environment. ICES Journal of Marine Science 54:998–1008.

McKinnell, S., and A. J. Thomson. 1997. Short communication: recent events concerning Atlantic salmon escapees in the Pacific. ICES Journal of Marine Science 54:1221–1225.

NMFS/FWS. 2000. National Marine Fisheries Service /U.S. Fish and Wildlife Service. November 2000. Guide to the listing of a distinct population segment of Atlantic salmon as endangered. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. 21 May 2001.

Reichhardt, T. 2000. Will souped up salmon sink or swim? Nature 406:10–12.

Volpe, J.P., E.B. Taylor, D.W. Rimmer, and B.W. Glickman. 2000. Evidence of natural reproduction of aquaculture-escaped Atlantic salmon in a coastal British Columbia river. Conservation Biology 14(3):899–903.

Zitner, A. 2001. Gene-altered catfish raise environmental, legal issues. 2 Jan. 2001. latimes.com. 21 May 2001. http://www.latimes.com/news/nation/updates2/lat_gene010102.htm

Appendix C -
List of some of the chemicals associated with marine fish farming, and their effects on health and the environment (Table excerpted the from Pew Oceans Commission report)[263]

Some Chemicals Used in Aquaculture and Potential Environmental and Health Effects

Type of Chemical	Examples of Chemicals	Potential Risks	Chemical Usage
Antibiotics[i]	Oxytetracycline (Terramycin); Sulfadimethoxine-ormethoprim (Romet[20]®); Amoxicillin trihydrate	Development of resistant bacteria; residues in food	Used on catfish and salmonids to treat various fish diseases
Parasiticides	Cypermethrin[ii] (Excis®)	Acute toxicity to marine organisms	Controls sea lice outbreaks on salmon
	Carbaryl[iii] (Sevin®)	Acute toxicity to marine organisms	Reduces burrowing shrimp infestations on oyster beds in Washington State
	Trichlorfon[iv]	Acute toxicity to marine organisms	Kills parasites in ornamental fish ponds; "special local need" permit required
	Formalin[v] (Parasite-S®)	Toxic; irritant to handlers	Controls fungus, protozoa, and trematodes on finfish
Fertilizers[vi]	Various nitrogen, phosphorus, and trace element mixes	Contribute to nutrient enrichment	Stimulates algae production in pond systems
Anesthetics[vii]	Methanesulphonate (Tricaine-S®)	Suspected carcinogen	Anesthetizes finfish
Spawning Hormones[viii]	Human chorionic gonadotropin (Chorulon®)	Minimal	Induces spawning in finfish
Oxidants[ix]	Potassium permanganate	Explosive; irritant to handlers	Used in pond systems to kill disease organisms and phytoplankton
	Hydrogen peroxide	Irritant to handlers	
	Calcium hypochlorite	Toxic; irritant to handlers	
Algicides and Herbicides	Copper sulfate[x]	Toxic to aquatic life at high dosages; irritant to handlers	Used in pond systems to reduce nuisance plant growth
	Chelated copper[xi]	Toxic to aquatic life at high dosages	
	Simazine[xii]	Effects on liver and thyroid in humans; carcinogen	
	2,4-D[xiii]	Effects on the blood, liver, and kidneys in animals; possible carcinogen	
	Diquat bromide[xiv]	Effects on kidneys in humans	
	Potassium ricinoleate[xv]	Minimal	

[263] Goldburg, et al. 2003 "Marine Aquaculture in the United States: Environmental Impacts and Policy Options." In: *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. Pew Oceans Commission.