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The Politics, Economics, and Ecology of Decommissioning Offshore Oil and Gas Structures

Final Technical Summary

Final Study Report

U.S. Department of the Interior
Minerals Management Service
Pacific OCS Region

The Politics, Economics, and Ecology of Decommissioning Offshore Oil and Gas Structures

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FINAL TECHNICAL SUMMARY

STUDY TITLE: The Politics, Economics, and Ecology of Decommissioning Offshore Oil and Gas Structures

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BACKGROUND: California has entered a new era of outer continental shelf (OCS) oil and gas activity. The decommissioning of offshore oil and gas facilities is rapidly becoming an issue of public concern, scientific study, and policy debate. Government, scientists and special interest groups have proposed the rigs-to-reefs alternative to complete removal. We explore the history, economics, ecology, politics of the rigs-to-reefs option in the Gulf of Mexico and California.

OBJECTIVES: (1) To identify the costs and benefits of various options to decommission California OCS oil and gas structure; (2) To describe the history of California's artificial reef program; (3) To characterize the political and ecological factors that have contributed to the policy debate over rigs-to-reefs as an alternative to complete removal of platforms slated for decommissioning; and (4) To characterize the political ecology of Gulf of Mexico's state rigs-to-reefs programs.

DESCRIPTION: In general, the transition from exploration/development to decommissioning of offshore oil and gas facilities marks a fundamental change in the history of OCS oil and gas activity. This report describes the political, economic, ecological policy-related factors that influence the debate over the rigs-to-reefs option to complete removal of California OCS oil and gas structures. We use John Kingdon's "revised garbage can model" and analytical framework to show that there is a political ecology to decommissioning policymaking in the Gulf and California OCS regions. Decommissioning policy (including the development of the rigs-to-reefs option) is shaped by the distinct ecological and political contexts of the Gulf and California. Section One is a brief introduction to the report. Section Two describes the ecological, political and historical context of California OCS oil and gas activity. Section Three describes the potential costs and benefits of various options to decommissioning of California OCS oil and gas structures. Section Four describes the history of California's artificial reef program and the policy debate over a rigs-to-reefs option to complete removal in the State Legislature. We also describe the political ecology and policy development of Gulf state rigs-to-reefs program. Section Five describes the ecology and history of the National Fisheries Enhancement Act of 1984, state artificial reef programs, and the adoption of the rigs-to-reef alternative in the Gulf of Mexico OCS Region.

SIGNIFICANT CONCLUSIONS: We show that state and federal decommissioning policymaking is based on economic and ecological factors that reflect particular regional and political settings. In the Gulf region, the rigs-to-reefs "idea" was less an invention and more a mutation of an old idea. The rigs-to-reefs idea represented the coupling of an already familiar activity of building artificial reefs in the Gulf to enhance commercial and recreational fisheries. The use of familiar ideas, such as the idea of artificial reef building in the Gulf, by policy entrepreneurs and experts is referred to as the "act of recombination". The rigs-to-reef policy idea represented a recombination of an old solution (the reliance on artificial reefs to enhance fisheries) to a perceived new problem (the lack of natural habitat and potential economic impacts associated with complete removal of OCS oil and gas structures).

In southern California, the political debate over the decommissioning of oil and gas structures involves the intermingling of ecological information, economic factors, preferences and interests associated with OCS oil and gas activity.

The southern California context is much different from that of the Gulf experience. Gulf states are willing to accept the rigs-to-reefs alternative, and have developed state policy and programs. Gulf state rigs-to-reefs programs continue to serve the needs and interests of commercial and sports fishing industries. In California, State Senator Dede Alpert has re-introduced (for a third year in a row) legislation that may lead to the creation of a state rigs-to-reefs program under the California Department of Fish and Game. We describe the ecological, economic and historical factors that are part of the California rigs-to-reefs debate.

STUDY RESULTS: In the case of the Gulf, an advocacy coalition that combined the interests of the oil industry, recreation and commercial fishing, scientists, and resource managers supported the use of offshore rigs as artificial reefs. The development of oil and gas in the Gulf OCS led to an increase in commercial and sports fishing activity. Scientific reports and workshops spoke to the benefit of artificial reefs in the Gulf. States and local artificial reef programs had been established before the passage of the National Fisheries Enhancement Act (NFEA) of 1984. In passing the NFEA, the federal government granted discretionary authority to states to create their respective rigs to artificial reef program. Many of these programs were based on existing artificial reef programs.

Despite the intent of the National Fisheries Enhancement Act of 1984, which fostered the development of Gulf state rigs-to-reefs programs, there remain a number of issues and concerns associated with the use of rigs as artificial reefs in California. The major issues and concerns that general public, the scientific community and policymakers are facing include the following:

(1) *The Liability Issue*. Since the publication of the National Artificial Reef Plan, which recommended that the US Army Corps of Engineers develop specific permit standards and conditions, the issue of liability remains vague and unclear. The Corps has developed a policy requiring the permit holder of an artificial reef to prove adequate liability coverage. Gulf states with reefing programs have assumed the role of the permittee. This has necessitated a close review of the role of the states and localities in implementing the NFEA. Clarification of this issue would improve operational procedures and potentially reduce uncertainty about exposure on the part of state artificial reef managers.

(2) *Scientific Uncertainty: Production versus Aggregation*. Scientists and policymakers remain concerned about the production versus aggregation question. It remains unclear if rigs attract or produce fishes. Some scientists and policy makers contend that too much emphasis has been placed on adult fishery enhancement activity associated with offshore structures, and not resources have been spent on restoring essential coastal processes, such as estuarine habitats and wetland ecosystems (the “nurseries of the sea”).

(3) *Limited Funding*. Since the passage of the NFEA, Gulf state and California artificial reef programs have not received adequate funding. State artificial reef programs maintain an average staff size of 1 full-time employee. Most funds are generated from either state appropriations or Wallop-Breaux funds, which refer to the 1984 Wallop-Breaux Amendment to the Federal Aid in Sport Fish Restoration Act (16 U.S.C. sec. 777 (1988)). Oil companies

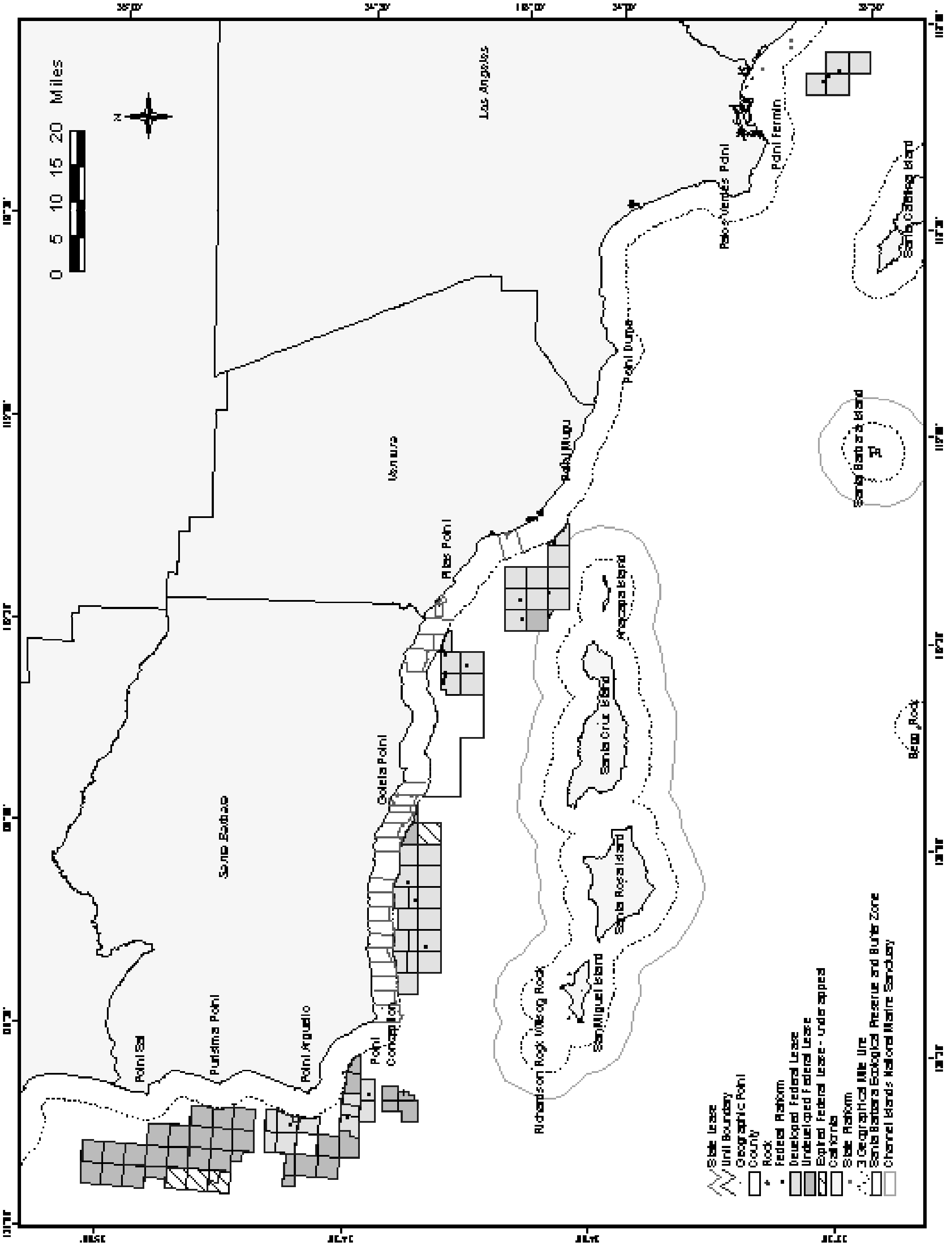
that "donate" structures are asked to contribute half of the disposal savings realized to the Fund. In addition, monitoring of existing artificial reefs and regulatory compliance issues remain important concerns of state artificial reef managers.

STUDY PRODUCTS: This final report is included in the UCSB's Ocean and Coastal Policy Center's webpage. In addition, the report has been submitted for peer review as a special symposium on decommissioning policymaking to the journal *Policy Studies Review*.

Michael Vincent McGinnis, Linda Fernandez, Caroline Pomeroy. The Politics, Economics, and Ecology of Decommissioning Offshore Oil and Gas Structures. MMS OCS Study 2001-006. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-30761. 96 pages.

Map 1. Map of the Southern California Bight, from Point Conception to the Mexican Border.

Map 2. Map of Active Federal Leases in the study area.



FINAL STUDY REPORT

SECTION ONE
INTRODUCTION TO THE REPORT
By Michael Vincent McGinnis

California has entered a new era of outer continental shelf (OCS) oil and gas activity. The decommissioning of offshore oil and gas facilities is rapidly becoming an issue of public concern, scientific study, and policy debate. This report describes the political, ecological, and economics of the decommissioning policymaking. The decommissioning issue is more than a matter of the technology-in-use. The politics of decommissioning policymaking is influenced by the context of the particular OCS region – the history of oil and gas activity, global economics and our reliance on fossil fuels, and marine science (studies of oceanography, ecology, biogeography, climate and biology). Decommissioning policymaking is influenced by regional ecological, economic and political factors.

This report addresses three primary questions:

(1) What are the potential costs and benefits of various options to decommission California OCS oil and gas structures?
(2) What is the history of California's artificial reef program, and how does it fit into the current policy debate over rigs-to-reefs as an alternative to complete removal of platforms slated for decommissioning?
(3) What is the policy history of state artificial reef and rigs-to-reefs programs in the Gulf of Mexico OCS?

To address these questions, this report is divided into four sections:

Section Two describes the ecological, political and historical context of California OCS oil and gas activity. In general, the transition from exploration/development to decommissioning of offshore oil and gas facilities marks a fundamental change in the history of California OCS oil and gas activity. The debate over the rigs-to-reefs option to complete removal of OCS oil and gas structures is situated in a particular political and ecological setting, which is very different from the Gulf OCS Region. Rather than construction and operation of oil and gas facilities (or what one Minerals Management Service employee ironically referred to as the development of the “oil and gas ecosystem”), the oil industry is mandated by international, federal and state law to completely remove offshore oil and gas structures. Currently, a number of representatives from government resource agencies and interest groups are proposing the “rigs-to-reef” alternative. We refer to the offshore oil rigs as “organic machines” – some oil rigs include tons of biomass. In this sense, the offshore structures of the Southern California Bight include organic material.

Section Three describes the potential costs and benefits of various options to decommissioning of California OCS oil and gas structures. Per the recommendation of the MMS Pacific OCS Region staff, this section analyzes three decommissioning options: "Complete Removal", "Partial Removal" (such as removing the platform from one marine location to another) and "Leave-in-Place". We identified variables that are associated with the costs and benefits of these three alternatives. We also determined monetary values to quantify these costs and benefits, then compared those costs and benefits of each alternative within and across categories.

We found a range of values associated with each alternative, suggesting that they can be compared relatively, with low and high bounds of the ranges enabling the ranking of alternatives. The range for Partial Removal has an upper bound that makes accounting for two sites (original platform site and site where rig is transported to) less attractive than the Complete Removal and Leave-in-Place alternatives. The overlap of ranges for Complete Removal versus Leave-in-Place means it is more likely that each platform should be considered individually in order to derive more specific estimates of costs and benefits to weigh alternatives. However, economies of scale from grouping platforms together for Complete Removal can be considered by accounting for spreading the costs from the engineering and planning, mobilization and demobilization, and platform and structural removal across several platforms.

Since this part of the study is an objective information document, we do not rank alternatives. Instead, our results identify the factors associated with decommissioning alternatives, especially for platforms standing in varied water depths that often exceed the depth of platforms that have been decommissioned in other geographic areas such as the Gulf of Mexico.

One category of interest that is not quantified here is liability. The oil producer retains all liability for the platform and wells under each of the decommissioning options.[1] Liability for accidents during lease clearance and abandonment is a cost to contend with in terms of personal injury, property damage and environmental damages for the Complete Removal alternative. Platforms can become top-heavy from biofouling growth that supports fisheries habitat. For both the Partial Removal and Leave-in-Place alternatives, liability for any recreational or fishing accident that might occur constitutes an additional cost. The liability issue remains a concern in California decommissioning policymaking. This lingering liability suggests that platform operators need to reserve financial resources to cover these potential costs.

Sections Four and Five employ the model developed by John Kingdon in his book, *Agendas, Alternatives and Public Policy* (1995). Kingdon provides a useful framework to characterize the policy developments. He uses a revised version of a classic essay by Cohen-March-Olsen (1972) on the "garbage can model of organizational choice" to explain the politics of agenda setting and policy generation.

Kingdon (1995) describes the policy making process as chaotic and turbulent. Public choices are not always based on scientific understanding. This type of political process operates on the basis of "trial and error", "learning from accidents of past experiences, " or on the basis of "inventions of necessity" (Cohen, March and Olsen 1972: 1). Choices are based on a variety of "inconsistent and ill-defined preferences", according to Cohen, March and Olsen (1972: 1-2), "To understand processes … one can view a choice opportunity as in a garbage can into which various kinds of problems and solutions are dumped by participants as they are generated."

Ideas are generated by policy "entrepreneurs", specialists, techno-experts in government, industry or non-government organization. Kingdon (1995) and other social scientists (such as Anton 1989 among others) describe the policy entrepreneur as an advocate who plays the fundamental role in "opening" a policy window by offering a solution to a

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[1] In the Gulf of Mexico, liability is transferred to the state at the point the structure is accepted by the state as an artificial reef, under the state's respective artificial reef programs (See Section Four of this report). The oil structure is transferred to the state (or, in some cases, another public entity) after the state has obtained a Corps of Engineers permit for an artificial reef development.

perceived problem. These solutions are not only based on some level of scientific information but perceptions and values as well. This process of exchange of information, partisan mutual adjustment, and communication is dynamic and fluid. Political elites and other participants in the process can act as policy entrepreneurs.

The specialist, technocrat, bureaucrat, policy elite, and expert play the role of policy entrepreneur. "Many ideas are possible in principle," notes Kingdon (1995: 19), "and float around in a primeval soup in which specialists try out their ideas in a variety of ways – bill introductions, speeches, testimony, papers and conversation." The policy entrepreneur *identifies* the problem and *offers* solutions. Without the entrepreneur, the idea will remain floating in the "primeval soup". Experts, specialists, and policy elites *couple solutions to problems* and couple "problems and solutions to politics" (Kingdon 1995: 20).

The capability of the entrepreneur to open "policy windows" and set government agendas depends on three separate, but interrelated, processes:

- Problems: the set of issues in particular public policy areas that come to capture the attention of those in and around government at any one time;
- Policy articulation: a process involving gradual accumulation of knowledge and perspectives among specialists in a policy area, and the resulting generation of policy proposals by those specialists;
- Politics: trends and events in the overall political environments, such as interest group campaigns and administrative changes.

Kingdon metaphorically refers to these processes as separate "streams" -- the political, problem and policy stream.[2] Policy change can occur when the streams join to form a "policy window of opportunity". The window opens when the political climate is ripe for policy change, when a problem is recognized by political elites, and when a solution is successfully developed and proposed by policy "entrepreneurs".

We use Kingdon's model and framework to show that there is a political ecology to decommissioning policymaking in the Gulf OCS and California OCS. Decommissioning policy (including the development of the rigs-to-reefs option) is shaped by the distinct ecological and political contexts of the Gulf and California. The next section turns to an analysis of the costs and benefits of California OCS decommissioning options.

Section Four describes the history of California's artificial reef program and the policy debate over a rigs-to-reefs option to complete removal in the State Legislature. Although the California Department of Fish and Game (CDFG) began a program of artificial reef research and development in 1958, legislation providing for the formal establishment of the program and allocation of (limited) personnel and financial resources did not occur until 1985. CDFG initiated its program of artificial reef development in the late 1950s in the interest of enhancing nearshore sport fishing opportunities in southern California. Using donated

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[2] Kingdon's model is based on the earlier work of Michael Cohen, James March and Johan Olsen, "A Garbage Can Model of Organizational Choice, " *Administrative Science Quarterly* 17 (March 1972): 1-25. Cohen *et al.* argue that "…organizations can be viewed for some purposes as collections of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be an answer, and decision makers looking for work." The Cohen *et al*. "garbage can model" is the foundation for Kingdon's framework to study agenda setting. For a critique of the "garbage can model" see Gary Mucciaroni, "The Garbage Can Model and the Study of Policy Making: A Critique," *Polity*, Vol. 24, 3 (Spring 1992): 459-482.

materials (due to a lack of funding), the Department oversaw the construction of several artificial reefs (such as at Paradise Cove in Northern Santa Monica Bay and Redondo Beach). CDFG biologists used these reefs to test the effectiveness of such structures in attracting fish; the study showed aggregation of fishes at both “reef” sites. This success led to a program to investigate the cost-effectiveness and practicality of different reef materials using a series of "replication reefs” in Santa Monica Bay. These studies determined that quarry rock was the most effective material (Lewis and McKee 1989:3).

From the late 1960s through 1980, little systematic study was done on these or newly placed reefs. In 1980, however, CDFG began a major program of artificial reef construction and research in connection with Southern California Edison's required mitigation for the negative impacts of warm water discharge on coastal kelp beds. That mitigation plan included a 6-year cooperative project with CDFG for the construction of Pendleton Artificial Reef (in northern San Diego County) and studies to evaluate the reef's potential for enhancing marine resources (Lewis and McKee 1989:3). Although it was clear that the reefs attracted fish, there were concerns this could lead to increased local fishing pressure and resultant negative effects on populations. Next, the program turned to an emphasis on designs that would promote production (by augmenting shelter and forage), as well as attraction. Research has shown that high relief, open structures serve best to attract fish, and better enable fishery exploitation, while low relief, complex structured reefs provide better nurseries and afford more diverse assemblages of fish and other organisms. An anonymous CDFG biologist noted, a drawback to rigs as reefs is that they are high relief, which works against survival of young-of-the-year fish, suggesting they may not be a source of production but rather simply an attraction site.

Artificial reef construction thus became one aspect of CDFG's Nearshore Sportfish Habitat Enhancement Program for restoring or enhancing sportfish habitat along the southern California coastline (Lewis and McKee 1989:1). The program's objective is to maintain sportfishing success in the face of the effects of increasing fishing pressure as well as negative impacts on the nearshore ecosystem (Lewis and McKee 1989:1). It is supported, in part, by Dingell-Johnson/Wallop-Breaux Federal Aid in Sport Fish Restoration Act Funds.

Although CDFG is charged with managing the state's artificial reefs and the program, several other agencies play a role in the pre-construction permitting process. Siting artificial reefs in California waters requires a (federal) permit from the U.S. Army Corp of Engineers (under Public Law 98-623. Title II); a coastal development permit from the California Coastal Commission (CCC); and a lease from the State Lands Commission (SLC) for activity on submerged state lands. In waters outside the three-mile state jurisdiction, an SLC permit is not required, but the CCC must issue a consistency finding before the Corps of Engineers will issue a permit. Other agencies that may be involved in the process include the U.S. Coast Guard (for navigation) and the MMS (when the proposed project involves an oil and gas structure). Any decision will require an environmental analysis performed by the lead agency.

At present, there are some 35 artificial reefs consisting of hundreds of modules off the coast of California. In general, administrative resources to support monitoring these sites and the CDFG's program are quite limited. Three CDFG personnel are assigned to the program part-time. There are no funds available for building new reefs, so materials for any new construction come from demolition projects or other donations. The CDFG maintains a keen interest, however, in building several large reefs.

Meanwhile, CDFG periodically monitors and continues to augment two artificial reefs outside of state waters. These reefs were permitted prior to any public discussion about CDFG's role in a rigs-to-reefs program. When CDFG lawyers started looking at rigs-to-reefs, they informed CDFG personnel that they have no legal standing beyond California state waters, with the exception of the two above-mentioned reefs.

In 2000, for a second year in a row, Senate Bill (SB) 241 failed to come to a vote in the California Legislature. SB 241 would have created a voluntary program whereby platform operators would yield to a portion of cost savings from partially removing or leaving a platform in place to support fisheries mitigation projects. SB 241 would not release operators from liability, but has provisions that essentially limit or constrain liability. The issue of liability could reduce the incentives for platform operators to pursue the rigs-to-reefs option.

Section Five describes the political ecology and history of the National Fisheries Enhancement Act of 1984 (NFEA), state artificial reef programs, and the adoption of the rigs-to-reef option in the Gulf of Mexico OCS Region. The section also uses the conceptual framework developed by Kingdon (1995).

The NFEA includes the following: 1) the recognition of social and economic values in developing artificial reefs, 2) establishment of national standards for artificial reef development, 3) calls for creation of a National Artificial Reef Plan under leadership of the Department of Commerce, and 4) establishment of a reef-permitting systems under the US Army Corps of Engineers that limits the liability of participants in the program. The law strongly encourages the development of artificial reefs but authorizes no direct appropriations for administration, planning, construction, enforcement, monitoring, or research on artificial reefs.

The NFEA was enabling legislation that allowed Gulf states to develop and implement rigs-to-reefs programs. State programs have been developed out of existing artificial reef programs and the NFEA with scarce resources and little administrative support (Murray 1994).

Soon after the MMS established an artificial reef policy that encourages the conversion of selected obsolete oil and gas structures to artificial reefs on the OCS with the particular focus on the value of fishery enhancement. The Gulf states and the federal government took a keen interest in developing rigs-to-reefs programs because of the economic values associated with recreational and commercial fisheries near rigs. In June 1986, Louisiana enacted legislation (Act 100--The Louisiana Fishing Enhancement Act) authorizing a state-directed rigs-to-reefs program. The program is administered by the Louisiana Department of Wildlife and Fisheries and conducted jointly with staff from Louisiana State University. Texas has a rigs-to-reefs program. There are more than 150 permitted artificial reefs off Florida, Alabama, Mississippi, and Texas.

Several artificial reef policy-related issues remain vague and unclear. Based on the findings of Murray (1994), this section concludes with a brief discussion of the problematic nature of the liability issue, the scientific dispute and debate over attraction versus production, and the concern over artificial reef administration and funding. These issues and concerns should be resolved if states are going to effectively and responsibly develop and implement artificial (and rigs-to-reefs) programs.

SECTION TWO
THE ORGANIC MACHINES OF THE SOUTHERN CALIFORNIA BIGHT
by Michael Vincent McGinnis

This section describes the political ecology of decommissioning of California OCS oil and gas rigs. In general, the transition from exploration/development to decommissioning of OCS oil and gas facilities marks a fundamental change in the history of California OCS oil and gas activity. The debate over the rigs-to-reefs alternative to complete removal is shaped by political, ecological, ethical and economic considerations. California OCS oil and gas structures should be thought of as "organic machines".[3] An organic machine is a metaphor for the combination of organic (living) material and machinery.[4]

There are currently 27 offshore platforms in southern California. The focus of this section is on those offshore platforms in the Santa Barbara Channel. Many of these mechanical structures have nearly reached the end of their economic production. Some of these mechanical structures are the size of the Empire State Building, and include some 75,000 tons of metal, concrete and wood. These structures also exist in a complex and dynamic ecological context that is shaped by biology, oceanography and climate-related factors (McGinnis 2000).

Because of the ambiguous relationship between marine life and offshore structures, a political and scientific debate over the rigs-to-reefs option to complete removal of offshore oil and gas structures is inescapable. There are potential ecological, economic, and political consequences to decommissioning. The National Research Council (NRC 1985) estimates that the cumulative costs for removal of all platforms in the OCS could total $2.9 billion by 2005 and $9.9 billion by 2020. The Governmental Account Office (GAO 1994) reviewed offshore structure removal operations and concluded that we need to better understand the risk of ecosystem damage posed by certain decommissioning practices, such as the use of explosives as a removal technique.

There are a number of important ecological and economic factors that are influencing the debate (McGinnis 1998). The question of costs and benefits associated with decommissioning options is the focus of Section Three. Rock fish represent $3 billion in sports fishing values and between $200 to 300 million annually in commercial landings. Preliminary evidence from Love (1997) and Love *et al*. (1999) show that between 90 to 95% of fish near rigs are rock fish. Populations of rockfish off southern California -- an area within the Southern California Bight that includes about 70 species of fish harvested by both recreational and commercial fisherman -- have dropped to 8% of their 1960 populations (Love, Caselle and Van Buskirk 1998; Love *et al*. in press). The significant decline of several rock fish species is not only a sign of the current low-nutrient regime (which began in 1977) but also a sign that rock fish have been over-fished by recreational and commercial fishers (Love, personal correspondence 2001). Field studies show that some rigs in the Santa Barbara Channel include juvenile Bocaccio, which may be listed as a threatened species in accordance

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[3] We agree with Kristin Shrader-Frechette and Mike McCoy (1994) who argue that the science of ecology includes categorical values. Our general use of the term "ecology", therefore, implies both science and sensibility.

[4] Drs. Jenny Dugan, Mark Page and others are currently investigating the biomass associated with some offshore oil rigs.

to the U.S. Endangered Species Act (Pacific Marine Conservation Council 1999).[5] There is also evidence that suggests that the largest Bocaccio exist near the bottom of offshore rigs.

There is currently a political debate over the future of California offshore oil rigs. The political debate is shaped by the ecological setting of the Southern California Bight, the economics of platform removal, and the uncertainty over the potential "fishery-related values" that may be associated with particular rigs in the Santa Barbara Channel. The debate is "trans-scientific"; it involves the intermingling of values and scientific information.[6] There is no easy answer or policy-related resolution to the debate over the future of California offshore oil rigs. Nevertheless, given the ecology of the Southern California Bight, the recent Scientific Advisory Committee on Decommissioning from the University of California (Holbrook, Ambrose, Botsford, Carr, Raimondi, and Tegner 2000: 3-5) wrote:

> *There is not any sound scientific evidence (that the Committee is aware of) to support the idea that platforms enhance (or reduce) regional stocks of marine species*. The primary reason for this conclusion is that the 27 platforms represent *a tiny fraction* of the available hard substrate in the Southern California Bight, so their contribution to stocks of most reef organisms is likely to be small relative to the contribution from natural reefs … The Committee found that the possible regional effects on a stock of habitat removal are much harder to assess than the short-term ecological impacts localized at the site of the platform because most marine species are composed of a series of local populations that are connected via larval dispersal of young stages. Thus, *populations are interdependent*, and impacts at any one location (a reef or platform) must be viewed in the context of the regional set of local populations. Regional effects cannot be projected at present because we do not fully understand how local populations are connected (such as we know that larvae are transported and older individuals move between various reefs, artificial reefs and oil platforms, but we do not understand specific links among local populations) nor do we know the degree to which populations on artificial structures are self-sustaining ...

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[5] In February 2001, the Center for Marine Conservation, the National Resources Defense Council and the Center for Biodiversity sued the National Marine Fisheries Service for failing to list the Bocaccio as a threatened species in accordance to the U.S. Endangered Species Act. The abundance of Bocaccio is less than 5% of their historical population in the northern Channel Islands. The Bocaccio is one species among several species of rockfish that are showing serious signs of decline in abundance and distribution in the Bight (Love, *et al*. 2001).

[6] Marine managers and planners cannot depend on scientific information to resolve the debate over the merits of the rigs-to-reefs alternative for the following general reasons: 1) There exists a mismatch between scales of atmospheric and oceanographic processes and the spatial and temporal dimensions of biological studies and research (such as McGowan, *et al*. 1998). As McGowan, *et al*. (1998: 210) write in their published article in *Science*, "Much of the biological, observational evidence is disconnected spatially and often discontinuous temporally ... we must accept less than ideal data in our attempt to understand what is happening"; 2) Marine science has yet to link information on oceanographic regimes with information on habitat distribution and marine biodiversity. Studies do not show how larger-scale conditions affect the general health of the local populations and marine habitats; and 3) There are few long-term and interdisciplinary studies of marine ecosystems. Marine scientists tend to focus on the distribution and abundance of marine species and habitats. In summary, we know very little about the function, processes and structures of marine systems (Costanza *et al*. 1998; NRC 1999 among others).

> Thus, in light of the strong evidence of the benefit and the relatively small contribution of platforms to reef habitat in the region, evaluation of decommissioning alternatives in our opinion should not be based on the assumption that platforms currently enhance marine resources [emphasis added].

Over 70% of the natural rocky reef habitat of the Southern California Bight exists around the Channel Islands (Dailey, *et al*. 1993). Given the ecology of the Southern California Bight and the presence of natural rocky reef habitats, the Committee proposes that the ecological benefits associated with artificial habitats around offshore platforms may not warrant a rigs-to-reefs alternative to complete removal.[7] In many respects, the ecology of the Bight is shaping the politics over decommissioning policymaking.

The politics of California decommissioning policy includes such issues as the question of “attraction versus production”, liability considerations, and funding to administer a potential California rigs-to-reefs program. These issues are described further in Section Four by Carrie Pomeroy. The political and ecological setting of California OCS oil and gas activity is shaping the debate over how to deal with the organic machines of the Bight.

The Notion of Organic Machines

In *The Organic Machine,* Richard White (1995) describes the relationship between human beings and hydropower development of the Columbia River. According to White (1995), the river has been transformed into an organic machine that can literally be turned on or off, like a house faucet. The “river” also includes several species of endangered and threatened plants and animals. In this sense, the organic machine combines both natural and artificial or mechanical components. Since the 1930s, White (1995) shows that hydropower development has *denatured* the once wild, free-flowing river into an organic machine.

White’s notion of the organic machine is a useful metaphor to describe the relationship between marine ecology (oceanography, biogeography and climate-related factors of the SCB) and OCS oil and gas activity. For some, the first mechanical act is the denaturing of nature, such as the threats posed by industrial development to species diversity (McGinnis 1999). For others, the machine has become “natural habitat” worthy of further study or protection as refuge (UCLA 1999; Alpert 1999).

Recent evidence in the decline of several marine species during the warm water regime, such as rock fishes, has led to arguments in favor of the rigs-to-reefs alternative to complete removal. Some advocates of the rigs-to-reefs alternative turn to the Gulf region as an example. But the political ecology of the Gulf of Mexico, which is briefly described in Section Five, is very different from the political ecology of the Bight. The significant level of offshore oil and gas development in the Gulf has led to a dependence of offshore structures as recreational and commercial fishing areas. Historically, the level of public support for oil and gas development has been accepted by local communities and states of the Gulf while residents of southern California have attempted to “get oil out” . To protect fishing interests, commercial and recreational fishing groups, state and federal resource agencies in the Gulf lobbied for a federal law to allow a rigs-to-reefs alternative to complete removal of offshore structures. States like Alabama do not have natural hard bottom habitat and now depend on artificial reefs to create fisheries, such as red snapper. This is not the case in southern California. There is a limited amount of natural marine habitat in the Gulf of Mexico. This is

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[7] The Committee’s report is supported by Love, *et al.* (2001), The Ecological Role of Natural Reefs and Oil and Gas Production Platforms in Rocky Reef Fishes in Southern California 1998-1999 Survey Report. US Department of the Interior. US Geological Survey. Biological Resources Division. Minerals Management Service. Pacific OCS Region. OCS Study MMS 2001-028. March.

not the case in the Bight. In short, the political ecology that is associated with each region often shapes the politics of how to treat the organic machines of the Gulf of Mexico and the Bight.

California OCS Oil and Gas Activity

A comprehensive survey of the early history of oil and gas development in Santa Barbara County is found in Lima (1994). Industrial histories for the region can also be found in the work of Molotch and colleagues (MMS 1998a, b, c).

Offshore oil and gas development has occurred in leased tracts in California waters (hereafter referred to as State waters) from the mean high tide line to 3 miles offshore, and Federal waters (from 3 to 200 miles offshore).

There is six offshore oil structures in California waters. These structures were installed prior to the passage of the National Environmental Policy Act of 1969 and the California Coast Act of 1972.

The MMS issues leases for natural gas and oil exploration in Federal waters off California. The only leases remaining are off southern California. These include 79 leases offshore San Luis Obispo, Santa Barbara and Ventura Counties. In 1999, forty-three of these leases are producing a total of 125,000 barrels per day of oil and over 215,000 cubic feet of gas per day.

There are currently 27 platforms in the Bight and approximately 200 miles of associated pipelines. The field, platform, installation date (year), and depth of the platform of oil and gas activity are found in Table 1. Both the installation date and platform depth should be recognized as important factors related to decommissioning. For example, decommissioning costs vary by water depth (MMS 1999). As noted in Table 1 a few of the offshore structures are over 1,000 feet deep.

Table 1. Active Units on Federal Leases off Santa Barbara County.

Field	*Platform(s)*	*Installation Date*	*Platform Depth (meters/feet)*
Hueneme	Gina	1980	29/95
Santa Clara	Gilda	1981	62/205
	Grace	1979	96/318
Dos Cuadras	Hillhouse	1969	58/190
	A	1968	58/190
	B	1968	58/190
	C	1977	58/190
Carpinteria	Henry	1979	52/174
	Hogan	1967	47/154
	Houchin	1968	49/163
Sockeye	Gail	1987	224/739
Pitas Point	Habitat	1981	88/290
South Ellwood*	Holly	1966	66/211
Hondo	Hondo	1976	255/842
	Harmony	1989	363/1,200
Pescado	Heritage	1989	326/1,075
Point Arguello	Hermosa	1985	184/603
	Harvest	1985	205/675
	Hidalgo	1986	130/430
Point Pedernales	Irene	1985	73/242

Based on information from *California Offshore Oil and Gas Energy Resources Baseline Conditions & Future Development Scenarios* (1999): 2-16 – 2-44 and California Coastal Commission (1999). Note, there are additional platforms at various depths off Orange County, including Edith (49m), Elly (80m), Ellen (80m), and Eureka (212m) in Federal waters, and Emy, Eva and Esther in State waters.
* oil and gas development on California State Leases.

A brief characterization of each developed field offshore Santa Barbara County follows.

- The Hueneme Field is located in the eastern Santa Barbara Basin approximately four miles southwest of Port Hueneme. The field is produced from Platform Gina, which is located approximately 6 miles from shore. This field is in a mature stage of development and production is declining.
- The Santa Clara Field is located in the eastern Santa Barbara Basin approximately 7 miles west of Oxnard. The field is produced from Platforms Gilda and Grace. Gilda is located approximately 10 miles from shore. Grace is located in the eastern Santa Barbara Basin, and is located approximately 10 miles north of Anacapa Island. As of August 1998, the Minerals Management Service (MMS) indicates that the operator has shut in or plugged and abandoned all the production wells at Platform Grace. The Santa Clara Field is in a mature development stage with total production declining.
- The majority of the West Montalvo Field is located onshore. The field extends offshore into the California State submerged lands. The field is produced from onshore wells, some of which are directionally drilled under the ocean. There are no platforms or drilling islands used to produce these offshore reserves, and the onshore wells produce from State leases.
- The Rincon Field is located in State waters. Eight onshore wells and an artificial island are used to produce from State leases. The current owner is evaluating methods to increase production of this field.
- The Dos Cuadros Field is located in the eastern Santa Barbara Basin, approximately 6 miles southwest of Carpinteria. The field is produced from four platforms including Platform Hillhouse, Platforms A, B, and C. All platforms are located 6 miles from shore. The field has reached a mature stage and most wells exhibit a decline in production.
- The Carpinteria Field is located in the eastern Santa Barbara Basin, approximately 4 miles south of Carpinteria. The field is developed from both State and Federal leases. The State leases were produced by Platforms Hope and Heidi. These two platforms were removed in early 1996. Federal leases are produced from Platforms Hogan, Houchin, and Henry. This field is a mature and in an advanced stage of depletion.
- The Sockeye Field is produced from Platform Gail, approximately 11 miles west of Port Hueneme. This field has reached a mature development stage.
- The Pitas Point Field is produced from Platform Habitat, approximately 8 miles from shore. The field is in decline and has a limited future productive life.
- The South Ellwood Field is located in State waters near Goleta, and is produced from Platform Holly, approximately 2 miles from shore. There is indication that this field is also in a mature level of development.
- The Hondo Field is produced from Platforms Hondo and Harmony in Federal waters, approximately 6 miles from shore.
- The Pescado Field is produced from Platform Heritage, approximately 8 miles from Gaviota.
- The Point Arguello Field is located in the southern part of the Santa Maria Basin, approximately 6 miles from shore. Platforms Hermosa, Harvest and Hidalgo are used to produce the field’s oil.

- The Point Pedernales Field is located in the southern Santa Maria Basin, approximately 6 miles west of Point Pedernales. The field is produced from Platform Irene.

The total production and future projection of oil and gas production for the period 1995 to the end of 2015 is found in Table 2. California OCS oil and gas production is expected to decline by the year 2015.

Table 2. Oil and Gas Production and Projections.

Year	Oil (MMSTB)	Gas(BCF)
1995	73.99	57.69
2000	48.65	83.15
2015	4.38	35.00

Source: California Offshore Oil and Gas Energy Resources Baseline Conditions & Future Development Scenarios. January 30, 1999.
MMSTB = million stock tank barrels
BCF = billion cubic feet

Undeveloped Leases

Commencing in the 1920s, the California State Legislature placed most of the California coast off limits to oil and gas leasing and development through a variety of oil and gas “sanctuary” statutes. However, large areas of the coast and submerged lands (0 to 3 miles offshore) remained unprotected. By 1989, the State Lands Commission filed in the remaining gaps in California “sanctuary statutes” and administratively foreclosed the possibility of new oil and gas leasing in State coastal waters, with few exceptions. This administrative sanctuary was later incorporated by the legislature in its comprehensive ban on new oil and gas leasing, through the California Coastal Sanctuary Act of 1994 (California Coastal Commission 1999). Pursuant to this California statute, all state coastal waters, except those under lease on January 1, 1995, are permanently protected from development.

Except for the limited geographic area of waters within the National Marine Sanctuaries, no portion of the federal Outer continental shelf (OCS) has a permanent moratorium on oil and gas leasing and development (California Coastal Commission 1999).[8] A temporary moratoria have been in place since 1982 (California Coastal Commission 1999). In addition to Congressional moratoria, the Bush and Clinton administrations issued directives under the OCS Lands Act to restrict leasing of new offshore areas. In 1990, President Bush directed that all areas protected by Congressional moratoria be deferred for leasing consideration until after the year 2002. This deferral included the federal OCS offshore of California. In June 1998, President Clinton also issued a directive under the OCS Lands Act that prevents the leasing of any area currently under moratorium for oil and gas exploration and development prior to June 30, 2012. These OCS “presidential deferrals” can be reversed by subsequent administrations.

The existing Congressional moratoria and presidential leasing deferrals do not restrict development of already federally leased areas. Thirty-six federal leases remain in a “non-producing” status. These 36 leases were leased between 1968 and 1984. These 36 tracts are

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[8] There is also the Federal Ecological Preserve and Buffer Zone offshore Santa Barbara County.

in the Santa Barbara Channel or the Santa Maria Basin. This means that there are several undeveloped leases that are not producing natural gas and/or oil, although some of these leases have been explored.

A few new platforms may be needed to develop the following federal leases (California Coastal Commission 1999: 23): Santa Maria, Purisma Point, and Point Sal. The MMS has granted a series of lease suspensions or extensions upon lessees' requests or directed suspension by the MMS Regional Director. When MMS receives a request for suspension, its options are to either approve or deny the request based upon the criteria in the MMS regulations. The future of these undeveloped leases is currently the subject of debate between policy makers. For a comprehensive review and summary of this issue, see California Coastal Commission (1999), *California Offshore Oil and Gas Leasing and Development Status Report*.

Decommissioning of California Offshore Oil and Gas Structures

Early development of onshore oil and gas wells in San Luis Obispo, Santa Barbara and Ventura Counties was not accompanied by adequate policies or techniques for abandonment or decommissioning of these onshore oil and gas structures (Muller 1997). Some of these wells pose health and environmental risks, remain a major source of oil seepage, and are recreational hazards (County of Santa Barbara Planning and Development Department, undated).

California OCS oil and gas production has occurred since the mid-1960s (Lima 1994). Advances in modern technology fostered the development of OCS oil and gas reserves (Lima 1994). These oil platforms have a finite economic lifespan; several platforms are nearing the end of the economic operation. Most of California OCS oil and gas platforms and structures will need to be decommissioned within the next 15 years.

To date, only seven relatively small structures have been decommissioned; all were located in State waters. The most recent project occurred in 1996 when Chevron removed Platforms Hope, Heidi, Hilda and Hazel. These platforms were in water depths ranging from 100 to 140 feet. One hundred and thirty-four wells were plugged and abandoned on these platforms. In order to remove the rigs to be brought ashore for recycling and disposal, explosives and heavy machinery were used to tear the rigs from their foundations. The biomass that accumulated around these OCS oil and gas structures was destroyed during the decommissioning activity (MMS 1998d).

Current Regulatory Requirements

As of May 2000, international, federal and California law requires the complete removal of offshore oil and gas structures. A comprehensive review of the regulatory requirements is found in Minerals Management Service (1998d), California Coastal Commission (1999) and Santa Barbara County Energy Division (2000). As a brief overview, the regulatory compliance requirements are as follows:

- US Minerals Management Service: Federal regulation (30 CFR 250) requires the plugging and abandonment of wells; 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.

- California Department of Conservation, Division of Oil, Gas and Geothermal Resources: The basic plugging requirements are found in the California Code of Regulations Title 14 Division 2, Chapter 4, Section 1745.
- California State Lands Commission: The basic plugging requirements are found in the California Code of Regulations Title 2 Section 2128(q).

There are also lease and permit requirements that must be met during decommissioning of offshore oil and gas structures. Provisions of federal and state oil leases and MMS regulations can be changed by the state and federal government to allow the federal government to consider and approve methods of rig decommissioning other than complete removal, as evidenced in the Gulf of Mexico. With respect to California, Carolita Kallaur (Kallaur 1998: 10), the Associate Director for Offshore Minerals Management with the U.S. Department of the Interior, MMS writes, “MMS does not have a position one way or the other as to the rigs-to-reefs program here in California. We believe that is an issue that falls primarily within the regulatory jurisdiction of the California Department of Fish and Game, Army Corps of Engineers, and the California Coastal Commission.” California’s Department of Fish and Game (CDFG), the agency with oversight over the state’s artificial reef program, has policy guidelines in place for artificial reefs with a preference for those structures that provide “good” habitat.

New Policy Initiatives

Legislation introduced in the California legislature by Dede Alpert for a third consecutive year seeks to incorporate the provisions of the federal *National Fisheries Enhancement Act of 1984 (33 U.S.C. Sec. 2101 et seq.*). The National Artificial Reef Plan, developed pursuant to the *National Fisheries Enhancement Act of 1984,* identifies oil and gas structures as materials for development of offshore artificial reefs.

There is approximately 4000 OCS oil and gas platforms in the Gulf of Mexico. Approximately 100 platforms per year are decommissioned in the Gulf. Some of these platforms, in accordance to the Act and existing state artificial reef programs, are used as artificial reefs. Louisiana has established reef zones, such that platforms are completely removed, the sites “restored”, and platform components are deposited at a designated reef zone and enhanced with habitat-forming materials. In some instances in the Gulf, platforms are toppled in place if all government and non-government parties agree. The Gulf States (primarily Louisiana and Texas) assume full liability for the artificial reefs. It is important to note that the culture and socioeconomic characteristics of Gulf States and the biophysical features of the Gulf of Mexico are very different from those of southern California.

The Ecology of the Offshore Oil Rigs

The ecology of the Southern California Bight (SCB) is a contributing factor in the scientific and political debate over the future of oil rigs. OCS Oil and gas activity should not be understood in isolation from the ecology of the SCB. California OCS oil and gas structures are located and embedded in the SCB, a marine ecosystem that includes an area between Point Conception (in south-central California) and Punta Banda (south of Ensenada, Baja California, Mexico) (Dailey, *et al*. 1993).

The SCB is a system of relationships between circulating water masses and currents, various geochemical processes, oceanographic processes, microorganisms, phytoplankton, zooplankton, fishes, a rich flora of benthic macroalgae and seagrasses, benthic invertebrates, an abundance of nutrients and other organisms.[9] Where a rig or platform is in this oceanographic system of the SCB is one factor that can shape the level of biomass and organic matter associated with a rig.

The biomass associated with California OCS oil and gas structures often depends on the relationship between the biology of the structure and the oceanographic setting. This is a dynamic setting influenced by changing ecological patterns, oceanographic currents, and climate-related events, such as El Niño or La Niña. Ocean-climate variability is an important factor contributing to the ecology of the Bight.[10] Life around a platform should not be thought of as a "steady state". As the University of California's Scientific Advisory Committee on Decommissioning (Holbrook, *et al*. 2000: 4) note, "The particular species present at any given platform depend on the biogeographic setting of the platform and its depth, as well as other factors." The biogeographic setting of each rig can change over time. The character to marine life that we witness around the rigs today can change as the complex relationship between oceanography, biology and climate-related factors as changes. Life around a platform may change in a context of ocean-climate variability.[11] A decommissioning policy option that treats all 27 platforms the same across spatial and temporal scales would be unwise because it would fail to understand the impacts at any one rig in the dynamic and complex ecological context of the Bight (Holbrook, *et al*. 2000).

Biogeography

Offshore structures are embedded in one or more of these biogeographical provinces. The spatio-temporal scale of the biogeographical provinces change in accordance to hydrographic conditions of the SCB and climate perturbation. Rigid classification of these three biogeographical provinces is not recommended because such a classification inevitably de-emphasizes the complex and shifting interrelationships of these regimes (Horn and Allen 1978).

Offshore oil and gas structures are situated within one of three biogeographical provinces of the SCB. The northern Channel Islands straddle two faunal provinces and respective oceanographic regimes (such as the warm and cold temperate) (Murray and Littler 1981). San Miguel lies in the colder waters of the Oregonian Province, while Anacapa and Santa Barbara Islands are embedded in the warmer Californian Province. The eastern side of Santa Rosa Island and Santa Cruz Island lie in the transition zone between the two provinces. The transition zone is described as a third biogeographical province that affects the ecosystems of the islands (Murray and Bray 1993). The transition zone shifts position with time depending on the relative strengths of the causal processes.

Other studies of distribution patterns of species support the presence of two primary faunal regimes. California fish fauna assemblages may be classified into two groups -- those associated with cold- and warm-water masses (Horn and Allen 1978).

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[9] The spatio-temporal scale of dynamic and complex marine systems is difficult for human beings to predict. Hydrographic circulation patterns and climate events, such as El Niño, span scales of up to thousands of kilometers. The large range of spatial and temporal features of marine systems make it difficult to predict and understand ecological relationships and linkage.

[10] Human activity, such as pollution, oil development and fishing influence the ecology of the SCB (McGinnis under review).

[11] I have proposed the idea of a "living permit" as one response to variability (McGinnis 1998).

Transition Zones

Some offshore structures are embedded in a transition zone between these two water masses. This is particularly true for those oil and gas structures that are located within the Santa Barbara Channel. A transition zone involves an active interaction between two or more systems across their respective “boundaries”. This interaction between provinces results in a transition zone that includes properties from both systems. It can also result in a high-level of marine species diversity.

Marine scientists provide evidence for the transitional nature of the *entire* SCB using quantitative analyses of compositions of insular and mainland intertidal floras, which appear to show affinities of both warm- and cold- temperate biotas (Murray and Littler 1981).

The SB Channel includes patterns of warm, saline water from the Southern California Countercurrent and the colder water from the California Current. Upwelling often occurs where these water masses meet, near the massive headlands of Point Arguello and Point Conception, as well as along much of the California coast, depending on the season. Upwelling plumes expand southward from headlands and frequently enter the SB Channel on the southern side of the western mouth (Atkinson *et al*. 1986). There can be a channelwide response to upwelling north of Point Conception (Auad *et al*. 1998). Oceanographic thermal fronts are abundant in the SB Channel and form as a consequence of upwelling and of current shear between the two primary currents (Harms and Winant 1998).

The extent to which cold water enters the SB Channel is variable (Harms and Winant 1998). Moreover, the SB Channel includes mesoscale eddies that are important to the general health of particular species and organisms in the region. The changing character of the SB Channel eddy, for example, and its potential role in enhancing survivorship of fishes during El Niño events has been observed (Nishimoto and Washburn, under review). Nishimoto and Washburn (under review: 8) propose that persistent cyclonic eddies in the SB Channel are “important local mechanisms for offsetting large-scale declines in marine populations associated with climate variations.”

The importance of the SB Channel as a transition zone is linked to spatial and temporal variability observed in fish assemblages within habitats of the marine environment. Cross and Allen (1993) review the ecology of fishes in the major habitats of the SCB. In addition, Schroeder (1999) provides preliminary evidence that the large amount of spatial and temporal variability observed in fish assemblages within habitats is primarily associated with the SB Channel’s dynamic oceanography. In addition, recently published evidence (Nishimoto 1999) suggests that mesoscale spatial distributional patterns of pelagic juvenile fishes reflect hydrography and circulation in the SB Channel. Nishimoto and Washburn (under review) provide evidence that the closed circulation of persistent eddies can retain fishes through their early life histories. Behavioral responses to abiotic and biotic factors associated with eddies in the SB Channel may also be important in distribution, recruitment and survival (Love *et al*. 1999).

Changing Oceanographic Conditions

The mean circulation in the SCB is dominated by the poleward-flowing Southern California Countercurrent (Harms and Winant 1998). The California Current, which is fed by the West Wind Drift, is the eastern limb of the North Pacific gyre. This current turns shoreward near the southern US border, and a branch of the current turns poleward into the SCB, where it is known as the Southern California Countercurrent. The Southern California

Countercurrent flows equatorward along the west coast of the US throughout the year. This countercurrent is strongest in summer and winter. This counter current draws warmer water from the south and forces the water northwest through the Channel Islands.

The confluence of the California Current and the Southern California Countercurrent has been shown to affect the abundance and distribution of marine species (Dailey, *et al*. 1993). The systems of the SCB, including the Channel Islands and the biology of offshore oil and gas structures depend on relationships between circulating water masses and currents. Because the oceanography and climate of the SCB changes, the spatio-temporal character of marine life on or around particular offshore oil and gas structures will change.

Regime Disturbance in the SCB

The SCB is one of the most studied marine systems in the world (Hickey 1993). Members of the California Cooperative Oceanic Fisheries Investigations (CalCOFI) have studied the SCB since 1950 (Scheiber 1995). CalCOFI information provides an up-to-date characterization of some of the major ecological components and trends of the SCB. CalCOFI studies show that circulation within the SCB is highly variable in time and space, and is determined by the relative strengths of wind stress and oceanographic pressure gradients through the Santa Barbara Channel (SB Channel). For example, El Niño Southern Oscillation (ENSO) events have had dramatic effects on the flow patterns of the SCB (Chelton *et al*. 1992). Changes in the flow patterns have been shown to have a number of biological impacts:

- population shifts in commercially-harvested species, such as squid, rockfish and lobster;
- transport of enormous volumes of sediments and suspended materials from the mainland to coastal and offshore waters;
- disturbance to critical marine habitats, notably storm and water temperature damage to kelp forests.

Marine scientists show that large-scale changes, or what is referred to as a *regime shift*, in the physical and biological processes can lead to change in the distribution and abundance of some marine species. A regime shift changes the basic nature of marine ecology for several decades at a time (or on the order of several human generations). McGowan, *et al*. (1998) state that the last regime shift occurred in 1977. Based on an analysis of CalCOFI data,[12] Roemmich and McGowan (1995a, b) document large-scale changes in primary and secondary productivity throughout the SCB between 1951 and 1993. Hayward *et al*. (1996) and McGowan, *et al*. (1998) show that large-scale biological responses in marine ecology due to climatic variations in the atmosphere has resulted in changes in geographical ranges and spatial patterns of species and in community structure. This evidence suggests that the maintenance of community structure and patterns of native species diversity has changed in accordance to hydrographic perturbations and climate-ocean variability. A summary of the changes described by marine scientists is below (McGinnis 2000, under review):

- <u>The Euphotic Zone (upper sunlight zone of the sea, less than 120 m thick)</u>: Smith and Kaufmann (1994) show a long-term deficit in the supply of food necessary to

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[12] CalCOFI has compiled several spatially and temporally comprehensive data sets for the SCB from strategically located offshore stations (Hickey 1993: 21-25).

meet the metabolic demands of the sediment community. The long-term increase in sea surface and upper water column temperatures and physical stratification in the system has resulted in a lower rate of supply of nutrients to the euphotic zone; a decrease in productivity and a general decline of zooplankton and other species (such as larval fish production, sea birds, kelp production and a shift in benthic, intertidal community structure.) Despite this decline in food supply, the food demand of the deep-benthic sea community remained constant.[13]

- Macrozooplankton: Since the late 1970s, macrozooplankton volume in the California Current has declined over 70%, in concert with increasing sea surface temperatures (Roemmich and McGowan 1995a, b; McGowan, *et al*. 1998). Reduced macrozooplankton has a major impact at higher trophic levels by changing the nature of the food supply.[14]
- Fishes and Invertebrates: Dugan and Davis (1993) document the general decline in long-term productivity in 19 species of nearshore fishes and invertebrates in California from 1947 to 1986. Data from the California Department of Fish and Game (CDFG) show decreases in harvest for most categories of groundfish, California sea urchin landings, landings of swordfish and selected shark species, Pacific Mackerel, Pacific Herring, California halibut, market squid (for the period 1997-1998) among others (such as CalCOFI 1995, 1998). Long-term trends in the SCB commercial fishing vessel rockfish shows a substantial decline from 1980 to 1996, with extremely low catches from 1993 to 1996 (Pacific Marine Conservation Council 1996).
- The estimated abundance in streams south of Point Conception of steelhead rainbow trout is probably on the order of a 100 - 300 adults (Pacific Fishery Management Council 1999).
- Southern Sea Otter: The southern sea otter population is below equilibrium and listed as endangered under the Endangered Species Act (Bodkin *et al*. 1996; Estes *et al*. 1996).

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[13] In an investigation of food supply and demand in the eastern North Pacific off the central California coast between 1989 and 1996, Smith and Kaufmann (1994) show a long-term increase in sea surface and upper water column temperatures and physical stratification in the system. Because of this stratification, the depth of mixing nutrient-rich water has shoaled off, resulting in a lower rate of supply of nutrients to the euphotic zone; a decrease in productivity and a general decline of zooplankton and other species (such as larval fish production, sea birds, kelp production and a shift in benthic, intertidal community structure.) The investigators show that a long-term deficit in the supply of food necessary to meet the metabolic demands of the sediment community is unsustainable. Despite the decline in food supply, the food demand of the deep-benthic sea community remained constant. This issue is also addressed and critically reviewed by Druffel and Robison (1994).

The data suggests that if long-term climate change continues, one result will be a continued reduction in the supply of food to the deep-sea benthos. This reduction could produce a concomitant shift in the characteristics and in the composition of the abyssal community.

[14] Temperature of the water is described as playing a prominent role in determining faunal/floral distributions (Horn and Allen 1978). Hydrographic patterns affect the dispersal of organisms (and pollutants). For example, because most nearshore fishes, invertebrates, and macroalgae have planktonic phases in their life histories, the spatial and temporal variability of their recruitment is linked to physical oceanographic processes, such as currents, eddies and upwelling (Roughgarden *et al*. 1988).

- Oceanic Birds: Ecological theory predicts that in a stable ecosystem those species occupying high trophic levels maintain native species diversity and community structure. Upper trophic level animals such as pelagic birds are indicators of the health of the marine environment (Veit *et al*. 1996). Evidence suggests that the abundance of oceanic birds in the region and the SCB have declined steadily since 1988 (Veit *et al*. 1996, 1997). Veit *et al*. (1996) believe that this reduction reflects considerable biological change within the California Current System. Veit *et al*. (1996, 1997) indicate that ocean warming and climatic events change pelagic bird abundance within the California current system.
- Southern California Kelp: Starting in the late 1970s, Tegner *et al*. (1996, 1997) show that kelp forests have suffered great damage. Tegner *et al*. (1997) show a two-thirds reduction in standing biomass since 1957 in southern California kelp forests.[15]
- Global Climate Change: There is also some indication that the frequency of these climatic events may be increasing (McGowan, *et al*. 1998).[16]

Temperature of the water is described as playing a prominent role in determining faunal/floral distributions (Horn and Allen 1978). Hydrographic patterns affect the dispersal of organisms (and pollutants). For example, because most nearshore fishes, invertebrates, and macroalgae have planktonic phases in their life histories, the spatial and temporal variability of their recruitment is linked to physical oceanographic processes, such as currents, eddies and upwelling (Roughgarden *et al*. 1988).

Marine scientists show that a trend in the general decline in the food supply and biomass of the SCB began *before* the current warm-water regime was identified by marine scientists; the general decline in the biomass started before 1977 (McGowan, *et al*. 1998). The water temperature of the SCB is getting warmer. We can expect increased storm activity and other climate-related impacts to intensify in the future (McGowan, *et al*. 1998).[17] The

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[15] According to Tegner *et al*. (1996, 1997) kelp forests suffered great damage during these events are now systematically smaller and depauperate, a trend that began in the late 1970s. Tegner *et al*. (1996) show that the abundance and stipe number (an index of individual size) of southern California populations of the kelp *Macrocystis pyrifera* have undergone a substantial decline, following the trend of increasing sea surface temperature. Comparison with historical stipe data from 1957, 1973, and 1974 indicates up to two-thirds reductions in standing biomass since 1957 in southern California kelp forests.

[16] Development of coastal habitat (wetlands and saltwater marshes) is a contributing factor influencing the general health of the marine environment, pollution, commercial fishing and climate change. Important coastal locations in the study area that are important for marshbirds, waterbirds, shorebirds and seabirds include the Santa Ynez River Estuary and San Antonio Creek Estuary (on VAFB), Devereux Slough, Goleta Lagoon, Carpinteria Marsh, Santa Clara River Estuary, and Mugu Lagoon. Coastal development in or near many of these habitats and the general destruction of southern California's wetlands has significant impact on the health of various bird species (McGinnis, *et al*. In Press).

[17] A number of sources support this position, including US EPA. 2000. Regional Impact Report. Food and Fiber: Fisheries and Aquatic Systems. Oceans; http://www.epa.gov/globalwarming/publications/reference/ipcc/chp8/america12.html#two; US EPA. 2000. Regional Impact Report. Coastal Ecosystems; http://www.epa.gov/globalwarming/publications/reference/ipcc/chp8/america13.html; US National Assessment. 2000 (June). The Potential Consequences of Climate Variability and Change; B. Herbert. July 10, 2000. Cold

ecology of particular rigs *may* change with future regime shifts and ocean-climate variability. In addition, biogeographical patterns and the transitionary nature of the SB Channel influence the ecology of rigs (Holbrook, *et al*. 2000).

The Relationship Between Regime Disturbance and the Decommissioning Debate

Offshore rigs are part of a dynamic ecological system. The reduction in biomass and significant decline in the abundance of a number of species of rock fish and other marine animals and habitats sets the current ecological stage or context for the debate over the utility of the rigs-to-reefs option. It is important to keep in mind that rigs are situated in particular biogeographic settings that may change over time.

In summary, each offshore rig is situated in a particular ecological setting of the SCB. The ecology of a particular rig is influenced by oceanographic patterns (such as eddies and currents), biogeographic and faunal regimes, transition areas of the Channel, climate-related factors, and regime disturbance. Each platform has its own unique fish assemblage.[18] There are wide differences between platforms in the numbers or biomass of various species. With respect to some of the platforms, mussels from the platform pilings are dislodged and fall to the bottom, creating a sense bed. These mussel mounds appear to form a different habitat from the platform bottom. There may also be differences in fish communities inhabiting platforms and nearby natural reefs (Holbrook, *et al*. 2000). What is certain is that policymakers may need to make trans-scientific decisions that involve the intermingling of scientific information, values and interests.

The Political Ecology of Decommissioning

Scientific investigation does not take place in a political vacuum, but involves important perceptual, value-based and ethical issues (Shrader-Frechette and McCoy 1994). In a comprehensive analysis of the history of California coastal and ocean studies from 1945-1973, Harry Scheiber (1995) describes several factors that influence the use of scientific knowledge to inform ocean policies:

1) the dilemma of incomplete information (policy makers often act without a comprehensive understanding of a policy area);
2) the frustration of political entanglement (most policy areas include a number of government and non government interest);
3) the minefield effects of multi-level government (ocean and coastal policy making is an intergovernmental process that involves a number of different actors who may hold different interests and values); and
4) the pitfalls of naive faith in science.

In California, the politics of integrating scientific information in the OCS decision making process takes place within the context of a highly charged and contentious intergovernmental process. This process is often resolved by litigation (Lester 1991). Given scientific uncertainty, "good" scientific information is that which supports one's position in the decision-making situation.

Facts of Global Warming. NY Times; P. Hanson. August 3, 2000. Deep Sea Offers Clues to Global Warming. Chicago Tribune; Global Warming and California. www.nextgeneration.org.

[18] Love, *et al*. (1999, 2001) has found that juvenile fishes, primarily rockfishes (genus *Sebastes*), dominate the midwater around platforms. These are primarily widow, bocaccio, olive, blue and yellowtail rockfishes. Adult and older juvenile rockfishes dominate platform bottoms. The larger fishes tend to closely associate with the pilings and cross beam.

Moreover, Shrader-Frechette (a philosopher) and McCoy (an ecologist) received funding from the National Science Foundation to evaluate the role of ecological theory and information in environmental policy making. Their findings and analysis are supported by recommendations made by the National Academy of Sciences and the National Research Council. Their findings are also relevant to the politics of decommissioning policymaking (McGinnis 1998).

Shrader-Frechette and McCoy (1994) show the following: 1) Ecologists do not agree on what the basic principles or ecological laws ("community" and "stability") are; 2) All scientific facts are laden with epistemic or cognitive values. Values can be divided into three types: bias values, contextual values, and methodological values; 3) Ecology cannot dictate ends or goals (but can act as a guide to good environmental policy); 4) Ecologists and laypersons do not share the same uncontroversial and unambiguous goals; 5) Ecology cannot tell us what is "natural"; 6) Ecological applications arise when and because scientists have a great deal of knowledge about the (qualitative and quantitative) natural history of a specific organism or place (which is not the case in this policy area).

Based on the work of Shrader-Frechette and McCoy (1994), ecological information cannot provide the foundation for a future decommissioning policy or program. People will act out of their perceptual and value-based understandings of the world (Stone 1985). Ecology information cannot provide policy makers with goals or values for policies, but can guide policy makers regarding the means to attain or the reasons to attain policy ends or goals (Shrader-Frechette and McCoy 1994).

If there is scientific consensus, scientists agree that all the facts are not in (Holbrook, *et al*. 2000). There is no scientific consensus on the ecological importance of offshore oil and gas structures (NRC 1985, 1996). Moreover, evidence suggests that offshore oil structures do not serve the same ecological functions as natural reefs (Holbrook, *et al*. 2000). Scientists do not know whether offshore rigs "attract" or "produce" fish (Holbrook, *et al*. 2000).

Therefore, value-based conflict between scientist, policymakers and the general public is inevitable given the ecological and political issues and concerns associated with the rigs-to-reefs debate in California (Green 1996; MMS 1998d; McGinnis 1998). Scientists cannot tell us what is natural (Shrader-Frechette and McCoy 1994). The future of the organic machines of the SCB will remain a political and scientific debate over the various meanings and discourses of "nature", the role of science, and issues related to appropriate technology.

The next section describes the costs and benefits that are associated with three particular decommissioning options.

SECTION THREE

COSTS AND BENEFITS OF OPTIONS FOR CALIFORNIA OCS OIL AND GAS PLATFORMS

By Linda Fernandez and Sam Hitz

This section contains an analysis of three different alternatives for decommissioning oil platforms through identification and comparison of costs and benefits of each alternative. Monetary values are quantified for the cost and benefit categories along with identifying the influential variables affecting costs and benefits across nonuniform oil platforms. The estimates for the individual categories considered as well as the range of net costs in this analysis offer more details compared to previous studies that merely list speculative point estimates of fewer categories (for potential platforms in the North Sea) (Griffin 1996).

The three decommissioning alternatives are:

(1) Leave platform in place. This option involves steps to insure oil extraction activity is shut down as well as preparation of the platform to support other uses. Platforms would be stripped of all equipment directly related to the extraction of oil. Wells would be plugged normally (in compliance with 30 CFR 250) and conductors severed and removed completely to 15ft. below the mud-line. All other parts of the platform would remain, including potentially much of the above surface structure. The most biologically productive part of the platform is the upper part and this is likely to be removed in the process of the other two options. The euphotic zone is apparently from water surface down to about 100 feet. Juveniles are there and as the population ages, the fish move to lower depths.

(2) Complete Removal of offshore platform from the ocean. The material from the platform is removed from the ocean for multiple destinations (scrapping and reuse or onshore disposal). The timing of platform removal varies ranging from one at a time all at once or lagged over time for simultaneous removal of multiple platforms to account for economies of scale. Wells would be plugged and no other part of the platform itself would remain above 15 ft. below the mud-line.

(3) Partial removal of the oil platform with disposal of the material either offshore or onshore. The estimates of this option apply to material that is toppled in place, taken to another location that the original platform, or disposal of the removed portion onshore.

Partial removal encompasses several potential possibilities (see Figure 1). All scenarios under this last heading require wells to be plugged and conductors severed and removed as well. They also involve the removal of the topsides. Then, the jacket might be truncated to some specified depth. That portion of the jacket removed could be reefed on site, transported and reefed at another location, or disposed of onshore. The second possibility is that the entire jacket structure of the platform might be toppled in place. And finally, the entire jacket could be transported to another location and reefed.

The cost analysis undertaken is static in nature. All costs are assumed to occur at the moment that decommissioning commences and are assumed to be one time costs. There is no attempt made to account for the actual dynamic nature of costs. That is, we anticipate that for some categories costs might be incurred at different points during the course of the decommissioning project. Furthermore, were decommissioning to commence at some point in the distant future, the cost information provided would have to be inflated accordingly.

Table 3 contains the cost and benefit categories with estimates and variables to be considered in the estimates for each of the three options for decommissioning.

The subsequent paragraphs contain text to accompany each of the categories of costs and benefits in order of appearance in Table 3.

Table 3. Costs Associated with Decommissioning Options.

	OPTIONS		
COSTS	Leave-in-place	Complete Removal	Partial Removal
Engineering and Planning	Leave-in-place entails less engineering and planning. Costs are apt to amount to 1% of total removal costs. This produces a range of $14,700-$699,200	Engineering and Planning Costs represent 2% of total removal costs for platforms >30,000 tons and 4% for those whose weight is less. This gives a range of $58,800-$1,398,400	All partial removal options will entail more expensive engineering and planning than the leave-in-place scenario, but probably less than for complete removal. Hence the cost range is $14,700-$1,398,400
Permitting and Regulatory Compliance	undetermined	$230,000-$380,000	$230,000 $760,000
Platform Preparation	Platform preparation costs are less extensive and might amount to between ¼ and ½ of those for complete removal. This produces a range of $75,000-$600,000	Platform preparation costs are estimated to be some 12% of total removal costs scaled according to deck weight. Depending on size of the platform this method produces a range of $300,000-$1,200,000	The same deck preparations that are made for complete removal must also be made for any partial removal scheme. Costs remain the same, $300,000-$1,200,000
Plugging and Abandonment	Standard plugging and abandonment procedures would be employed in all options. No complications: $63,300/well; Major complications: $192,400/well. This results in a range of $633,000-$12,121,200 for all options.		
Conductor Severing and Recovery	Most likely completed in conjunction with P&A process. Undertaken regardless of disposition option. 400 ft. and less: $34,000; 400-800 ft range: $59,400; 800 ft and deeper: $3,029,400. These estimates give a range of $291,000-$3,029,400 for all options.		
Mobilization/Demobilization	Would involve a minimal use of heavy lift equipment, whose cost drives this category. Total mobilization/demobilization costs would probably amount to less than $500,000	Depends on market conditions and extent of demand for heavy marine construction equipment as well as the size of heavy lift vessel that will be required. These vessels will either be deployed from Asia (100 days of transit) or the Gulf (200 days of transit). This yields a cost range of $500,000-$12,000,000.	Potentially some small savings might be achieved here relative to the complete removal case. However, costs could easily be just as large. $500,000-$12,000,000
Platform and Structural Removal	No costs incurred. Decks, jacket and piles would be abandoned in place.	Platform and structural removal cost includes the cost of removing topsides, cutting piles and removing jackets. It depends most critically on the size of the structure and conesquently its depth. 200 ft. = $3,960,000; 400 ft. = $15,263,000; 700 ft. = $21,450,000; 1200 ft. = $48,675,000. Accordingly, the range is $3,960,000-$48,675,000	Costs depend on exact partial disposition option. Complete removal where entire structure is reefed in another location would not change the costs relative to complete removal with onshore disposal 3,960,000 - $48,675,000. A toppling in place scenario would result in a range of $2,904,000-$8,632,000 depending on the depth of the structure. A truncation scenario would result in a range of $2,376,000 - $14,850,000
Pipeline and Power Cable Decommissioning	Pipelines and cables must be dealt with in the same way they might for a complete removal scenario. $400,000 - $550,000	Abandonment is most likely strategy. Removing lines and cables could esclate costs sharply. There are no exact estimates of the cost of doing so for platforms in greater than 700 ft. of water. For a typical platform the cost might be $400,000 - $550,000	Pipelines and cables must be dealt with in the same way they might for a complete removal scenario. $400,000 - $550,000

Table 3. Costs Associated with Decommissioning Options (continued)

	OPTIONS		
COSTS	Leave-in-place	Complete Removal	Partial Removal
Materials Disposal	Minimal costs incurred.	Cost estimates for materials disposal include transportation and assume that all steel is scrapped and recycled. Estimates are net of the revenue generated by recycling. All other materials are assumed to be disposed of in appropriate landfills. Based on the size of the platform the cost range would be $1,925,000 - $23,450,000	Materials disposal cost depends upon partial removal scheme employed. Toppling in place would entail costs of $1,262,500- $4,050,000. Truncating jackets to a navigable depth (100 ft.) and disposing of the jacket section on land would give a range of $1,668,750 - $6,000,000. A scheme that involved transporting part or all of the jacket and reefing it in another location would not change costs significantly relative to the topple-in-place scenario.
Site Clearance and Verification	Costs would be less than in a complete removal scheme, however exact cost savings is difficult to quantify.	Total for platforms in <300 ft. of water: $244,200-$521,400. Total for platforms in >300 ft. water: $590,700 - $1,060,400	Costs could be less than in a complete removal scheme(for truncation options) but higher for reefing an entire structure in another location. The overall range would vary from the leave-in-place costs to perhaps twice the complete removal costs.
Shell Mounds	No costs incurred.	Removal of mounds could cost up to $2.5 M/platform in 4H case. Likely more in deeper water. Alternatively providing trawlers with navigational aids might entail one time cost of $1.5M for those affected by 4H mounds. Cost of buoying represents a low end at $30,000	Costs only incurred in move and reef scenario, in which case they will be the same as in the complete removal option
Navigational Aids	Visual presence minimizes need for additional measures	No costs incurred	Costs might range from buoys on order of $30,000 to provision of more sophisticated navigational aids for effected parties. Perhaps as much as $75,000/ ship. Truncating to a minimum depth of 100 ft. should reduce potential liability.
TOTAL COSTS	$2,085,900 - $18,560,200+	$8,500,000 - $106,364,400+	$5,879,400 - $90,354,800+

	OPTIONS		
BENEFITS	Leave-in-place	Complete Removal	Partial Removal
Commercial Fishing	Shellfish harvest by Ecomar removing biofouling consists of: Mussels: 50-100,000 lbs/rig/year, Oysters: 100-1000 bushels/rig/year Scallops: 1000-10,000 lbs/rig/year. Using average prices for 1999, range of commercial value: $16,150 - $460,000	No data tying area without rig to fish stock	No data tying area without rig to fish stock
Recreational Value	Diving and Fishing value from recreational boat operations: $10,000/year at rigs where currents and weather do not limit access as well as presence of habitat		
TOTAL BENEFITS	$26,150 - $470,000		

Engineering and Planning Costs

The Engineering and Planning phase of decommissioning consists of several stages. The first stage is a review of all contractual obligations and decommissioning requirements from lease, operating, production, sales or regulatory agreements. The second stage is an engineering analysis aimed at developing a plan for every phase of the decommissioning effort, from well plugging and abandonment to the removal and disposal of platform materials. The third stage involves the process of surveying the market for required equipment and vessels and beginning to contract for such equipment. The nature of the marine construction business necessitates that this be done well in advance of planned decommissioning, perhaps as early as three years proceeding. Finally, an assessment must also be made of which tasks can be handled in-house and which require outside operational assistance or responsibility. The process of hiring outside contractors might also include procuring the services of firms with large project management and engineering expertise to act as a general contractor of sorts.

Costs under this heading represent the company manpower or consulting costs incurred to devise a detailed plan for all stages of the decommissioning process. The engineering and planning phase and the costs incurred during this stage will themselves depend on the technical procedures and the particular dismantling strategies to be employed which this process identifies. For instance, the extent of planning involved for the decommissioning of a platform with an integrated topside will be less than for a platform with a complex modular deck (See Topsides Removal Section below). The latter might necessitate planning fairly involved modifications to deck modules and prefabrication in preparation for individual lifts. Similarly, attempting to remove a deep water jacket by progressive transport is apt to require far more detailed planning than removing a small jacket in a single lift.

However, while this phase will be different for each particular platform it is important to recognize aspects of the decommissioning process that are common across platforms. Certain aspects of the planning process need not be repeated for all platforms and consequently cost savings could be realized at this stage under some sort of a combined decommissioning effort. These savings would of course depend upon the number of platforms to be decommissioned and the extent of their similarities.

The 4H engineering and planning cost figure ($1.6M) indicates the costs involved in planning for the complete removal of a series of relatively shallow water platforms (Clement, personal communication, 1999). This cost represents some 4% of the total removal costs of $38M (Clement, personal communication, 1999). Four percent seems comparable to the engineering and planning costs in the Gulf as a percentage of total expenditures. The absolute planning costs incurred for a large deep-water platform decommissioning effort would undoubtedly be greater than those for a small-shallow platform. However, as a percentage of total cost they are apt to be less. A previous analysis prepared by the MMS asserts that 2% might be more accurate representation for heavier platforms (greater than 30,000 tons) (MMS 1999). Most OCS in the Pacific fall into four cohorts, small (5,000 ton range), medium (10,000 ton range), large (30,000 ton range) and ultra-large (70,000 ton range). This same MMS analysis suggests that $1000/ton represents a fair estimate for the total cost of removing a ton of steel platform (MMS 1999).

The leave-in-place scenario would entail fairly minimal planning and engineering costs. These cost would be related to planning for plugging and abandoning wells, removing conductors, removing or abandoning pipelines and power cables and clearing the topsides or equipment (Culwell 1998). One percent or less of total removal costs might represent a fair indication of costs in this scenario.

In the case of a partial removal these costs would be somewhat less than the complete removal scenario depending upon the nature and extent of removal (Culwell 1998). Toppling in place might represent the partial removal scenario with the least planning and engineering, and consequently lowest costs. The engineering and planning costs for the topple-in-place option might be bounded on the lower end by the those costs incurred under the leave-in-place scenario. Both partial removal where part or the entire jacket is transported to another location (be it in the ocean or onshore) are apt to involve a level of planning that equals or potentially even exceeds complete removal.

Example of cost calculation:
Platform Hermosa (depth 603’, weight 28131 tons)
Complete Removal: $1000/ton × 28,131 tons × 2%= $1,125,000
Leave-in-place: $1000/ton × 28,131 tons × 1%= $280,000
Partial Removal: < $1,125,000

Cost Range based on weight
Platforms Gina (weight 1470 tons) to Harmony (weight 69920 tons) Table 4 contains the corresponding details for each platform.
Complete Removal: $58,800-$1,398,400
Leave-in-place: $14,700-$699,200
Partial Removal: $14,700-$1,398,400+

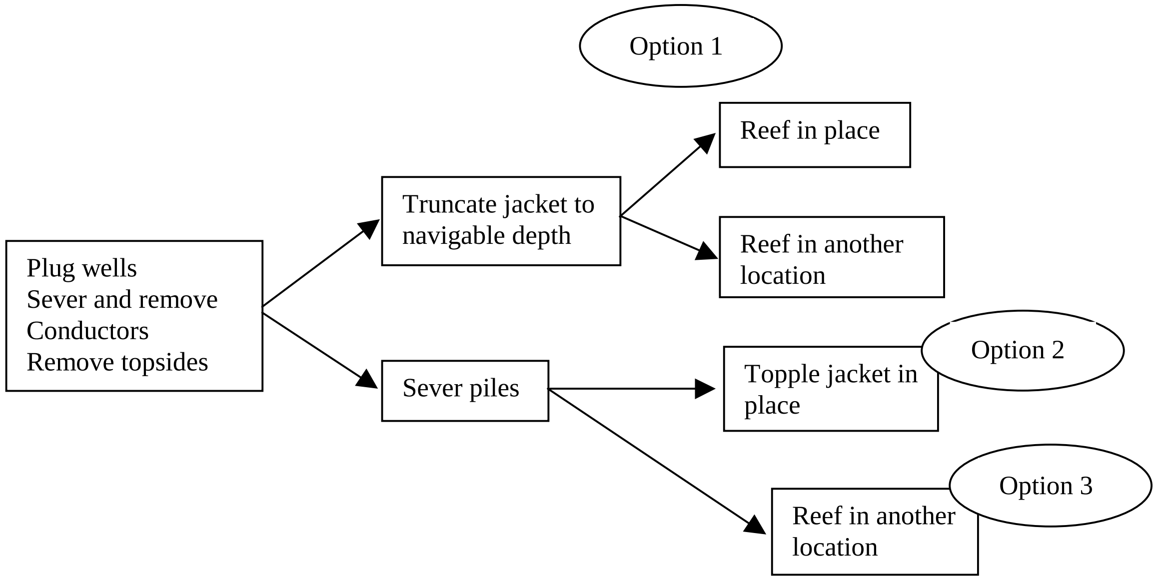
Costs and variables for Engineering and Planning are summarized in Table 3 and Figure 2.

Table 4. Platform Specifications.

	Well and Conductor Specifications			**Projected Platform Removal Weights**		
Platform	Water Depth (ft.)	Wells to Plug	Conductors	Jacket Wt. (tons)	Deck Wt. (tons)	Total Wt. (tons)
Gina	95	12	12	434	815	1470
Hogan	154	40	40	1263	2259	4110
Edith	161	18	23	3454	4134	8298
Houchin	163	36	36	1486	2591	4637
Henry	173	23	24	1311	2500	4247
A	188	52	55	2516	2601	6350
B	190	57	57	2516	2601	6355
Hillhouse	192	47	52	2000	2500	5538
C	192	38	43	2516	2601	6270
Gilda	205	63	64	3220	3792	9342
Irene	242	24	24	3110	2500	7652
Ellen	265	61	64	3200	5350	11634
Habitat	290	20	20	3200	3514	8853
Grace	318	26	35	3090	3800	9390
Hidalgo	430	10	10	10950	8100	21421
Hermosa	603	13	16	17000	7830	28131
Harvest	675	19	21	16633	9024	30190
Eureka	700	50	60	18500	5200	29192
Gail	739	21	22	18300	7693	31320
Hondo	842	29	29	12200	8450	27250
Heritage	1075	27	49	32420	9826	60556
Harmony	1198	26	51	42900	9839	69920

Source: MMS, “Offshore Facility Decommissioning Costs, Pacific OCS Region,” March 31, 1999

Figure 1. Partial Removal Options



Permitting and Regulatory Compliance Costs

This category describes costs related to obtaining the necessary federal, state and local permits required to conduct decommissioning operations and satisfy the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). Typically, companies might contract consultants to guide them through the complex and sometimes length permitting process required by numerous federal, state and local agencies and to provide the services that ensure compliance. The latter might include addressing marine mammal protection provisions or measures required by local Air Pollution Control Districts to offset emissions during decommissioning operations. Much of the information available on these costs is derived from Chevron's experience with the 4H platform removal project (Clement, personal communication, 1999) with costs as follows:

Environmental Consultants	$200,000
Marine Mammal Protection	$200,000
SLC Administrative Fees (State Lands Commission)	$450,000
APCD Offset Fees (Air Pollution Control District)	$450,000
Fishermen Preclusion Compensation	$510,000

The final category describes the cost ($15,000 average) to compensate 34 fishermen who were precluded from the fishing areas in which they commonly operated during the decommissioning process. The actual figure corresponds to navigational tracking aids to avoid the area.

Clearly, some of these costs can be extrapolated to future decommissioning efforts and others cannot. For instance, in the case of OCS decommissioning, State Lands Commission fees would not be relevant as OCS platforms are not located in State waters. Furthermore, in light of the fact that state law now precludes Air Pollution Control Districts from levying offset fees it does not make sense to include this category. In the 4H case, fees for environmental consultants cost $200,000 per platform. This represents a relatively fixed cost that to some extent does not depend upon whether one platform or four are being decommissioned. It seems reasonable to assume that these costs might range between $50,000/platform and $200,000/platform depending upon how many were removed in conjunction. Marine mammal protection costs (covering the expense of NMFS observers and observation vessels) probably represent less of a fixed cost. Accordingly, $50,000/platform is a fair estimate. Finally, the compensation of fishermen will depend upon the scope of the decommissioning effort as well as the number of fishermen operating in the area, the type of fishery affected and the duration of preclusion. The per platform costs of compensating fishermen in the 4H cost may give a fair indication of this cost for future decommissioning projects (approx. $130,000). Taken together these costs sum to a range of $230,000 – $380,000 for the complete removal of a platform.

The leave-in-place option will avoid the majority of these costs, but may incur other costs related to leaving the bulk of the structure in place such as compensation for the permanent loss of what might have been fishing grounds. This amount might be distinct from the navigational hazard or net hazard posed by leaving a structure in place. This cost is apt to be negotiated and critically dependent upon the political atmosphere at the time of abandonment (MMS 1999).

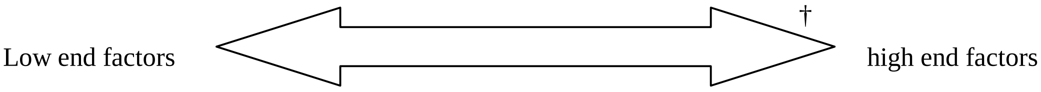
Any partial removal plan would undoubtedly lead to regulatory and compliance costs substantially higher than those incurred under a complete removal plan. This would especially be the case for any scheme involving transport of a portion (or the entirety) of a jacket to state waters for reefing. In this case permitting and related activities would have to be undertaken for at least two sites. Consequently, these costs could be several times as large as those incurred for complete removal (perhaps $430,000 – $760,000 or more). The expected range would then be bounded by the minimum potential complete removal costs ($230,000) on the low end and twice the maximum potential complete removal costs ($760,000).

Costs and variables for Permitting and Regulatory Compliance are summarized in Table 3 and Figure 2.

Figure 2. Factors Contributing to Range of Costs by Category*

Example Cost Category

— Factors determining



* Based on Complete Removal Costs,

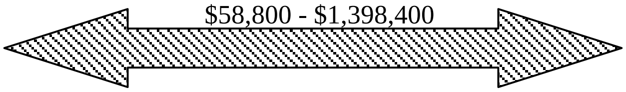
† Size of arrows is not proportional to estimated costs

Figure 2. Factors Contributing to Range of Costs by Category (continued)

Engineering and Planning

- Size of structure (gross tonnage)
- Complexity of Topsides
- Water depth

Small
integrated deck
shallow



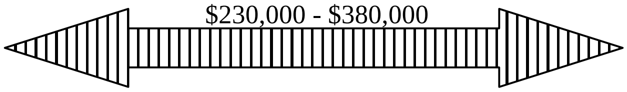
$58,800 - $1,398,400

large
complex, modular deck
deep

Permitting and Regulatory Compliance

- Number of platforms decommissioned during effort

single platform



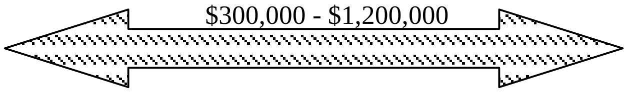
$230,000 - $380,000

multiple platforms

Platform Preparation

- Size of structure (gross tonnage)
- Complexity of Topsides

Small
integrated deck



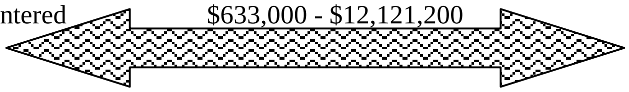
$300,000 - $1,200,000

large
complex, modular deck

Plugging and Abandonment

- Degree of difficulty
- Number of well slots

no difficulty encountered
few well slots



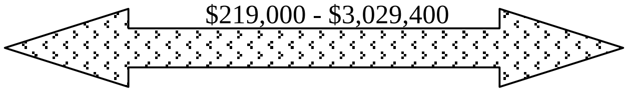
$633,000 - $12,121,200

difficulty encountered
many well slots

Conductor Severing and Removal

- Depth

shallow



$219,000 - $3,029,400

deep

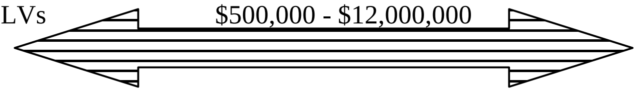
Based on Complete Removal Costs. Size of arrows is not proportional to estimated costs.

Figure 2. Factors Contributing to Range of Costs by Category (continued)

Mobilization and Demobilization

- Market conditions in marine construction industry
- Size of structure (gross tonnage)
- Location from which large equipment deployed
- Number of platforms decommissioned during effort

low demand for HLVs
small
Asia
single platform

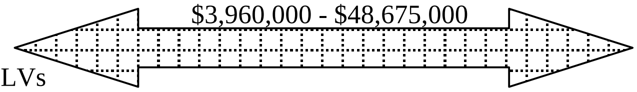


high demand for HLVs
large
GOM or North Sea
multiple platforms

Platform and Structural Removal

- Size of structure (gross tonnage)
- Depth and type of diver support required
- Market conditions in marine construction industry
- Complexity of Topsides

Small
shallow/air diving
low demand for HLVs
integrated deck

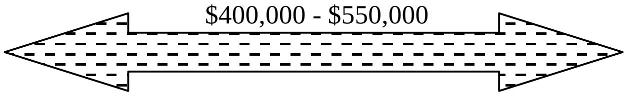


large
deep/saturation diving
high demand for HLVs
complex, modular deck

Pipeline and Power Cable Decommissioning

- Depth
- Extent and length of pipeline removed (removal costs not incorporated in analysis)

shallow

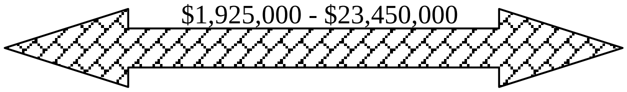


deep

Materials Disposal

- Size of structure (gross tonnage)
- Distance to disposal facility

small
disposal facility close



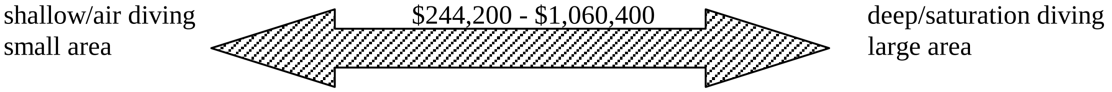
large
disposal facility distant

Based on Complete Removal Costs. Size of arrows is not proportional to estimated costs.

Figure 2. Factors Contributing to Range of Costs by Category (continued)

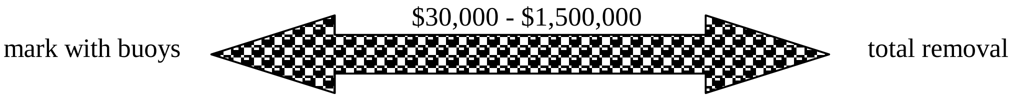
Site Clearance and Verification

— Depth and type of diver support required
— Size of area to be cleared



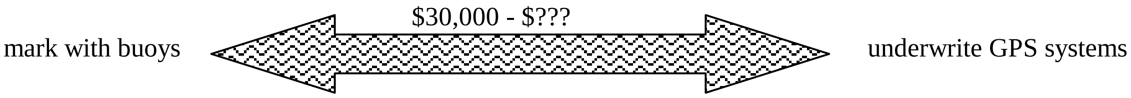
Shell Mounds

— Depends on selected disposition method



Navigational Aids

— Depends on method of marking residual structure



Based on Complete Removal Costs. Size of arrows is not proportional to estimated costs.

Platform Preparation Costs

Platform preparation describes costs incurred in connection with ceasing operations and preparing the platform for decommissioning. These steps might include cleaning the decks of hydrocarbon residual, degassing and cleaning tanks and lines, removing platform equipment, installing equipment needed for decommissioning, cutting pipelines and power cables, installing structural reinforcement required for lifting, etc. (Culwell 1998). The key factors driving the costs of this stage of decommissioning are apt to be size and complexity of the deck (Prasthofer 1998).

In the Gulf of Mexico, platform shutdown and decommissioning costs were reported to be some 6% of the total cost of platform removal ($1000/ton) (MMS 1999). However, the MMS analysis correctly points out that for the purposes of extrapolation, the cost of platform preparation should be related only to the size of the deck (MMS 1999). Since approximately ½ of the total platform weight is contributed by the deck in a shallow water platform, as most of those in the Gulf have been, this percentage should be doubled in any extrapolation. The weight of the deck as a proportion of the total platform weight decreases disproportionately as total platform weight increases (MMS 1999). MMS identifies the following categories for platform size:

Small	12% of 2500 tons @ $1000/ton = $300,000
Medium	12% of 4000 tons @ $1000/ton = $480,000

Large 12% of 7500 tons @ $1000/ton = $900,000
Ultra-Large 12% of 1000 tons @ $1000/ton = $1,200,000
yielding a range of $300,000 - $1,200,000 per platform for complete removal.

For the leave-in-place scenario, platforms must still be cleaned and stripped of equipment related to the extraction of oil and gas. However, there is obviously no need to make preparations for further platform removal. It might then be reasonable to assume that the costs related to cleaning and clearing the decks might be ¼ to ½ those incurred during complete removal (Prasthofer 1998). This would give a range of $75,000 - $600,000.

Since all the partial removal scenarios involve the removal of the topsides, they would entail essentially the same deck preparations that would be required under a complete removal option.

Costs and variables for Platform Preparation are summarized in Table 3 and Figure 2.

Plugging and Abandonment Costs

Plugging and abandonment procedure is highly regulated and would be required under all decommissioning scenarios. Consequently, the costs incurred to meet the regulations governing plugging and abandonment would not be the distinguishing factor between decommissioning options (Byrd, personal communication, 1999). Hence, this category is only discussed briefly. The primary factor which can control plugging and abandonment costs is the degree of difficulty encountered, experienced as unforeseen time or operational delays. Well depth is a less important factor. Depending on the degree of difficulty encountered a well might take between 5 and 10 days to plug (Fields and Martin 1998). The number of wells to be plugged in Pacific OCS platforms ranges from 10 to 63 (MMS 1999).

While the nature of the plugs and the depth of the wells will have an impact on the overall costs, those incurred during the 4H decommissioning project give an indication of the scale. Overall costs for well plugging and abandonment were $ 11,883,000 for Platform Hope with 46 well slots; Platform Heidi with 36 well slots; Platform Hazel with 24 well slots; and Platform Hilda with 29 well slots (Clement, personal communication, 1999). The resulting average cost per well $88,000 from the 4H project represents an average cost per well for minor complications. This is in line with the MMS analysis which suggests an average cost of $95,500 per well under the minor complications assumption and based on a contract with a service company to plug multiple wells (MMS 1999). MMS estimates a “no complications” cost of $63,300 per well and a “major complications” cost of $192,400. Taken together this results in a range of $63,300 - $192,400 per well. Using this price range and Platform Gina with 10 well slots and Platform Gilda with 63 well slots (See Table 4) generates a cost range of $633,000-$12,121,200.

Costs and variables for Plugging and Abandonment are summarized in Table 3 and Figure 2.

Conductor Severing and Removal Costs

Conductor severing and removal would most likely take place as part of the plugging and abandonment process (Culwell 1998). As a cost common to all options, it does not significantly effect the overall decommissioning decision but it is discussed briefly nevertheless. Traditionally, mechanical casing conductors have been used with good success. However other options for conductor severing which could be used include abrasive water jet cutting or explosives. Since the use of explosives is generally prohibited in open water, severing is done mechanically. After severing, conductors are pulled (generally in 40 ft.-long segments) and offloaded (Byrd, personal communication, 1999). While the cost of conductor removal for the 4H project was on the order of $14,000 per well this cost probably does not translate well to conductors in deeper water (Clement, personal communication, 1999). The length of the conductor is dependent upon the depth of the water column and the amount of material to be removed and disposed of varies accordingly (Culwell 1998). Conductors are generally severed 15 ft. below the mud line and extend up through the deck, perhaps 40-50 ft. above the water (Culwell 1998). Consequently the depth of the water column plus 65, multiplied by the number of well slots gives a fairly reliable indication of the length of conductor to be removed and disposed of (Byrd, personal communication, 1999). It is commonly estimated that the concrete grout used to bind together well casings weighs about 60-100 pounds per foot of conductor (or alternatively occupies a volume of .5 ft^3) (Byrd, personal communication, 1999). Depth then is the driving variable for conductor removal cost.

MMS estimates a price of $21,900/conductor removal in depths of 400 ft. and less, $34,400/conductor in depths of 400-800 ft. and $59,400/conductor for those in depths of 800-1200 ft (MMS 1999). The number of conductors for platforms in the Pacific OCS varies from 10 to 64. The shallow water platform with the fewest conductors (12) is Gina. The deep-water platform with the largest number of conductors is Harmony with 51 (See Table 4). These two platforms, at $219,000 (10 @ $21,900 each) and $3,029,400 (51 @ $59,400) also represent the cost extremes for conductor removal (MMS 1999).

These costs do not include transportation or disposal of conductor material. The costs reflect costs associated with removal of marine growth offshore as the conductors are pulled. The concrete would have to be disposed of onshore. The cost of disposal could be easily estimated using landfill rates at the time based on this weight or volume. It is not anticipated to be difficult to locate a landfill capable of handling the concrete.

Costs and variables for Conductor Severing and Removal are summarized in Table 3 and Figure 2.

Mobilization/Demobilization Costs

The cost of assembling all the necessary equipment and transporting it to the decommissioning site can be considerable. This is especially the case for the U.S. West Coast, where there are currently no heavy lift vessels that have the capacity to handle platform decommissioning (Clement, personal communication, 1999). In the 4H case, a relatively simple decommissioning project relative to deepwater platform decommissioning, these costs approached $2.4 M (Clement, personal communication, 1999). For deepwater platforms that require the heaviest lift vessels available and large cargo barges, this figure would certainly be eclipsed (Clement, personal communication, 1999). The exact value of this figure will be sensitive to the state of the marine construction market during decommissioning and the other demands for this relatively scarce equipment. It will however principally depend upon the cost of mobilizing and demobilizing the heavy lift vessel that the decommissioning project requires (Culwell 1998). This cost will vary depending upon from where the heavy lift vessel must be deployed. The approximate time to deploy a heavy lift vessel from Asia would be fifty days, or a total mobilization/demobilization time of 100 days (MMS 1999). If a vessel were to be deployed from the Gulf of Mexico or the North Sea area this figure might be closer to 200 days (MMS 1999). The day rate for a 500-ton capacity lift vessel is on the order of $25,000 (MMS 1999). The rate for the largest capacity dual-crane semi-submersible heavy-lift vessels can be upwards of $300,000/day (potentially as high as $500,000/day depending upon the demand for marine construction equipment) (MMS,1999).

It is however important to recognize that if the decommissioning of these large platforms were undertaken in a serial fashion, the mobilization/demobilization costs on a per platform basis could be minimized through economies of scale. The cost range could be calculated as follows:

Low end: 100 days @ $25,000/day ÷ # of platforms decommissioned
High end: 200 days @ $300,000/day ÷ # of platforms decommissioned

If decommissioning was done in groups of 5, this range might be between $500,000 and $12,000,000 (Clement, personal communication, 1999).

A leave-in-place scenario would greatly reduce the need for and consequently the need to mobilize heavy lift vehicles. In most instances the cost to mobilize equipment would probably be less than the lower end of the range calculated above.

A partial removal scenario would not be apt to affect mobilization/demobilization costs. In most instances, heavy lift vessels would still be required (Culwell 1998). A scenario that saw the jacket structure truncated or simply toppled might not require a heavy lift vessel of the same capacity that complete removal would. However, under all partial removal scenarios, the topsides must be completely removed. This could be the factor that determined the capacity of lift vessel required. Furthermore, any scenario in which the jacket structure was transported to another location would call for a lift vessel of the same capacity that complete removal might otherwise dictate. Consequently, that a partial removal scheme would not substantially reduce mobilization/demobilization cost.

It should be noted that this discussion does not attempt to project what types of new technology might be available to employ in the decommissioning process. There is simply not enough information at this point to make projections about the availability of new technologies and the cost of mobilizing and demobilizing such technology.

Costs and variables for Mobilization and Demobilization are summarized in Table 3 and Figure 2.

Platform and Structural Removal Costs

Topsides Removal

The diversity and range of complexity of topside facilities suggests that no one removal technique will be most appropriate or cost effective in all cases (Byrd, personal communication, 1999). This makes it difficult to generalize about the costs associated with this stage in the overall decommissioning process. However, the costs stemming from the removal and disposal of topside decks can be a substantial portion of the overall costs of decommissioning. They have been estimated to account for 30-40% of the total removal costs of the installation (Byrd, personal communication, 1999). A number of complexities as well as the method of removal employed drive costs.

As described in the Platform Preparation section, topsides must first be cleaned. This process involves draining all tanks and piping of operating fluids and removing all small or loose equipment from the decks. Regulated substances must be removed in accordance with all guidelines (Culwell 1998). For the leave-in-place disposition scenario, all further equipment directly related to the extraction of oil must be removed. Additional removal as required under the complete removal and partial removal scenarios can then proceed in one of four ways.

Removal in one piece entails lifting off the entire topside at once after it is severed from the jacket. While this method has the advantage of requiring the least amount of offshore work, which can rapidly escalate costs, it requires the use of a large capacity lift crane. There are few cranes actually capable of lifting the loads that might be required if this method were employed for California platforms. A number of the topsides under consideration off the coast of California weigh in the 8,000 to 10,000-ton range. While the very largest semi-submersible dual-crane heavy-lift vessels have a combined lift capacity on the order of 14,000 tons, most current generation high capacity heavy lift vessels are 5,000-ton capacity and their expense can be considerable (potentially in the range of $300,000-$500,000/day) (Byrd, personal communication, 1999). Consequently, this method is only practical for the smallest of topsides.

A second method that can be applied to those topsides whose construction is modular in nature is reverse installation removal (Prasthofer 1998). So-called modular topsides are assembled piecemeal from units as opposed to integrated deck structures where the facilities and hooked up and commissioned onshore and simply attached to the jacket or substructure offshore (Prasthofer 1998). These modular topsides can be removed in a fashion that parallels their installation, but in reverse sequence. While reverse installation requires more pre-lift planning than one-piece removal it makes the removal of large topsides feasible with the current generation of moderate capacity or heavy lift crane barges (Culwell 1998). It would be possible to extrapolate from cost records of installation, adjusted for inflation, to get a handle of what exactly this process might cost. Records indicate that between 6 and 17 main lifts were required to install the topsides of those platform decks that are modular in nature (Prasthofer 1998). The largest lift for any one module or support structures was 2,000 tons (Prasthofer 1998).

A similar method of removal reduces the number of lifts and consequently time for which expensive heavy lift vessels are required by lifting combined modules. This method however can require more extensive preparation and stabilization for lifts (Culwell 1998).

Finally, a last approach is to deconstruct topsides on the platform using cutting devices and make a number of smaller lifts. These lifts can be made from deck mounted cranes, eliminating the need for heavy lift vessels or cargo barges all together. However while this method alleviates the need for expensive heavy lift equipment, it is time and labor intensive (Culwell 1998).

While individual circumstances will determine which method is most cost effective, the removal of topsides in most cases is likely to be by the reverse installation process (Prasthofer 1998). The basic driving costs which must be weighed in each case and in light of prevailing market conditions are heavy lift vessel commissioning, cargo barge hiring and manpower costs. Clearly single lift strategies (if technically feasible) might minimize the number of trips that a cargo barge would have to make between the platform and onshore scrapping facility (Byrd, personal communication, 1999). However, it would necessitate the use of the very largest heavy lift vessels, potentially very expensive. Strategies that disassemble the topsides offshore to some degree (modular removal or small piece removal) reduce the need for heavy lift vessels but probably increase labor costs and might require multiple cargo barges making multiple trips to and from the scrapping facility (Prasthofer 1998).

Pile Cutting

While the open water use of explosives has been restricted, application below the mud line continues to be permitted and is seen as the most reliable method of severing piles (Culwell 1998). This reliability translates into lower costs. However the use of explosives requires that measures be taken to ensure that the impact on marine life is minimal. These costs are outlined in the Permitting and Regulatory Compliance section. In addition to method of cutting it is also important to consider factors such as piling access for cutting, diving requirements and water depths.

Jacket Removal

Jacket removal is apt to be the costliest portion of the decommissioning process for larger Pacific OCS platforms (MMS 1999). In some cases, jacket removal can be accomplished as a single lift. This is not likely except for very small jackets. In most instances for larger platforms this will not be possible. Jackets can also be removed in sections potentially. However, deep-water structures present a serious hurdle, as their weights exceed the limits of current lift technology. Pacific OCS jackets range in weight from 400 tons to approximately 43,000 tons and are located in water depths that range from 95’ to 1198’(MMS 1999). One proposed strategy (progressive transport) relies on rigging the structure between several barges, winching it off the sea floor and dragging it into shallower water where the exposed portion is removed and the process is repeated (Byrd, personal communication, 1999). The costs associated with jacket removal will depend on the method of removal selected. This will determine the size of the heavy lift vessels and other equipment required as well as the quantity of offshore cutting required and labor. It is likely that gross tonnage will be the driving factor in the choice of method.

Transport to the scrapping facility (Portland, Oregon) represents another significant portion of the total removal costs. Distance to the scrapping facility is influential due to the high cost of marine equipment

The absence of jacket removal costs for the leave-in-place scenario represents a significant source of cost savings. For the partial removal scenarios the cost of jacket removal could vary tremendously. The topple-in-place scenario would probably be the cheapest partial removal option. Cutting and removing part of the jacket would undoubtedly constitute a larger expense. And finally, actually moving the entire jacket to a different location could be as expensive as complete removal, depending upon how far the structure is transported.

Costs for Complete Removal

MMS estimates the costs of removing topsides, cutting piles and removing jacket structures based on estimates of the size and weights of the structures, the number of modules, the number of lifts needed and maximum weight of lifts needed (MMS 1999). The number of days required for completing various tasks is also estimated (MMS 1999) (See Table 5) and the removal costs are estimated for a typical platform at depths of 200, 400, 700 and 1,200 feet. Based on these factors the study calculates costs of $3,960,000, $15,263,000, $21, 450,000 and $ 48,675,000 for platforms of increasing depth (MMS 1999). These cost estimates are primarily composed of the derrick barge costs and a per day estimate of related diver support, survey and other related vessels and equipment. A 10% contingency cost is also included to account for weather and other unforeseen factors. For 200 ft. platforms and less, a 2,000 ton derrick barge ($150,000/day) is considered sufficient while for 400 ft. and greater platforms 5,000-ton barges are assumed ($310,000/day). The diver support and related equipment rate is estimated to be $30,000 per day for platforms in 200 ft. of water and $65,000 for platforms in 400 ft. of water or greater. These assumptions lead to the following costs:

200 ft. water depth platform total cost of removal
($ 150,000/day + $ 30,000/day + 10% contingency) × 20 days = $3,960,000

400 ft. water depth platform total cost of removal
($ 310,000/day + $ 65,000/day + 10% contingency) × 37 days = $15,263,000

700 ft. water depth platform total cost of removal
($ 310,000/day + $ 65,000/day + 10% contingency) × 52 days = $21,450,000

1200 ft. water depth platform total cost of removal
($ 310,000/day + $ 65,000/day + 10% contingency) × 118 days = $48,675,000

Costs for Leave-in-place

A leave-in-place decommissioning strategy would incur no further ordinary costs beyond the platform preparation stage. Cleaned and stripped decks would remain in place as would piles and jackets.

Costs for Partial Removal

Many partial removal scenarios would greatly reduce the costs associated with structural removal and they are considered here. A partial removal scenario where decks are removed, piles severed and the entire jacket structure is relocated and reefed in an alternate location would not change the costs of structural removal (Byrd, personal communication, 1999).

However a scenario where decks were removed, piles severed and the jacket was toppled in place would reduce maximum lift required (toppling could be done by simply winching the jacket structure onto its side (Byrd, personal communication, 1999). Working with the MMS assumptions, (See Table 4) this would mean that for platforms of all depths, a 2000-ton capacity derrick barge would be sufficient. Furthermore, the days devoted to jacket removal (4, 12, 24 and 75 for increasing depth) would no longer be required. Related costs might remain at 50% of their previous values. This yields the following estimates for the toppling in place scenario:

200 ft. water depth platform total cost of removal
($ 150,000/day + $ 15,000/day + 10% contingency) × 16 days = $2,904,000

400 ft. water depth platform total cost of removal
($ 150,000/day + $ 32,500/day + 10% contingency) × 25 days = $5,019,000

700 ft. water depth platform total cost of removal
($ 150,000/day + $ 32,500/day + 10% contingency) × 28 days = $5,621,000

1200 ft. water depth platform total cost of removal
($ 150,000/day + $ 32,500/day + 10% contingency) × 43 days = $8,632,000

These cost give a fairly good indication of what deck removal and pile severing might cost. The actual process of toppling the jacket could be expected to add to these figures but not substantially. Thus, they are a fairly accurate indication of how much removal for the topple-in-place option might cost.

Finally, it is also possible to build a scenario for partial removal in which the topsides are removed and the jacket is truncated to a depth thought to be safe for navigation (approximately 100 ft.). In this type of scenario the cost of cutting piles would be avoided as would much of the jacket removal work. Based on the MMS assumptions about the size of jacket sections to be removed and the number of days required for each section, truncation to a least 100 ft. requires 2, 3, 4 and 10 days for platforms of 200, 400, 700 and 1200 ft. depth respectively. Pile cutting and removal days are avoided all together. Number of days required for deck removal is unchanged (10, 16, 16, and 26 for increasing depth) as are the maximum lifts. The three deeper categories of platform still would require a 5,000 ton capacity derrick barges ($310,000/day) but would probably require a diminished level of support (again we assume ½ the level as for complete removal). The total number of removal days would then be 12, 19, 20, and 36 respectively. These assumptions yield the following cost estimates for the truncation scenario:

200 ft. water depth platform total cost of removal
($ 150,000/day + $ 30,000/day + 10% contingency) × 12 days = $2,376,000

400 ft. water depth platform total cost of removal
($ 310,000/day + $ 65,000/day + 10% contingency) × 19 days = $7,837,500

700 ft. water depth platform total cost of removal
($ 310,000/day + $ 65,000/day + 10% contingency) × 20 days = $8,250,000

1200 ft. water depth platform total cost of removal
($ 310,000/day + $ 65,000/day + 10% contingency) × 36 days = $14,850,000

Clearly, then the cost savings represented by either of these latter two partial removal scenarios are substantial.

Notes about Further Research and Reuse

Given the fact that each platform is unique, specific engineering and removal plans must be formulated before costs can be delineated thoroughly. The feasibility and cost effectiveness of new technologies that might be employed in the removal process must also be investigated if a more accurate assessment of removal costs is to be conducted. Finally the technical potential to reuse refurbished deck components and equipment should be investigated thoroughly. Similarly, a potential market for the distribution and reuse of equipment between industry players and not simply within one company's operation, must be explored further.

Platform and Structural Removal costs and variables are summarized in Table 3 and Figure 2.

Pipeline and Power Cable Decommissioning Costs

At the present time there are 55 pipelines (315 miles) and 19 power cables serving 23 facilities in federal waters offshore California (MMS 1999). Any decommissioning strategy deal with the offshore pipeline and power cable infrastructure associated with an oil platform. Whatever approach to pipeline and power cable removal or abandonment is adopted, it will be applied in all potential platform disposition options. In this respect, costs incurred for pipeline and power cable disposition are common to all platform-decommissioning options and do not effect this decision. Therefore, the discussion of this category is brief.

Both Federal and California regulations allow decommissioned OCS pipelines to be abandoned in place so long as they do not constitute a hazard to navigation, commercial fishing or unduly interfere with other uses of the OCS. California State Lands Commission policy requires removal, when feasible, of pipeline segments in the surf zone to a depth of 15 feet. Too date, with few exceptions, most power cables have also been abandoned in place.

Any plan for power cable and pipeline decommissioning (be it removal or abandonment) begins with a survey and data collection phase. This process is aimed at identifying where pipelines or cables might pose a liability as well potentially as determining pipeline and cable burial locations and depth, water depth, nearby pipelines or structures and environmental information (Culwell and McCarthy 1998). In addition engineering information such as pipeline and power cable characteristics must be known. Under any scenario pipelines must be cleaned thoroughly. This involves “pigging” and flushing the lines with various substances aimed at removing all hydrocarbons (Culwell and McCarthy 1998). On a large scale, if complete removal were undertaken for instance, disposal of pipeline and power cable would constitute a potential hurdle. Reuse of pipeline steel is not feasible due to coatings (Culwell and McCarthy 1998). Any pipeline removed would have to be cut into short lengths and landfilled appropriately. Similarly, it is not likely that power cable could be reused. It too would have to be taken to a dumpsite. In an abandonment scenario, pipelines would be severed, capped and buried. Similarly, free ends of cut power cables would also be buried. Finally, post removal or abandonment site-clearance would be required. Costs associated with pre- and post-decommissioning surveys, engineering and planning, and transportation and disposal are included elsewhere.

It is likely that many pipelines could be abandoned in place in the Pacific OCS (39 of 55) however, some 16 would have to be removed (MMS 1999). The largest costs considered in this category are incurred during any such removal operations, and are driven by both fixed (mobilization/demobilization) and hourly rates for vessels and diver-related services. These costs are apt to increase with increasing depth and length of pipeline.

The cost to decommission 2 pipelines in place, a typical number for a Pacific OCS platform would range from $400,000 - $550,000 (MMS 1999). “Decommissioning projects, which necessitated partial or total removal of pipelines, could be as much as an order of magnitude higher depending upon length of pipeline and water depth. These estimates include economies of scale that might be achieved in decommissioning several closely-spaced lines in concert and average fixed costs over multiple projects." (MMS 1999). MMS does not attempt to project the costs for decommissioning pipelines in place in water depths greater than 700 ft. or removing pipelines in water depths beyond 150 ft. due to the paucity of data. Pipeline abandonment and decommissioning is clearly an area where further study and experience will allow for more accurate forecasting of cost.

Costs and variables for Pipeline and Power Cable Decommissioning are summarized in Table 3 and Figure 2.

Materials Disposal Costs

There are three avenues for disposal of materials generated from decommissioning operations: reuse, scrapping and recycling and disposal in landfills. Opportunities for large scale or wholesale reuse of topsides or equipment are apt to be limited given recent stricter technical standards for equipment and the fact that many components were designed for a specific set of functional requirements (Byrd, personal communication, 1999). Scrapping remains perhaps the most viable option for the bulk of the steel removed while land-filling is the likely option for other material. Potentially harmful substances, while apt to occur in small quantity must be dealt with prudently and appropriately.

No onshore facility in California is capable of landing or dealing with the large deep-water structures (Byrd, personal communication, 1999). The nearest facilities capable of landing and scrapping such structures are in the San Francisco Bay area (400 miles away) and Portland, OR (1000 miles away) (MMS 1999). The overwhelming bulk of the waste stream generated from decommissioning platforms is the steel from jackets. Schnitzer Steel Industries, Inc. in Portland processes some 500 tons of steel per hour. The total weight of California's offshore platforms is 401,387 tons (MMS 1999). Schnitzer has quoted a price of $400/ton for scrapping the steel from offshore platforms. The steel must be cleaned of marine growth. This can be problematic as far as air emissions are concerned but marine growth can be disposed of in non-hazardous wet landfills. At most, marine growth might represent 5% by weight of the total gross tonnage of a platform. There has been some discussion of attempting to blast this growth off the jackets as they are removed from the water. This however would require permitting and its cost implications are not entirely clear. Scrapped steel could be sold at a conservatively estimated price of $75-100. In the past much of this scrapped steel has been sent to Japan. These figures are in line with the costs faced by Chevron during the 4H-decommissioning project (MMS 1999). The net cost of scrapping steel in that instance was $333/ton.

Other materials that are part of the waste stream but represent far smaller quantities include concrete and insulating materials and mud that could be disposed of in landfills in the Southern California area (Clement, personal communication, 1999). Most concrete is present as part of the conductors. This volume can be estimated as indicated in the discussion of conductor removal. Insulation and other materials might represent an even smaller proportion of the waste stream, perhaps 100 tons/platform (Byrd, personal communication, 1999). A more direct way to estimate these costs is to extrapolate based on the 4H costs ($350,000/platform) (Clement, personal communication, 1999). The following calculations build on the 1999 MMS study and assume that the cost of disposing of all non-steel waste will range from $300,000/platform for the smallest of platforms to $700,000 for the largest of platforms. The handling, transport and disposal of concrete would most likely dominate the cost of disposing of other materials (Byrd, personal communication, 1999). These estimates, combined with a cost of 325$/ton (after sale of scrap steel at $75/ton) yield the following cost estimates:

Small	5,000 tons of steel × $325/ton + $300,000 (other materials) = $1,925,000
Medium	10,000 tons of steel × $325/ton + $350,000 (other materials) = $3,600,000
Large	30,000 tons of steel × $325/ton + $500,000 (other materials) = $10,250,000
Ultra-Large	70,000 tons of steel × $325/ton + $700,000 (other materials) = $23,450,000

Leave-in-Place

The leave-in-place scenario would incur few costs related to disposal of materials.

Partial Removal Schemes

A topple-in-place scenario would require only that deck material be scrapped. If the bulk of the deck material is in fact steel, the numbers just calculated can be adjusted. For most platforms categorized as small, the deck weight constitutes approximately half of the total tonnage (Byrd, personal communication, 1999). This relationship holds true for medium tonnage platforms as well. For large platforms, deck weight is more nearly 1/4 of the total platform weight. And, for ultra-large platforms, deck weight is closer to 1/7 of the total platform weight (Byrd, personal communication, 1999). This results in the following costs:

Small	½ × $1,925,000 + $300,000 (other materials) = $1,262,500
Medium	½ × $3,600,000 + $350,000 (other materials) = $2,150,000
Large	1/4 × $10,250,000 + $500,000 (other materials) = $3,062,500
Ultra-Large	1/7 × $ 23,450,000 + $700,000 (other materials) = $4,050,000

A scheme that truncated jackets at approximately 100 feet below the surface would be apt to incur roughly the same non-steel related disposal costs as in the aforementioned scenarios (again, concrete from conductor removal is apt to dominate this category) (Byrd, personal communication, 1999). Steel-related disposal costs could be calculated based on the number of sections that would have to be removed to achieve truncation to 100 ft. and their summary weight (See Table 5 below).

Table 5. Platform Deck and Jacket Removal Times and Costs.

	WATER DEPTH (ft.)			
	200	400	700	1200
Derrick Barge Capacity (tons)	2000	4000-5000	4000-5000	4000-5000
Jacket Weight (tons)	2500	11000	18500	43000
Jacket Sections				
Max Weight per Section (tons)	1250	3000	3000	3000
Number of Sections	2	4	6	15
Days per Section	2	3	4	5
Total Jacket Removal Days	4	12	24	75
Deck Modules				
Max Weight per Module (tons)	1000	2000	2000	1300
Number of Modules	5	8	8	13
Days per Module	2	2	2	2
Total Deck Removal Days	10	16	16	26
Rig up/Rig down Days	4	7	10	15
Pile Cut/Removal Days	4	7	10	15
Total Days	20	37	52	118
Coat per Day ($)	3,9600,000	15,263,000	21,450,000	48,675,000

source: MMS, "Offshore Facility Decommissioning Costs, Pacific OCS Region", March 31, 1999

Finally, the cost of disposing of decks must also be included

Small 1,250 tons of steel × $325/ton +$1,262,500 (deck and other) = $1,668,750
Medium 3,000 tons of steel × $325/ton +$2,150,000 (deck and other) =$3,125,000
Large 3,000 tons of steel × $325/ton +$3,062,500 (deck and other) =$4,037,500
Ultra-Large 6,000 tons of steel × $325/ton +$4,050,000 (deck and other) =$6,000,000

Finally, a partial removal scheme that involved transporting part or all of the jacket and reefing it in another location would not result in disposal cost significantly different than the aforementioned topple-in-place scenario.

Costs and variables for Materials Disposal are summarized in Table 3 and Figure 2.

Site Clearance and Verification Costs

The scope of site clearance work will be determined by the disposition option selected. Also the potential future uses of a site will determine the extent to which debris clearance might be required. If for instance a platform is located in an environment unsuitable for trawling or any other use that require site conditioning, debris clearance (beyond the removal of hazardous material) could be less of an issue (McCarthy 1998).

Typically, site clearance might begin with a pre-decommissioning survey of the area surrounding the platform using side-scan sonar (McCarthy 1998). Debris extraction, which relies on the use of ROVs and divers, would follow platform disposition (McCarthy 1998). This process might be part of a leave-in-place or partial removal scenario as well but it seems logical that, complete removal might motivate a more thorough debris removal (as would the move and reef option under partial removal). The actual cost of removing debris depends strongly on depth, size of area to be cleared and verified, quantity and type of debris, and weather conditions. Greater depths require different methods of removal, namely saturation diving. Trawling with heavy nets or using remotely operated vehicles (ROVs) working in conjunction with divers can be effective in shallow waters; deep water might necessitate larger ROVs and even manned submersibles (McCarthy 1998). This would escalate costs considerably. Regulatory requirements also require test trawls.

MMS estimates costs of clearance and verification for complete removal (MMS 1999). It is assumed that air diving is used for platforms in less than 300 ft. of water and saturation diving is used in platforms in greater than 300 ft. of water.

Pre-Demolition Side Scan Sonar Survey (3 day)	$55,000
Post-Demolition Side Scan Sonar Survey (3 day)	$55,000
ROV deployment (7-14 days @ $11,000/day)	$77,000-$154,000
Air Diving (7-14 days @ $10,000/day)	$70,000-$140,000
Saturation Diving (7-14 days @ $45,000/day)	$315,000-$630,000
Test Trawl (7-14 days @ $5,000/day)	$35,000-$70,000
Total for platforms in < 300ft. of water	$244,200-$521,400 (includes 10% contingency)
Total for platforms in > 300ft. of water	$590,700-$1,060,400 (includes 15% contingency)

These costs are in line with the 4H case, where pre-abandonment surveying expenses amounted to $50,000 for the four platforms (Clement, personal communication, 1999). Trawling costs totaled approximately $238,400 for all four platforms (Clement, personal communication, 1999). The debris removal costs incurred in the 4H decommissioning process were on the order of $1.5M (Clement, personal communication, 1999).

It is difficult to speculate reliably about how these costs might change in a leave-in-place scenario or any of the partial removal scenarios. A leave-in-place scenario would probably result in some cost savings. First, the extent to which site clearance and verification is required is apt to be less stringent. Furthermore, because less work is required to simply clean and prepare the decks for abandonment, there is apt to be less debris added to the sea floor during decommissioning than in all other options. While the former reasoning applies equally well to a platform toppled in place or one whose trunk is left in place, there is apt to be more debris added to the sea floor during the decommissioning process (McCarthy 1998). Consequently, there is some reason to believe that costs are apt to be higher than the leave-in-place scenario but still less than those incurred under complete removal. Finally, any scenario that reefs platform material in another location might incur the additional costs of surveying and clearing that new location. This could potentially double site clearance and verification costs (McCarthy 1998).

Costs and variables for Site Clearance and Verification are summarized in Table 3 and Figure 2.

Costs of Shell Mounds

Complete removal of shell mounds, if ultimately required, could be a significant cost category. Chevron has estimated that, if required to remove the mounds left from the 4H decommissioning, costs could reach $10 M or $2.5 M per mound (Clement, personal communication, 1999). Clearly these costs might escalate in deeper water. Alternatives to actually removing shell mounds have been explored. In addition to buoying, these alternatives include providing fishermen with specially equipped trawling nets with roller aimed at preventing snags. Also a draft agreement of the South Coast Trawlers Association Navigational Aid Program proposes compensating fishermen for constraining fishing grounds with differential GPS units (Carr, personal communication, 1999). This particular agreement, part of the 4H decommissioning, would involve an investment of approximately $1.5M to buy units for some twenty vessels (Carr, personal communication, 1999). Handling shell mounds and the threat they pose to trawling vessels requires further research, as do the ecological consequences of disturbing the shell mounds (Carr, personal communication, 1999).

A leave-in-place or partial removal scenario (with the exception of reefing the entire platform in another location) is not apt to require the removal of shell mounds. In all such instances, there is apt to be debris that constitutes a more significant threat to trawling or navigation than do shell mounds.

Costs and variables for Shell Mound decommissioning are summarized in Table 3 and Figure 2.

Costs of Navigational Aids

In all instances where some portion of the platform remains in the ocean, provisions must be taken to ensure safe navigation and trawling. For a leave-in-place scenario, where a substantial remainder of the above surface platform will continue to serve as a visual marker, few additional measures might be required. However, fishermen might still demand compensation for the continued loss of fishing grounds. While it is hard to extrapolate about the likely magnitude of such compensation, we know that in the 4H case the proposed compensation (in the form of differential GPS navigation systems) for exclusion due to the shell mound was on the order of $1.5 M ($75,000/fishing boat) (Clement, personal communication, 1999). These costs could substantially be higher depending upon the location and number of fishermen affected. For various partial-removal and reefing alternatives, other measures have been discussed. Buoys, costing $30,000 per mound on average have been used at least as a temporary measure to mark the shell mounds remaining from the 4H-decommissioning project (Clement, personal communication, 1999). Buoys might be employed to mark any reefed material or the stump of a truncated platform. Alternatively or in addition, some more sophisticated navigational aid such as differential GPS units could be supplied to those vessels operating near an effected area. As with the 4H shell mounds, this might cost $75,000/vessel (Clement, personal communication, 1999).

Costs and variables for Navigational Aids are summarized in Table 3 and Figure 2.

Onshore Facility Removal Costs

All three decommissioning options will bear the same onshore facility removal costs. Therefore, this is not a category of costs that requires details of estimation since it will not be a determinant in which decommissioning option is chosen.

Preface to Biology Benefits

The area that the platform occupies can support other activities due to biological resources that translate to benefits in terms of commercial fishing and recreational use. Currents in excess of seven knots, wave actions exceeding 15 feet and seasonal storms dictate utilization of materials and approaches that are inherently risky. Thus, any derivation of benefits for commercial and recreational fishing and aquaculture must be qualified with the fact that access to the resource near a platform may be limited and therefore seen as an unachievable benefit.

The following description of what evidence there is of biological growth and derivation of an economic value of this biological growth should be viewed in the context of what might occur near the platform delineated by the jacket and above water structure. No generalizations can be made in terms of the distribution, recruitment, and survival of biota for all platforms due to the variation across platforms in the multiple variables influencing the presence of biological growth such as currents, geochemical process, food chain dynamics, and nutrients (Chelton *et al*. 1992). There is no evidence at this time to make a case for attributing any potential value to pipelines that lead from the platforms to shore. Therefore under the different alternatives of full removal, partial removal or leave-in-place, there's not a measure that takes into account any biological activity on these pipelines. Another key distinction to make based on evidence of two series of biological monitoring studies (Simpson 1977 and de Wit 1999) is that the biological growth of shellmounds can only be counted with the option of leaving the platform in place. Observations made during the 4H study suggest that the removal of the upper portions of the platform legs and cross members and the elimination of deposits of live mussels to the shell mound has been a factor in this general reduction in shell-mound associated epibiota (de Wit 1999). The fish assemblage on the mound is related to that of the platform (Love *et al*. 1999). Average shell mound fish abundance with the platforms is 100 individuals per 100 square meter or 1 per square meter at seven platforms studied (Love *et al*. 1999). There is evidence that the act of removing the platform as well as what the platform offered the shellmound influences the overall decline in biological growth. In addition to physically disturbing the surface and subsurface shell layers during decommissioning operations, removal of the platforms has effectively eliminated the source of shell talus (de Wit 1999). Without the mound being re-supplied with live bivalves from the platform legs, support members, and drill pipes, the organic input has been reduced and the epibiota has been substantially altered (de Wit 1999).

Commercial Fishing Benefits

Under the leave-in-place scenario, current commercial fishing value derived from the platforms may continue. Ecomar of Goleta, California, contracts with a number of oil and gas operators offshore of the California coast to remove what is considered biofouling by oil and gas operators from their platforms. The substantial buildup of sea life attached to the underwater support for the platforms causes enough wave and current drag to present a potential hazard in terms of structure instability (Dougall 1996). To alleviate this problem, operators pay Ecomar for divers to remove the growth. One man's biofouling is another's gourmet dinner (Dougall 1996) and Ecomar has established a business of selling the shellfish it harvests and seeds at the platforms. The species that it harvests are mussels, scallops, and oysters from the platform legs during the cleaning. The divers also harvest clams from bags that they seed by hanging infant clams suspended on the platform over a few months. The reason for the growth of species near the platform is that the offshore location tends to moderate swings in water temperature and water currents make the system essentially self-cleaning, providing new, oxygenated water and removing wastes from fish and feeding. The ranges in weight of shellfish biomass harvested are provided for Ecomar in Table 3 on a per platform basis. For mussels, 50-100,000 pounds harvested per year is multiplied by the average 1999 price of $3.00 pound for the wholesale market yielding $150-$300,000. For oysters, 500-5,000 bushels harvested per year is multiplied by the average 1999 price of $20 per bushel yielding $10,000-$100,000. For scallops, 1,000 to 10,000 pounds harvested per year is multiplied by the average 1999 price of $6 per pound yielding $6,000-$60,000.

In order to predict any value of potential spillovers of fish from platforms as refugia to support recreational or commercial activities some distance away, it is necessary to obtain data that has not adequately been gathered indicating the range of movement (migration) of the species. The investment in tagging the fish underwater in order to deal with constraints on rockfish physiology (swimbladders). It is clear that the dispersal of larvae for the Piccachio is distant (from Mexico to Pt. Conception). Platform Gina is shallow, therefore, recreational access is possible. But, Platform Irene is deep and surrounded by strong current so recreational and/or commercial access would be from a distance. With tagging data it might be possible to link the data available from California Dept. of Fish and Game on catch per patch (square area) per time period and location of the platform in order to establish a value of the platform in generating fish stock benefits for the commercial fishing industry as well as for recreational fishing.

The partial removal scenario and complete removal scenario cannot be assigned commercial fishing values. Foregone fish catches due to the presence of the platform are not quantified in detail due to the fact that the presence of the rig over the years has not led to compensation already of the fishing industry. There’s no guarantee that the area now occupied by the rig would necessarily have been used for trawling.

Recreational Value

It is possible to quantify some value for recreational activities associated with the platforms by using available information from entities such as the Liberty dive boat out of Channel Islands Harbor scheduling dive recreational trips to the platform Grace. The value is derived through the travel cost method. By adding up the costs for traveling in the boat and participating in diving (equipment costs, other amenities), the travel cost method indicates what people pay to recreate at the platforms. $60 per person multiplied by 50 people multiplied by 3 trips per year per platform plus the monetary value of miles traveled ($1,000) equals $10,000 per year. Clearly, the ability to derive this value is site-specific due to a variety of conditions that might limit access to the platforms even though there might be fishing and diving amenities. Table 3 indicates the recreational benefits value.

There is evidence from Simpson (1977) of the presence of 20 varieties of avian species and 4 species of marine mammals including sea lions and gray whales at the 4H platforms. The recreational value for observing such species could be derived from quantifying the travel cost for boat trips in the Channel (using Island Packers out of Ventura as a reference).

Habitat Value

The most productive part of the platform is the euphotic zone that is delineated from the water surface down to about 100 feet. Since this portion is likely to be removed for either the complete removal or partial removal option, the habitat value is a benefit for the leave-in-place option. Some factors that determine whether the platforms serve as ideal conditions for reef habitat are whether the material of the platform has stability, durability, and function in terms of supporting material for fisheries.

Simpson (1977) indicates twenty to fifty more fish were found under the platforms than on adjacent sedimentary bottom and five times more fish were present under the platform than at natural hard bottom habitats. Love *et al.* (1999, 2001) have conducted the most extensive analysis of the platforms in terms of investigating specific mechanisms (e.g. enhanced juvenile recruitment, increased survivorship of adults) that lead to biological function of the platforms. Results from their three year study (1995-1997) show that platform fish assemblages were less diverse and more variable in space and time than natural reef fish assemblages (Love *et al*. 1999). Fish abundance and species richness were negatively correlated with platform depth. The most abundant species at the platforms are rockfish. Schroeder has modified a measure developed by Bond *et al*. (1999) that is an index of habitat value. The index sums the square root transformation of the product of each species' density, mean size (total length) and fidelity (Schroeder 1999). Each of those are empirically measured with density quantified on the basis of number of fish per hectare and fidelity measured by the number of times a species is observed in all surveys divided by the total number of surveys. The index is used to produce a measure of biological production and might serve as the basis for estimating an economic value. On average, platform habitat values were 42% lower than natural reef habitat values. The four northern platforms located in the Santa Maria Basin had lower values than the south eastern platforms in the Santa Barbara Channel. The platform values were more variable than natural reef values due to oceanographic processes reinforcing the notion that Love *et al.* project of not generalizing but looking at each site separately. It is difficult generalize about the value of biological resources for the area and leads to a limitation in quantifying exact economic measures of benefits. More details about the fisheries value based on observations from Love, Schroeder, *et al.* suggest that the habitat value does incorporate some trend analysis in terms of seasonal changes in the presence of fish at the platforms through the variable, fidelity. By accounting for how many times the fish were spotted over the number of observations, it is possible to detect the frequency trend. Otherwise, by listing a range of values to indicate the low and high value corresponding to the scarcity and abundance of the species over time, it is also indicative of a trend. Based on the ranking the top 10 fish, it might be possible to narrow the comparison between natural reefs and platforms to indicating that rockfish are more abundant on platforms and surfperch and others more abundant on natural reefs. The habitat values are listed by species and by platform. The following equation from Schroeder *et al*. is used to quantify economic value with the habitat value multiplied by the monetary value of the species listed as present.

The following equation offers a method to use a habitat value for each species that could be relevant for deriving a possible monetary value.

$$HV\ \% = (HV/\sum HV) * 100$$

Where HV is the habitat value contributed by each species and the sum of HV is the habitat value of the entire site. From Schroeder *et al.* (1999), the sum of values for nine platforms is 16,600. Since this represents both a percentage and size of the fisheries biomass, if might be useful to multiply this total for all of the platforms by a monetary value of the various fish. Assuming an average price of $5.00 for the variety of species, the habitat value for nine platforms is $83,000. From the table we can disaggregate to value each platform separately using the same average price. In this manner, we do not distinguish between what is commercially valued or what is nonmarketed for recreational and existence value.

The costs of establishing and maintaining artificial reefs are common to all decommissioning options, according to David Parker of California Department of Fish and Game since the criteria for material for artificial reefs is that the material have the potential for maximizing complex, diverse biological growth that fosters production as well as attraction of flora and fauna (Parker, personal communication, 1999). The ideal material is quarry rock for stable substrate to have rugosity and to provide microhabitat hiding holes for production of flora and fauna not just attraction. Submersible and scuba surveys of platform structure reveal that fishes aggregate in crevices and corners at the bottom of platforms (Schroeder 1999). Parker asserts that it is likely for any platform that is proposed for potential reefing would still require material to be added to it (rock added within and around the legs and pilings to build the substrate for enhancing the complex, biological growth). Hence, there would be additional costs for making the rig into a reef besides just locating the rig somewhere (in place, toppled, cut and brought to shallow water). Granted, with a platform left in place, especially in a shallow position, there may be less purchase of quarry rock required due to the presence of shell mounds. The interaction between the mounds and the platform detritus fosters biological growth. However, since it has been noted that without the rigs and the constant supply of new material to the mounds, there is little growth (habitat for flora and fauna to thrive). Parker believes that the lost of the most productive euphotic zone with any change in the current platform orientation means there’s even more need to add more amendment material to have any potential for a reef. An example of the cost of quarry rock for reef activity is:

$300,000 for 10,000 tons of quarry rock from Santa Catalina Quarry delivered onsite (mid 1990s)

Figure 2 indicates the factors (variables of importance) contributing to the estimated range for each cost category.

For example, the cost category for Engineering and Planning can yield costs increasing in structure size and weight, water depth and complexity of topsides. Permitting and Regulatory Compliance costs increase in the number of platforms decommissioned. The cost of Platform Preparation increases in the size of the structure and the complexity of topsides. Plugging and Abandonment costs increase in the degree of difficulty as well as the number of well slots. Costs of Conductor Severing and Removal increase by the variable of water depth. Mobilization and Demobilization costs are a function of market conditions in the marine construction industry and can increase with the size of the structure, distance between platform and location of equipment deployment, and the number of platforms decommissioned. There may be economies of scale from decommissioning several platforms in proximity with the same equipment. Costs of Platform and Structural Removal increase in the size and weight of the structure, water depth and labor support required as well as the complexity of topsides. Market conditions in the marine construction industry will influence the costs (the fewer number of operators, the higher the price of service, common of oligopoly and monopoly markets). Pipeline and Power Cable Decommissioning costs increase in water depth and the extent and length of the pipeline to be removed. Costs of Materials Disposal increase in the size of the structure and the distance from platform to disposal facility. Site Clearance and Verification costs increase in the water depth and type of labor support required as well as the size of the area to be cleared. Costs of Shell Mound Decommissioning are a function of the method chosen. Navigational Aid costs also depend on the method of marking residual structures.

Figures 3-7 indicate the cost categories that are most influential for each decommissioning option. Figure 3 graphs the leave-in-place scenario. Clearly, Plugging and Abandonment Costs could dominate all other cost categories with the largest range and highest upper bound. Figure 4 graphs the complete removal scenario. The costs of Platform and Structural Removal have the largest range and could surpass the next largest range of costs, Materials Disposal. Figure 5 graphs the reefing onsite partial removal scenario. Platform and Structural Removal costs could be as much as the range for complete removal and this category can far exceed other costs of Mobilization and Demobilization as well as Plugging and Abandonment. Figure 6 graphs the truncation partial removal scenario. The range for Platform and Structural Removal costs is largest followed by costs Mobilization and Demobilization and Plugging and Abandonment. Figure 7 graphs the topple-in-place partial removal scenario. This scenario is parallel to the truncation alternative with a decrease in the upper bound of the range for costs of Platform and Structural Removal.

Figure 3. Cost Ranges by Category for Leave-in-place Scenario.

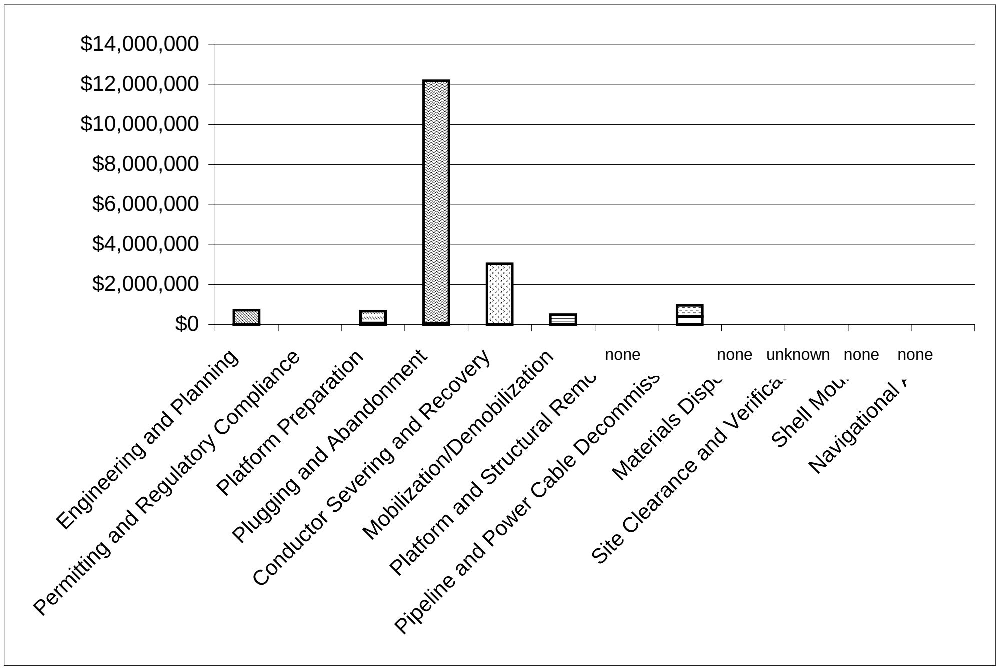


Figure 4. Cost Ranges by Category for Complete Removal Scenario.

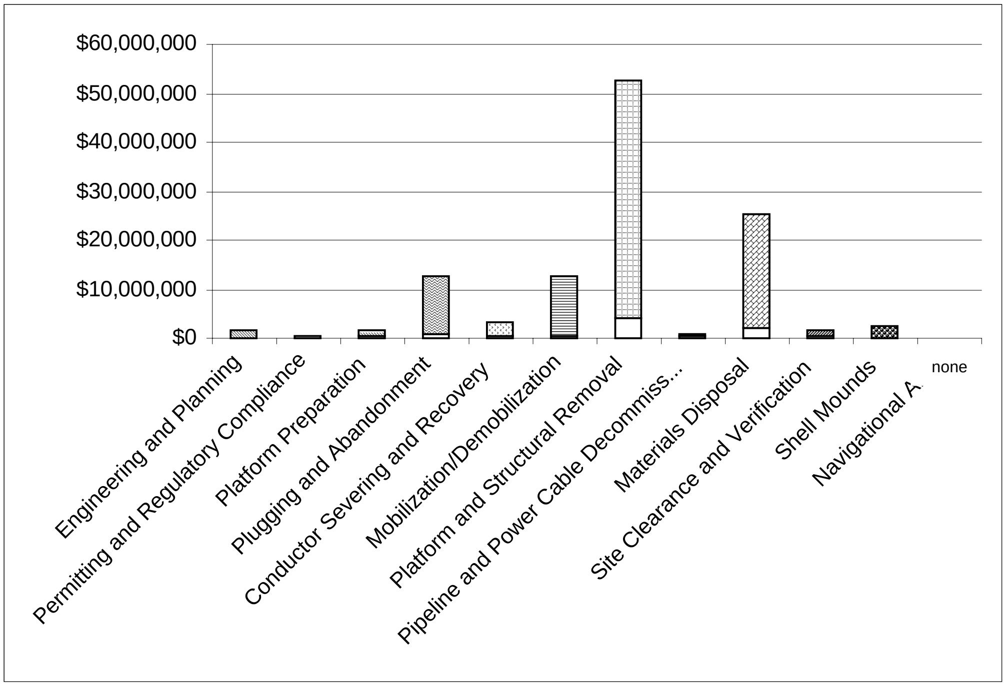


Figure 5. Cost Ranges by Category for Reefing Offsite Scenario

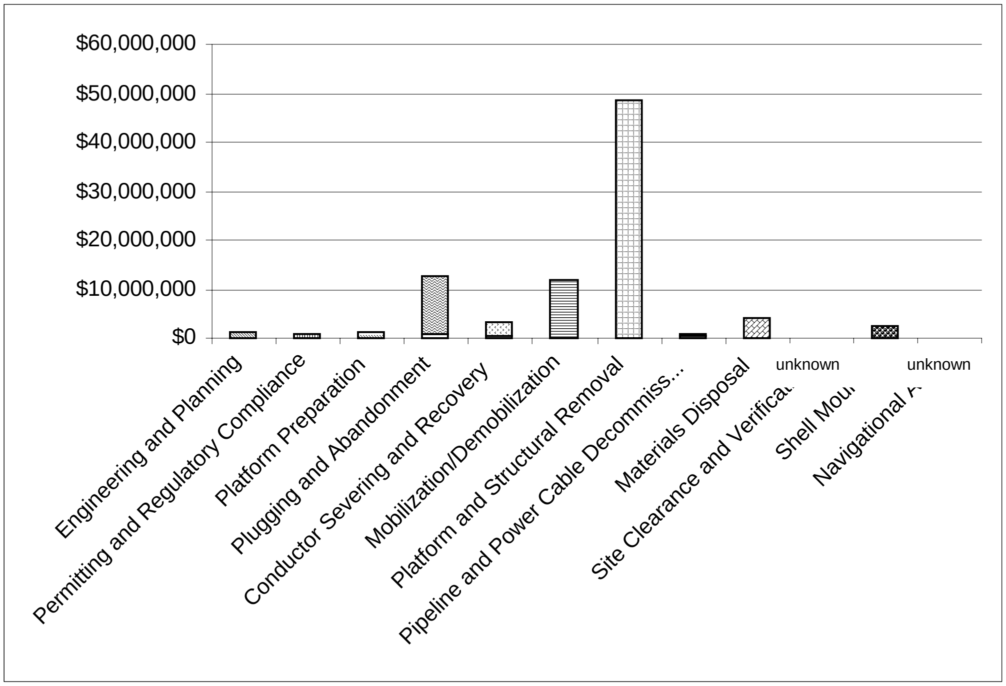


Figure 6. Cost Ranges by Category for Truncation Scenario

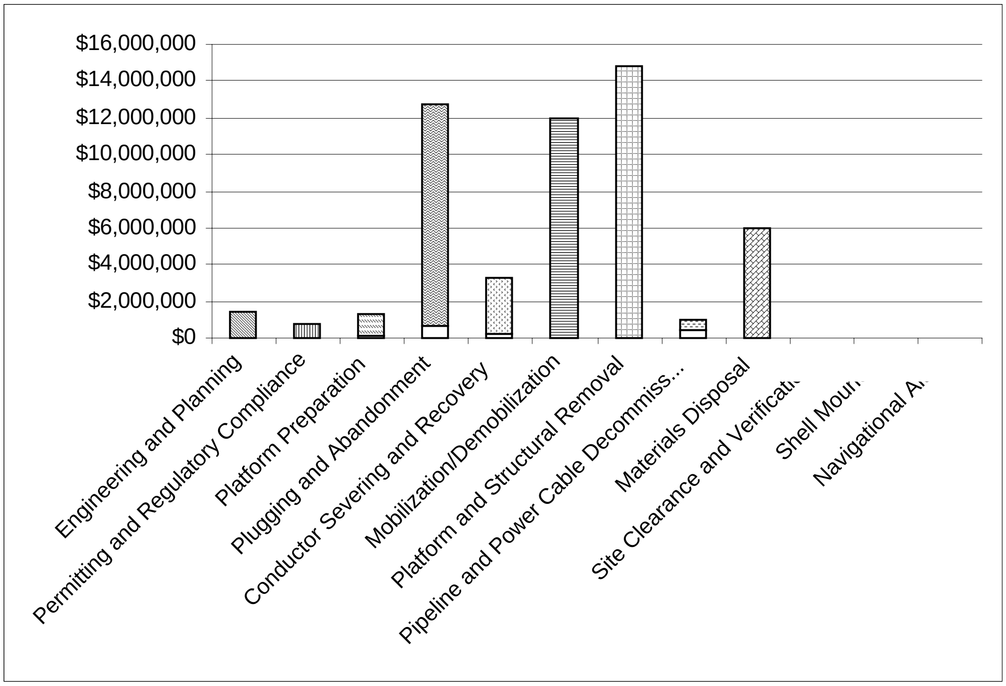
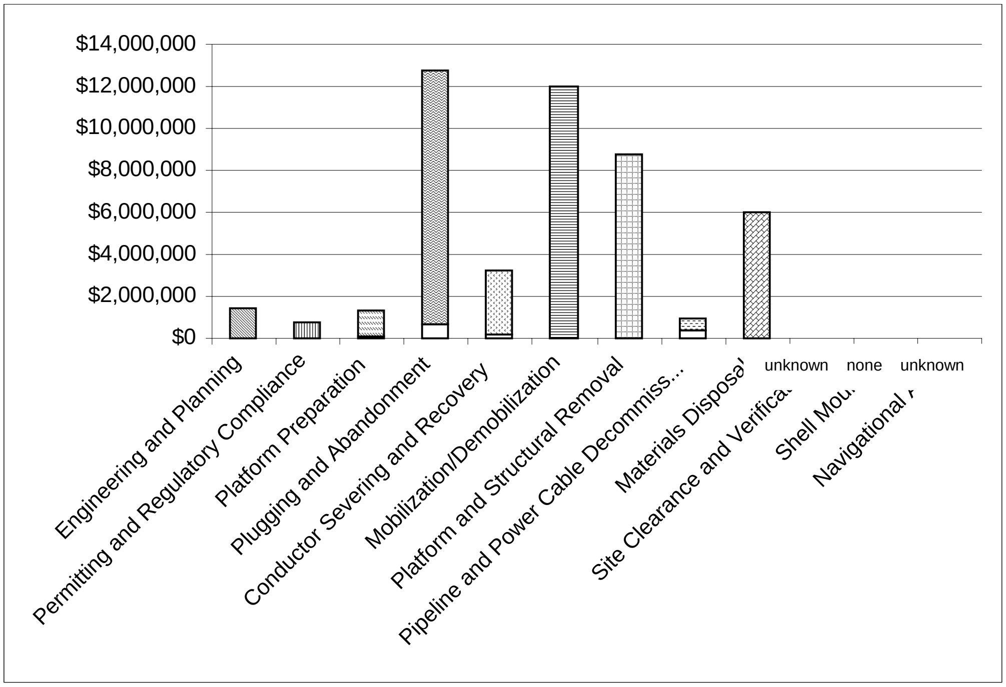


Figure 7. Range of Costs by Category for Topple-in-place Scenario



Comparing Alternatives

The range of values for the three alternatives implies they can be compared relatively, where low and high bounds of the ranges may lead to a ranking. The range for Partial Removal has an upper bound that makes accounting for two sites (original platform site and site where rig is transported to) less attractive than the Complete Removal and Leave-in-place alternatives. The overlap of ranges for Complete Removal versus Leave-in-place means it is more likely that each platform should be considered individually in order to derive more specific estimates of costs and benefits to weigh alternatives. However, the ability to consider economies of scale from grouping platforms together for complete removal is possible by accounting for spreading the costs from the engineering and planning, mobilization and demobilization and platform and structural removal across several platforms.

Since the study is an objective information document, the result should not be one alternative ranked above all others. Instead, the results identify the factors involved in decommissioning, especially for platforms standing in varied water depths that often exceed the depth of platforms that have been decommissioned in other geographic areas such as the Gulf of Mexico. Table 3 depicts the costs associated with the three decommissioning options described in this section.

One category of interest that is not quantified here is liability. The oil producer retains all liability for the platform and wells under various decommissioning options.

Liability for accidents during lease clearance and abandonment is a cost to contend with in terms of personal injury, property damage, and environmental damages for the complete removal alternative. Liability for any recreational or fishing accident taking place at a platform is a cost to contend with for the leave-in-place and partial removal alternatives.

The potential costs of liability with the leave-in-place or partial removal alternatives call into question the logic of pending legislation (Senate Bill No. 1, Alpert) within the State of California that suggests platform operators can and will yield cost savings from leaving the platform in place for fisheries mitigation projects. The platform can still cost the operators long after ceasing oil production with threats of top-heavy platforms from biofouling growth supporting fisheries habitat leading to possible toppling and/or personal injury or property damage from accidents around the platform. The operators should hold financial resources to cover these potential costs.

SECTION FOUR
CALIFORNIA'S ARTIFICIAL REEF PROGRAM AND THE RIG-TO-REEF DEBATE
By Caroline Pomeroy

In the Gulf of Mexico OCS region, the connection between artificial reefs and rigs-to-reefs has long been evident. In the Gulf States, artificial reef programs were created *pursuant to*, rather than prior to the emergence of questions about offshore rig decommissioning policy (See Section 5). In California, however, the interest in - and the development of - artificial reefs in state waters occurred nearly two decades prior to the first offshore platform decommissioning efforts, and even longer before the onset of the current rig-to-reef debate within the state. Table 6 depicts a chronology of the California Artificial Reef Program (CARP) and Rig-to-Reef Debate.

Table 6. California Artificial Reef Program and Rig-to-Reef Chronology

1958-1964	Early investigative period.
1958-1960	Ocean Fish Habitat Development Project study of two artificial reefs built by CDFG from donated materials and offshore oil drilling platforms to investigate the effectiveness of various reef materials for increasing sportfishing success.
1958-1961	CDFG and Western Oil and Gas Association (WOGA) three-year agreement for CDFG to study effects on marine life of man-made structures and of depositing washed drill cuttings on ocean floor.
1960-1965	Study of three experimental, multi-component man-made reefs and one "production" model reef in Santa Monica Bay to determine optimum material for artificial reefs and effects on fishing.
1965-1980	CARP slow-down.
1974	Platform Harry, 1 mile off Pt. Conception, decommissioned; reefing proposed, but tabled.
1980-1986	Southern CA Edison builds an artificial reef to mitigate kelp forest loss. Major program of CARP reef construction and research begins with CDFG's kelp restoration group and Sport Fish Restoration Act funds redirected to CARP.
1984	National Fisheries Enhancement Act passes. Breaux amendment to Sport Fish Restoration Act allocates funds to artificial reef programs.
1985	California SB 70 passes institutionalizing CARP and providing one-time $.5 million funding.
1988	Platforms Helen, Herman decommissioned; reefing proposed, but tabled.
1992	Last new artificial reef constructed by CDFG. 4H Platforms (Hazel, Heidi, Hilda, Hope) proposed for decommissioning; CDFG determines materials not suitable for reefing.
1994	MMS/SLC Decommissioning Workshop: "Abandonment and Removal of Offshore Oil and Gas Facilities: Education and Information Transfer". Use of decommissioned platforms as artificial reefs within Sycamore Canyon MRPA Ecological Reserve proposed, then withdrawn.
1996	Decommissioning of four Chevron platforms begins; liability issues prevent reefing.
1997	Interagency Decommissioning Working Group (IDWG) formed by MMS and SLC. MMS/SLC Decommissioning Workshop: "Decommissioning and Removal of Oil and Gas Facilities Offshore California: Recent Experiences and Future Deepwater Challenges".
1998	Senator McPherson (R – Santa Cruz) introduces Rig-to-Reef bill (SB 2173); bill dies in the Senate. National Oceans Conference, Monterey, CA. California Artificial Reef Enhancement (CARE) organization established. AB 1241: Marine Life Management Act passes (Fishery management reform, Nearshore Fishery Management Act).

Table 6. California Artificial Reef Program and Rig-to-Reef Chronology (continued)

	Artificial Reef Conference (UCLA): "The Politics and Long Term Management of Essential Fish Habitats, with Particular Reference to Artificial Reefs and Offshore Structures".
1999	Senator Alpert (D - San Diego) introduces Rig-to-Reef bill (AB 241); bill held over to second year.
	UC Select Committee on Decommissioning formed.
	MMS/SLC Decommissioning Workshop: "Rigs-to-Reefs".
	Sea Cliff Pier (offshore facility, Southern CA) decommissioned.
	AB 993: Marine Life Protection Act passes (Marine managed areas reform).
2000	CARP administers 35 artificial reefs.
	West Coast Groundfish Fishery declared a disaster.
	Clinton issues executive order calling for nationwide system of marine protected areas.
	Belmont Island (offshore facility, Orange County, CA) decommissioned.
	AB 241 placed on inactive file by request.
2001	Senator Alpert (D - San Diego) reintroduces Rig-to-Reef bill (SB 1).

In this section, we provide 1) a brief history of the California Artificial Reef Program (CARP), 2) brief discussion of rig to reef proposals and related activities leading up to the current legislative debate, and 3) an analysis of the recent rig-to-reef policy debate in California.

California's Artificial Reef Program

California's Artificial Reef Program (CARP) has a lengthy history, dating back to 1958, when concerns about declining ocean resource productivity and increasing demands, especially for sportfishing opportunities, prompted the California Department of Fish and Game to explore artificial reefs as a mechanism for addressing those concerns and needs. Over the ensuing decades, the Department oversaw research, development and monitoring of artificial reefs, albeit in fits and spurts as funding and political support fluctuated. It was not until 1985, however, the year after the passage of the National Fishing Enhancement Act, that the program was acknowledged by the Legislature and incorporated into the California Fish and Game Code (Sections 6420 - 6425). Most recently, the program's continuation has been called into question, as the Department's Strategic Plan does not provide explicitly for the program. Recent efforts to establish a state rig-to-reef program, however, might increase the program's profile, and the resources available to it. In the following paragraphs, we provide a brief history of the California Artificial Reef Program, focusing on four periods: 1) the early investigative period (1958-65), 2) a subsequent slow-down period (1965-80), 3) renewed activity (1980-1992), and 4) a recent slowdown period, but one that has seen the more serious introduction of rig-to-reef proposals (1992-present).

The early investigative period: 1958-1965

The predecessor of the present day CARP was created by the California Department of Fish and Game (CDFG) in 1958 as the Ocean Fish Habitat Development (OFHD) Project (Turner, *et al*. 1969). The program was initiated in response to the observation that although there were anecdotal reports of greatly increased sportfish yield where state and private agencies had placed old automobile bodies and other materials on the sea floor "barren of sportfish", there had been no scientific evaluation of the reefs (Carlisle, *et al*. 1964:6). The goal of the program was to conduct research on the possibility of increasing marine resource production both to mitigate negative environmental impacts of growing coastal and marine resource use and to enhance recreational (especially) and commercial (to a lesser degree) fisheries (Turner, *et al*. 1969). The OFHD Project was designed to determine 1) the practicality of artificial reefs in southern California waters, 2) the best materials to use, and 3) the return to the fisherman (Turner *et al*. 1969:196). The CDFG full-time biologists and a few other part-time personnel were involved in this project. More generally, they were responsible for several tasks including planning, permitting, siting, constructing , augmenting, and monitoring artificial reefs. [A Marine Habitat Advisory Council, comprised of representatives of the petroleum industry, California Wildlife Federation, the Ocean Fish Protective Association, and relevant state agencies provided oversight for the part of the study that dealt with offshore oil drilling (Carlisle, *et al*. 1964:5).]

With financial support from the Dingell-Johnson Federal Aid in Sport Fish Restoration Act (SFRA) of 1950 and other sources, CDFG biologists conducted a series of studies over the next several years to address the need for scientific evaluation of artificial reefs in southern California waters. The first study, initiated in May 1958, entailed the construction of experimental reefs to determine the effectiveness of various reef materials for increasing sportfishing success. In July 1958, CDFG entered into a 3-year agreement with the Western Oil and Gas Association to study the effects of man-made structures and washed drill cutting deposits on marine life. As a result, the CDFG study entailed the monitoring both of the newly created artificial reefs and of selected offshore oil drilling installations (Platforms Monterey, Hilda, Hazel, and Rincon Islands) (Carlisle, *et al*. 1964). The researchers concluded that quarry rock was the best material for constructing artificial reefs (Carlisle, *et al*. 1964:73). With regard to offshore oil installations, they concluded that the changes in habitat brought about by establishing offshore oil-drilling installations were generally beneficial to the flora and fauna, and that depositing washed drill cuttings on the bottom at these sites was "neither deleterious nor beneficial to the marine life in the area" (Carlisle, *et al*. 1964: 73).

This early success led to a second set of artificial reef studies from 1960 through 1965. These entailed the study of three experimental, multi-component man-made reefs and one "production" model reef in Santa Monica Bay to further explore and determine the most appropriate material for artificial reefs, and to begin to address the "attraction versus production" question that is at the crux of many artificial reef debates. Funding support included SFRA funds, along with $18,000 from California's Wildlife Conservation Board, and $6,000 from the Los Angeles County Fish and Game Commission (Turner, *et al*. 1969:7). The researchers confirmed their previous conclusion that quarry rock is preferred material. In addition, they found that an ideal configuration for an artificial reef would include its being moderately large, with many holes and crevices, on barren substrate over large area (200,000 ft^2), at 10 to 80 ft in depth (Turner, *et al*. 1969:199). They also stressed that it is critical to use adequate biological and physical data, and to have government supervision of artificial reef efforts because "other groups, no matter how well intended, are all too prone to consider only their own special interests" (Turner, *et al*. 1969:199).

Program dormancy: 1965-1980

These results notwithstanding, however, program funds dropped off soon after the study was completed, and the program entered a 15-year period of relative quiet. Funds from traditional sources such as the Wildlife Conservation Board, which had helped pay for the construction of many artificial reefs in the early years, diminished. Staff duties were reduced to maintaining permits and accepting materials donated for reef construction and augmentation (Parker personal communication). It is important, however, to note certain events that occurred in the broader context during this time, and how they may have related to the state's artificial reef program. These events included the 1969 oil platform blow-out in the Santa Barbara Channel, the passage of the National Environmental Policy Act in 1970, the Coastal Zone Management Act in 1972, and both California's Coastal Act and the (federal) Fishery Conservation and Management Act in 1976. Nationwide, and arguably statewide, attention was re-directed toward more pressing concerns about the risks of offshore oil development and competition between foreign and domestic fishing fleets.

Program Renewal: 1980-1992

The state's artificial reef program took another turn in 1980. As part of its mitigation for negative impacts of power plant discharges on nearby kelp forests, Southern California Edison engaged in a 6-year (1980-1986) cooperative project with CDFG for the construction of Pendleton Artificial Reef (in northern San Diego County) and studies to evaluate the reef's potential for enhancing marine resources (Lewis and McKee 1989:3). The resulting influx of funds and interest prompted the redirection of Sport Fish Restoration Act funds, along with CDFG's existing Kelp Restoration group, to the CARP. Staff was increased from three to five biologists, and their duties were expanded to include site selection, permitting and surveys. Artificial reef construction became one aspect of CDFG's Nearshore Sportfish Habitat Enhancement Program for restoring or enhancing sportfish habitat along the southern California coastline (Lewis and McKee 1989:1). The program's objective was (and still is) to maintain sportfishing success in the face of the cumulative effects of increasing fishing pressure as well as negative impacts on the nearshore ecosystem (Lewis and McKee 1989:1).

Although it was clear that the reefs attracted fish, there were concerns that this result could lead to increased local fishing pressure and resultant negative effects on populations. Next the program turned to an emphasis on designs that would promote production (by augmenting shelter and forage), as well as attraction (Lewis and McKee 1989:4). Japanese researchers found that high relief, open structures served best to attract fish, and better enable fishery exploitation (Lewis and McKee 1989:4). CDFG then sought to combine this strategy with one that also provided shelter and forage to increase production, with the goal of increasing "fish carrying capacity of selected areas" (Lewis and McKee 1989:4).

Five years into the renewed artificial reef program, and one year after the passage of the National Fisheries Enhancement Act of 1984, the California Legislature passed SB 70, providing legislative recognition of and support for the program (some 27 years following its initiation by CDFG). SB 70 added Sections 6420 through 6425 to the Fish and Game Code, which 1) declared the need for and potential value of an artificial reef program to enhance southern California marine fishes (Sec. 6420), 2) defined pertinent terms (Sec. 6421), 3) specified CDFG as CARP administrator and outlined the program's activities (Sec. 6422-6423), and 4) specified current and future funding sources (Sec. 6424-6425). Of particular note, the legislation included a one-time appropriation of $0.5 million to augment other resources (including Southern California Edison, Sport Fish Restoration Act, and Wildlife Conservation Board funds) that supported the CARP. Soon afterward, the program received an increased budget, and was able to support five positions, with one group working on site selection and another working on surveys. In 1991, however, the program was cut back to three positions, and both reef construction and research were curtailed.

Ebb and flow: 1992 - present

Since 1992, CDFG has sponsored the construction of only one new reef, but has continued its permitting activities for reefs proposed by non-governmental groups, and its reception of augmentation materials. Most of these efforts occur near major ports, and follow from nearby demolition projects as a cost-saving measure (Parker personal communication). In recent years, sport fishing and diver interest in artificial reefs in southern California has grown considerably. Numerous groups have initiated reef building and augmentation projects, which CDFG then oversees through the permitting process and beyond. Among the most recent of these is the San Diego Oceans Foundation-sponsored Project Yukon, which involved the sinking of a decommissioned Canadian military vessel in Fall 1999. At present, CARP manages 35 artificial reefs (each consisting of several modules) in state waters.

With the recent implementation of CDFG’s Strategic Plan, resources that would have been directed to the CARP have been reallocated to other, more pressing needs. As a result, “there’s no real artificial reef program” at present. A skeleton team of CDFG biologists attends to permits and materials made available for augmentation, but there is no monitoring. (One CDFG biologist noted that such monitoring could be resumed by incorporating it with ongoing programs to monitor natural reefs.) Moreover, program staff say they have taken care not to let the state program become a waste-dumping programs; “We'll take materials and/or construct a reef only if it suits our needs and criteria of stability, longevity, substrate value” (Parker, personal communication)

Fluctuations in the state program aside, there is a formal procedure for establishing an artificial reef in California waters. The applicant must obtain both federal (U.S. Army Corps of Engineers) and state (California Coastal Commission) permits, and a lease from the State Lands Commission. The applicant is responsible for completing an extensive environmental impact review which usually involves multiple agencies (e.g., Corps of Engineers, California Department of Fish and Game, U.S. Environmental Protection Agency, U.S. Coast Guard). The Corps of Engineers has oversight over navigational concerns while the California Department of Fish and Game is responsible for making sure the proposed reef complies with the Fish and Game Code. If the reef is proposed for state waters, it must comply with California Environmental Quality Act criteria, with U.S. Environmental Protection Agency having some authority as well. If it is proposed for federal waters, NEPA would be the primary guide for environmental impact assessment. Once these steps are completed, and other permits are in place, the proposal is submitted to the California Coastal Commission, which checks it for consistency with the California Coastal Act. Once the CCC grants a coastal development permit, it is the responsibility of the underlying property owner/project applicant to operate and maintain the reef. (If the reef is to be sited in federal waters, an SLC permit is not required, but the Coastal Commission must issue a consistency finding before the Army Corp of Engineers will issue a permit. Where artificial reef proposals are initiated by an entity other than CDFG, the Department serves as a commenting agency (Bedford personal communication; Ewing personal communication).

Initial rig-to-reef efforts in California

The rig-to-reef option is not new to California and its artificial reef program. Proposals to convert platforms slated for decommissioning have been put forward intermittently since the 1970s. The first documented rig-to-reef proposal was entertained when Platform Harry, located one mile off Point Conception, was decommissioned. Although it was suggested that some of the platform's materials be reefed, the proposal was tabled amid controversy over proposed relocation of parts to reefing sites (IDWG 1999a). Fourteen years later, reefing of decommissioned rigs was again considered, this time for Platforms Helen and Herman. As in 1974, however, controversy over leaving parts of the platform in place resulted in complete removal and clean-up of the site. The rig-to-reef concept was revived in 1992, when Chevron moved toward decommissioning its 4H platforms (Hazel, Heidi, Hilda, Hope). However, CDFG determined that the rig materials were not suitable for reefing. Nonetheless, in 1994, a proposal was made to use portions of these structures for the construction of test reefs in the newly created Sycamore Canyon MRPA Ecological Reserve, but this proposal failed amid controversy and delays, to the dismay of southern California sport fishing and other recreation interests. Most recently, Exxon-Mobil's Belmont Island was proposed for reefing in 1999, but the SLC did not approve the plan following receipt of evidence that the area was not suitable for an artificial reef, as well as the recurrent problems of liability and site selection (IDWG 2000). However concrete rip-rap surrounding the structure will be made available to CDFG for the enhancement of the Bolsa Chica artificial reef (IDWG 2000).

Chevron's 1992 proposed decommissionings served as a catalyst for more directed attention toward decommissioning issues and options, including rigs-to-reefs, for California’s offshore platforms. The Minerals Management Service and the California State Lands Commission (SLC) have jointly sponsored public workshops: "Abandonment and Removal of Offshore Oil and Gas Facilities: Education and Information Transfer" in 1994, "Decommissioning and Removal of Oil and Gas Facilities Offshore California: Recent Experiences and Future Deepwater Challenges" in 1997, and a Rigs-to-reefs Workshop in 1999. Pursuant to the 1997 meeting, the MMS and the SLC convened an Interagency Decommissioning Working Group (IDWG) to facilitate communication among the relevant local, state and federal agencies. The group meets three to four times a year, and serves as a clearinghouse of information for its member agencies. In 1999, the IDWG released a draft Action Plan. The Action Plan was prepared to “guide agency efforts in addressing the technical, environmental, disposition, and site clearance issues associated with decommissioning operations” (IDWG 1999b:1). The Plan does not address or resolve policy issues, but identifies information needs relative to the selected policy issues the group can address (IDWG 1999b:1). (Existing law already allocates much authority to individual agencies.) The Plan identified five categories of issues: technical, environmental, disposition, site clearance and policy, with numerous separate issues falling within each of these categories. Over the next three years, the IDWG is to collect, synthesize and disseminate relevant information, and coordinate issue-specific forums to facilitate communication among parties interested in decommissioning.

In addition to these agency-sponsored efforts, there have been meetings and other events sponsored by the University of California, Los Angeles and other non-governmental groups to consider, and in some cases actively promote, rigs-to-reefs for California. In December 1998, UCLA convened a meeting “to discuss the issue of whether a “Rigs-to-Reefs” program was of potential value for the southern California area.” (Hamner 1999). Various interests in the rig-to-reef debate participated in the meeting, and included representatives of the American Sportfishing Association, the San Diego Oceans Foundation, the Professional Association of Diving Instructors, Proteus SeaFarms International, the California Sea Grant Extension Program, a commercial fisherman, the Center for Marine

Conservation , the Environmental Defense Center and the United Anglers of Southern California/American Sportfishing Association Conservation Coordinating Committee. In Spring 1999, the Southern California Academy of Sciences' Annual Meeting included a Symposium on Artificial Reefs, which included scientific and interest group presentations on the rigs as potential reef sites/materials.

Throughout, attention has focused upon a number of scientific, technical and institutional issues. These include: 1) whether rigs actually enhance, or simply attract reef fishes; 2) the net ecological benefits or costs of removal and of reefing; 3) the practicality of removal and of reefing, especially involving rigs in very deep waters; 4) concerns for navigational safety; 5) interference with other ocean uses; 6) funding to support maintenance and monitoring as well as initial reefing; and 7) liability, among others. Recent rig-to-reef policy proposals manifest in legislation first introduced in 1998, then re-introduced in 1999 and 2000, have sought to address many of these issues. And this is where the state's artificial reef program and the rig-to-reef concept have become intertwined.

California's rig-to-reef policy debate

We can use Kingdon's (1984) model of the policy process to consider the current debate over rigs-to-reefs in California. As the current California Legislative session comes to a close, the most recent rig-to-reef program proposal, in the form of Senate Bill 241 (Alpert), has been placed on inactive status. That action, effectively tabling the notion for another several months, is the outcome (to this point) of convergent - and divergent - events in the problem, policy and political streams identified by Kingdon (1995). In the following pages, we illuminate this situation.

The Problem Stream

According to Kingdon(1995), problems needing attention are brought to the attention of policy makers with the aid of systematic indicators, focusing events, and feedback from the operation of current programs. We would argue that there are two problems that have been brought to the attention of policy makers that are germane to the rig-to-reef debate. The first follows from the recognition that many of the oil and gas platforms offshore California are nearing the end of their productive life *as sources of oil and gas*. The problem lies in the debate that has arisen around the disposition of the rigs, specifically whether they should be removed or left in place to serve as artificial reefs. On the one hand, original leases require the complete removal of the rigs. On the other hand, there are three factors - not fully anticipated when the rigs were installed - that suggest potential problems or drawbacks to rig removal. These are: 1) the high cost of platform removal, 2) the risk of releasing presently concealed contaminants (e.g., encased in shell mounds that have accumulated around rig legs) into the marine environment, and 3) the rigs' value to some resource users and perhaps to the marine environment as habitat for several commercially and recreationally important species and other marine life. Although the first of these is a problem of the lessees, and therefore less a public policy issue, the latter two fall clearly within the public interest. Yet while the idea of a rig-to-reef program might appeal to some sectors of the public, the first dampens that interest. Moreover, the relatively long time (5 to 20 years) before decommissioning is to begin detracts from its salience when so many other issues are more compelling. This became evident in 1998 when the first rig-to-reef bill (SB 2173, McPherson) was introduced into, then abruptly withdrawn from, the California Legislature. According to legislative staff members, the

Senator did not anticipate the extent to which the bill appeared to be exclusively directed toward certain special interests, nor the extent to which the environmental community and other groups would oppose it.

The second problem complements, and provides a broader and more compelling case for considering rigs-to-reefs. The rigs serve as habitat for a diversity of marine species, including juvenile and adult rockfishes (*Sebastes* spp.). Declines in many of these species, and critical concerns for the health of their stocks were, in part, the basis for the January 2000 declaration of the "Federal Groundfish Disaster" (US Department of Commerce Press Release). The disaster declaration was a focusing event that brought the problem of declining rockfish stocks in the southern California Bight and throughout much of the U.S. west coast into sharp relief for policy makers and the broader public.

These two problems have converged to help bring rig-to-reef policy proposals to the fore, although it is the latter that has made a compelling case for the continued and expanded consideration of a California rig-to-reef program. Indeed, SB 241, through several iterations, was reshaped to address these two interdependent issues. (See below.)

The Policy Stream

The policy stream is the setting in which policy proposals are generated by a process "like natural selection in biology," through which they "float, combine and recombine with one another" (Kingdon 1995). Ultimately, the survival of a policy proposal is contingent upon its technical feasibility, its value acceptability and the extent to which it is expected to not be overcome by budget or political constraints over the longer term (Kingdon 1995).

Rig-to-reef policy proposals for California have moved through such a policy stream. Moreover, the rig-to-reef proposals have combined and recombined with other proposals, namely those directed toward restoring and enhancing southern California fish stocks and opportunities for their use, especially by (consumptive and non-consumptive) recreationalists.

The first bill to propose rigs-to-reefs for California was SB 2173, introduced by Senator Bruce McPherson in February 1998. Entitled "Artificial Reefs", it was cast as a proposal to extend the state's artificial reef program to the Outer Continental Shelf off the California coast. As introduced, the bill cited declines in southern California's marine species and their adverse effects on the state's recreational and commercial fishing industries as the basis for expansion of the state's artificial reef program, both within state waters and into federal waters. Moreover, it declared artificial reefs' ability to duplicate natural conditions and induce production.

Neither of these arguments, however, proved convincing. They were struck from an early version of the bill, the arguments were recast, and new provisions were added. The amended bill cited instead the "diverse values " of southern California's marine resources, and highlighted the value of commercial and especially sport fishing to the state economy. It declared the need to prevent overfishing, facilitate resource protection, and foster growth in coastal and marine tourism. Artificial reefs were recast as a mechanism for facilitating protection, enhancing diversity, increasing production, and improving fishing opportunities.

SB 2173 addressed the technical feasibility of a rig-to-reef policy (without naming it as such) in several ways. It highlighted the state artificial reef program's 40-year history of construction, research and management as an indication of its capability to effectively carry out the proposed expanded activities. The bill also cited the National Fishing Enhancement Act of 1984, which provided for the establishment of artificial reefs in OCS waters. It also provided for the development of artificial reef program elements to address other technical aspects, including the determination of design criteria for increasing biomass of marine flora and fauna, the specification of siting and placement requirements, and the development of mechanisms for program planning, coordination, management and evaluation; monitoring and enforcement; environmental impact assessment and compliance, and damage assessment.

The McPherson proposal appealed to certain values in the broader political arena, namely the value of living marine resources to the people of California, and the value of sustainable fisheries - especially recreational fisheries. It asserted the value of artificial reefs as duplicating natural conditions, and their potential for facilitating habitat protection, enhancing diversity, increasing production and improving fishing opportunities. Moreover, it precluded the transfer of liability from offshore platform owners and operators to the state, a critical issue of public concern.

Provision also was made to limit the likelihood that the proposed policy would be overcome by budget or political constraints over the longer term. Key provisions to address this concern included the removal of language from the California Fish and Game Code that appropriated $500,000 to the artificial reef program in 1985 [Fish and Game Code 6425 (a)]; and the creation of an Artificial Reef Program Account within the Fish and Game Preservation Fund (FGPF) and a Marine Preservation Endowment Fund. The one-time $500,000 legislative appropriation for the artificial reef program was made in 1985, but its persistence in the codes could be used as a constraint on subsequent program funding; striking it from the codes diminishes this likelihood. The importance of doing so lies in the uncertainty of costs of an expanded artificial reef program, especially one that extends into federal waters offshore California. The establishment of a dedicated account for the artificial reef program addressed not only funding needs of a rig-to-reef program, but also long-standing funding problems for the state's artificial reef program. The establishment of dedicated accounts within the FGPF is a recurrent issue in California; monies generated by specific resource uses otherwise go to the General Fund, from which they are then allocated to those issues or resource uses that are politically salient or popular, to the neglect of other, less visible, yet important programs.

In addition to the development of a dedicated artificial reef program account, the bill created a supplementary fund, the Marine Preservation Endowment Fund (MPEF). The fund was to be administered by the California Endowment for the Preservation of Marine Resources (whose members were to be appointed by leaders in the Legislature), which would receive and disburse cost savings from offshore platform and facility conversion to artificial reefs. The bill specified that an owner/operator would be required to contribute 10% of cost savings from converting an offshore platform to an artificial reef to both the MPEF and the ARP Account. Touching on the critical issue of liability, the bill provided for 50% of any cost savings to be apportioned among these funds, should CDFG assume full liability, control and management for such an artificial reef.

All of these provisions notwithstanding, SB 2173 died only four months into the 1998 legislative session. (The bill text was replaced by an entirely different measure, on employment application fees.) The policy proposal, however, did not die. It was revived and re-introduced by Senator Dede Alpert at the beginning of the next legislative session in January 1999. It made little progress in the legislative process initially, and was tabled in April 1999. In December 1999, however, it was revived again by its author, and reintroduced with significant amendments in January 2000.

SB 241, entitled "Decommissioned oil platforms and production facilities: California Endowment for Marine Preservation", was very similar to its predecessor in some respects, but also reflected greater attention to issues of technical feasibility, value acceptability and resistance to budget and political constraints over the long term. The issue of technical feasibility was addressed with declarations that rigs-to-reefs had already been considered within the state, paving the way for its institutionalization; and that artificial reef management would best be done by the California Department of Fish and Game (CDFG) *with the assistance of other institutions*. This declaration and associated provisions reduced the potential burden on CDFG, and called attention to the relevance of other sources of technical support. In doing so, it also suggested that these other institutions might partake of the benefits (e.g., Fund monies to support artificial reef research, monitoring and management) should the policy proposal be enacted. In an effort to bolster this notion, as well as the viability of the bill itself, Senator Alpert requested assistance from the state university system in convening a "Blue Ribbon Panel" to identify the scientific questions to be resolved, evaluate existing data on potential ecological and environmental consequences of decommissioning alternatives, and identify uncertainties regarding such assessments.

SB 241 also differed notably from SB 2173 in its attention to other agencies (e.g., the State Lands Commission, the California Coastal Commission, the Bay Conservation and Development Commission) and laws (e.g., the California Environmental Quality Act, the federal Clean Water Act), and the value of interagency coordination on artificial reef siting and management. Concerns for technical feasibility were further addressed by the funding mechanism, under which cost savings to be contributed to the program fund (see below) would increase as a function of water depth, thereby providing greater funds to match (or parallel) greater costs of platform removal from or maintenance as an artificial reef in deeper waters.

Another aspect of technical feasibility pertains to the converted rigs' potential for serving the goals of the state's artificial reef program, especially that of biomass production rather than simply attraction. The attraction versus production debate has been a critical issue in the debate over artificial reefs in general, and has been a focus of the state program's research - and its permitting criteria - since the 1960s. There are two dimensions to this issue: determining what materials are conducive to production (and perhaps protection) rather than attraction, and insuring that such reefs do not increase target species' vulnerability to overfishing by concentrating fishing effort in key habitats. SB 241 sought to address the first concern by noting that the rigs are already serving as artificial reefs, and by requiring that new artificial reefs be constructed of materials allowed by the NFEA (under the assumption that these are materials determined to afford production) - which include offshore oil platform materials. Moreover, by requiring that CDFG designate rigs converted to reefs as marine reserves (i.e., no-take marine protected areas, with a surrounding buffer), SB 241 addressed both of the foregoing concerns. This latter requirement implicitly linked the proposed rig-to-reef program to the state's marine managed area system, suggesting the possibility of additional technical (and political) support for the proposal.

SB 241's marine reserve requirement also constituted an appeal to emerging values among the California public, as did several other provisions in the bill. By requiring that rig-to-reef sites become marine reserves, SB 241 broadened its appeal beyond that of SB 2173, which had been directed toward the more narrow interests of recreational fishing and tourism in southern California. While such a provision may have alienated a subset of recreational fishermen in southern California, it expanded its realm of likely supporters to broader interests within southern California and statewide. As a marine reserve, a rig-to-reef would contribute to coastwide efforts to protect and restore the marine environment and fisheries. SB 241 highlighted the cost savings to be realized by rig-to-reef conversion, and asserted that those savings should be shared with the citizens the state, not just recreational users in southern California.

The bill's provision of funding mechanism based on these cost savings is one element of the proposal directed toward insuring its long term fiscal viability. As noted above, the bill required that a portion of the cost savings, to be calculated based on the platform's depth, be split between a newly created Artificial Reef Endowment Fund (AREF) and CDFG. Unlike SB 2173, the bill failed to specify that formula, perhaps raising questions as to whether the resulting funds would be sufficient to cover program costs. (SB 241's program element are the same as those articulated in SB 2173.) Like SB 2173, however, it also would have struck the 1985 allocation from the Fish and Game Code, thereby helping to guard against the program's vulnerability to budgetary and political constraints in the future. SB 241's explicit recognition and encouragement of continued interagency coordination on artificial reef and rig-to-reef matters (noted above) also served this purpose.

The Political Stream

The political stream, broadly construed, refers to the political climate into which a policy proposal is introduced. The political stream is influenced by swings in national, state and local mood, elections, party control of the legislative and executive branches, the composition of key committees, the degree of interest and commitment of congressional leaders, and interest group pressure campaigns. To uncover some of these influences, it is helpful to look at the different sets of actors engaged in the policy process, the positions they have taken and the roles they have played as the policy situation has played out.

Sportfishing and other recreational interests

California hosts extensive sportfishing and other marine recreational activities statewide, but especially in southern California (i.e., south of Pt. Conception) (McWilliams and Goldman 1994). Sportfishing takes place from beaches and piers on the mainland, and from private and commercial passenger fishing vessels (CPFVs)]. Other, non-consumptive recreational activities include diving, pleasure boating and nature tourism.

These interests have been active in southern California resource enhancement and management for decades. They are acknowledged for their contributions to the state’s artificial reef programs since the 1950s, and have continued to donate time , materials and other resources to support the state’s artificial reef program (e.g., Carlisle *et al*. 1964, Turner *et al*. 1969; McKee and Lewis 1989).

Most recently, many of them have become strong advocates of a rig-to-reef policy for California. Their interests and arguments for a state rig-to-reef program are noted in transcripts of the December 1998 UCLA-sponsored conference on rigs-to-reefs. For example, Bill Shedd of the American Sportfishing Association noted the sportfishing community’s concerns that “the 4H Rigs were decommissioned prematurely and that a tremendous opportunity to benefit natural marine resources was lost...With so little hard bottom in Southern California we can’t afford to waste valuable habitat, as with the 4H Rigs removal.” Vishwanie Maharaj of the American Sportfishing Association highlighted declines in

Southern California saltwater anglers from 1994 to 1997 as a loss of potentially valuable economic inputs that could be realized with the enhancement of fishing opportunities through a rig-to-reef program. Similarly, Kristin Valette, of the Professional Association of Diving Instructors, noted the potential for increased recreational activity, and economic benefits of associated tourism for southern California communities.

As rig-to-reef policy proposals, SB 2173 and its successor, SB 241, have received growing support of this interest group, starting with United Anglers and the Channel Islands Council of Divers in 1998, and expanding to include the Sportfishing Association of California, the Recreational Fishing Alliance, the San Diego Oceans Foundation, San Francisco Reef Divers, among others, as SB 241 moved through the legislature in 1999 and 2000.

The Offshore Oil Industry

Like sportfishing and recreational interests just noted, the oil industry has a keen interest in the development of a rig-to-reef policy in California, both as a cost-savings mechanism and as an opportunity for promoting its image as an environmental steward or benefactor. As noted above, the industry has a long history of working with CDFG in its artificial reef monitoring studies. Moreover, it has long sought reefing as a decommissioning options for some of its platforms. At present, the most visible industry actor is Chevron, which played a large role in drafting SB 2173 and later officially supported SB 241.

Moreover, Chevron has provided seed funding to two non-profit organizations, California Artificial Reef Enhancement (CARE) and the Coalition for Enhanced Marine Resources (CEMR). The purpose of CARE, whose board of directors includes the various rig-to-reef proponents noted above, is to facilitate and disseminate information on artificial reefs and their role in the marine ecosystem. As noted in CARE's literature, the organization will "work in tandem with the Blue Ribbon Committee (coordinated by the University of California) and the general public, to systematically address scientific questions on artificial reefs." The purpose of CEMR is to advocate for the development of a state rig-to-reef program.

Commercial Fisheries

Commercial fishermen, in general, have been strongly opposed to the rig-to-reef option. In the mid-1990s, Richards and colleagues interviewed southern California commercial fishermen to ascertain their views on and preferences for various decommissioning options (Richards *et al*. 1998). Although there were some differences of opinion among gear types, fishermen from all gear types strongly favored full removal of platforms and associated debris over all other options. The option of moving the platform jacket to an existing artificial reef site was considered a possible option by most fishermen. A preferred alternative (over the latter, not the former) was non-removal with multiple use. Richards notes, “Non-removable, in fact, was preferred by nearly all of the fishermen interviewed, if one or two platforms were carefully selected to serve as weather stations.”

Southern California’s commercial fishermen have long resisted rigs-to-reefs. Trawlers, in particular, have been strongly opposed to rigs-to-reefs. They cite assurances made to them by the offshore oil industry and the agencies involved that once production ceased, offshore platforms and all associated materials would be completely removed, and their traditional fishing grounds would be restored. Although they argue that they have experienced negative socio-economic impacts as a result of offshore oil and gas activity, Senator Alpert questions the veracity of such claims, following CDFG analysis of the fishery that "failed to demonstrate a clear negative impact of oil platforms in the general catch areas reported on commercial trawl logs" (Senate Natural Resources and Wildlife Committee 2000). Although the Southern California Trawlers Association has been perhaps the most vocal on this topic, other commercial fishing interests have also expressed their opposition to such a policy.

There have been two exceptions to this stance. The first is the position of Santa Barbara and Ventura Country lobster fishermen, who favored the reefing of Rincon Island, and have noted the value of selected offshore pipelines as abalone habitat. On the other hand, these fishermen raise a broader issue regarding permit obligations and compliance: "In most [fishermen's] minds, they're concerned that there's not going to be some kind of double standard there where we have to take care of our permits, and we have to be accountable for our impacts on the habitat and that there's somehow a lot more flexibility for the oil companies" (IDWG 1999a).

The second, and more generalized exception is found in mariculture interests, who view the rigs as potential sites of operation. At the 1998 UCLA Rigs-To-Reefs Conference, Thomas McCormick of Proteus SeaFarms cited several benefits of offshore platforms to offshore aquaculture, as they can provide secure mooring for cage systems, house centralized feeding systems, serve as a navigational aid, provide shelter for maintenance workers, and house watchmen and hatchery operations.

Environmental and Resource Conservation Interests

“Environmental” interests have long been involved in the debate over offshore oil and gas development, and continue their efforts in the context of decommissioning. But their positions on the decommissioning and rig-to-reef issue vary. The Center for Marine Conservation, a national organization with a strong presence in California, has taken a “wait and see” stance on rigs-to-reefs. In his UCLA Conference presentation, CMC’s Warner Chabot suggested 1) there was “no need to rush” into legislation until fundamental legal, technical and scientific questions regarding rigs-to-reefs could be addressed and policy options could be developed, 2) the need for “some agreement of...further knowledge on some of the basic scientific questions [e.g., production versus attraction]” and 3) seeking political consensus rather than risk further polarization on the issue. (He cited the social capital required and reinforced by the recent passage of AB 1241, the Marine Life Management Act, and the potential risk to that capital of pursuing rig-to-reef legislation.) A more staunch opponent of rig-to-reef proposals is the Santa Barbara-based Environmental Defense Center (EDC). EDC, an environmental law firm known for its "environmentalist" stance against rig-to-reefs, supports a “cautious, deliberative approach.” It's key concerns focus on long-term environmental impacts of leaving the rigs in place, liability and financial issues. Several other environmental/conservation organizations (e.g., Sierra Club, Vote the Coast, Surfrider Foundation, California Coastkeeper) have weighed in on the issue as well, primarily in opposition to SB 241. A notable exception was the Sea Shepard Conservation Society, which enlisted itself among the bill’s supporters.

Federal agencies

In addition to the Minerals Management Service, the U.S. Army Corps of Engineers and the National Marine Fisheries Service (NMFS) have participated in the rig-to-reef policy debate. The Corps' jurisdiction over projects within state waters is comprehensive, but extends also to seabed construction in federal waters (pursuant to the NFEA), and pertains to both navigation and water quality issues. NMFS' interest in the rig-to-reef debate stems from its general responsibilities for the conservation and management of living marine resources, together with its specific interest in groundfish resource management and essential fish habitat. As of 1999, the agency's Southwest Regional Office did not hold a position on the issue, but "is more inclined to support original agreements between industry and the public regarding removal once operations become unproductive" (IDWG 1999a).

State Natural Resource Agencies

Three key state agencies play a role in the rig-to-reef debate: the Department of Fish and Game (CDFG), the State Lands Commission (SLC), and the Coastal Commission (CCC). These agencies come to the rig-to-reef debate after decades of artificial reef and offshore oil platform experience. CDFG, whose artificial reef program stands to be enhanced (though perhaps also burdened) by the programs proposed in SB 241, nonetheless has been firm in its concerns about program costs, liability and the appropriateness of rig materials for reefing. In its 1999 white paper on the issue, as well as its co-sponsorship of the IDWG and associated workshops, the SLC demonstrates its interest in the rig-to-reef option, but also highlights critical permitting, scientific, technical and institutional issues that must be resolved for such a program to move forward successfully. The CCC has been more reserved on the matter. According to a December 1999 memo from CCC Executive Director Pete Douglas to the SLC, it is the opinion of the CCC that "the jury is still out" on many of the scientific questions associated with artificial reefs in general and rigs-to-reefs in particular, such as "whether these structures constitute good habitat with diverse and robust habitat values and function to actually increase the regional abundance of fish populations or where they are primarily fish-attractive devices" (IDWG 1999a). The CCC anticipates receiving "substantial new information about the nature of artificial offshore structures and their habitat values" through its involvement in the Southern California Edison artificial reef project, which will be useful to the further consideration of rig-to-reef policy for the state. He also noted that any proposal to partially demolish an offshore oil platform or other structure and leave it in place would require regulatory review and approval pursuant to the Coastal Act.

Cities and Counties

Several south central and southern California counties have a stake in the rig-to-reef debate as Responsible Parties under CEQA and NEPA because of the onshore components of offshore production facilities and the potential impacts of their decommissioning. Yet their positions diverge from one another. Whereas the Cities of San Diego and Newport Beach supported SB 241, Santa Barbara County opposed it, in keeping with a history of concern about offshore oil and gas development. At the 1999 Rigs-To-Reefs Workshop, the county representative noted the county's interest in "substantial scientific evidence of public and environmental benefit and the absence of any potential future environmental impacts" (IDWG 1999a).

The Window of Opportunity

A "window of opportunity" opened in late 1999, allowing for the re-introduction and serious consideration of a rigs-to-reefs policy proposal for California. Within the problem stream, private concerns about the costs of removing offshore oil platforms and recreational user groups' interests in enhanced recreational opportunities were augmented by public concerns about precipitous resource declines of some southern California marine fishes, made especially cogent by the state push for a nearshore fishery management plan and the subsequent declaration of a western groundfish disaster. In the politics stream, these concerns led to growing interest in marine resource restoration by "natural" means (e.g., marine reserves) and by artificial means (e.g., artificial reefs) at the local, state and federal levels. Within the state, decommissioning discussions picked up, with new coalitions formed and old ones revived between the offshore oil industry and recreational interests on the one hand, and environmental and commercial fishing interests on the other hand. Meanwhile, the state's once vibrant artificial reef program had been reduced, for lack of funding and political support, to a bare minimum of activity.

Although the original rigs-to-reefs policy proposal as articulated in SB 2173 did not succeed, it did present a solution, albeit and imperfect and incomplete one, for the ecological and economic problems not fully identified or reckoned with at the time of its introduction. The growth in public concern for the marine environment between the time of its introduction in early 1998 and it's re-introduction in 1999 (and 2000) led to the clear identification of the problems a rig-to-reef program could help to address. During that time, the proposal was re-shaped to address some of its deficiencies, and over its two year course through the legislature as SB 241, it underwent further refinement to address critical issues including program funding, scientific merit and liability. Moreover, it was reshaped to mesh with state and federal fishery (and other marine) management resource management, especially recent policy changes and new concepts pertaining to marine resource restoration, marine reserves, and essential fish habitat.

Yet the rig-to-reef policy proposal embodied in SB 241 has fallen short in meeting these and other myriad concerns. Uncertainties regarding liability issues, start-up and ongoing funding, and the scientific merits of such a policy, together with strong opposition from certain interests proved insurmountable. The increased attention to problems in the marine environment and rigs-to-reefs as a policy solution, and the active debate of liability, funding and ecological impact concerns, however, have likely prompted policy entrepreneurs to seek solutions to those issues, and incorporate them into a revised policy proposal, ready for the next window of opportunity.

SECTION FIVE

SETTING THE RIGS-TO-REEFS POLICY AGENDA: THE CASE OF THE GULF EXPERIENCE

By Michael Vincent McGinnis and Carla Navarro

This section describes how and why the idea of the rigs-to-reefs policy evolved in the distinct political, intergovernmental, regional and ecological context of the Gulf. The political, problem and policy streams met to form a policy window of opportunity. Various policy entrepreneurs from the MMS, oil and fishery industries, and others advocated the idea of a rigs-to-reefs alternative to complete removal of Gulf OCS oil rigs (Reggio 1987a, b; Reggio and Kasprzak 1991; Murray 1994). Reggio, from the Gulf Region of the MMS, and Kasprzak, from the Louisiana State University, (1991: 15) explain:

> [T]here are ever increasing demands on marine fish and restrictions on fishing.
> Through state and industry leadership, we have an unprecedented opportunity
> in the Gulf of Mexico to create artificial reefs with oil and gas structures,
> which will concentrate marine life and enhance fishing.

In contrast to the scientific and political debates in California over the future of OCS oil rigs described in Section Three, the perceived problem was not whether the oil rig produced or attracted fish. The attraction versus production debate was not resolved before the passage of the National Fisheries Enhancement Act (NFEA). This question remains an important concern of state artificial reef managers (Murray 1994). In an analysis of state artificial reef programs, Murray (1994: 960) argues, “The National Artificial Reef Plan of 1985 suggested that states should play a major role in the development of guidelines for artificial reefs. However, most coastal states have not established clear artificial reef development plans that consider social, economic, environmental and biological factors associated with their artificial reef programs.”

In general, the development of the rigs to artificial reef programs in the Gulf serves the need of the recreational and commercial fishing industries. The significant development of oil on the Texas-Louisiana OCS created a web of artificial “habitats” for marine species that are harvested by the commercial and recreational fishing industries. Given the perceived “lack of natural habitat” in the Gulf OCS, removal of offshore rigs would have associated economic impacts (and potential ecological impacts) to these fishery industries. Removal of a rig would mean the removal of a “fishing hole”, such as the removal of the “best Snapper Fishery in World” offshore Alabama (a state with very little natural reef fish habitat). The Gulf’s commercial and recreational fishery industries are the largest in the US.

Gulf offshore oil production is analogous to the creation of the “organic machine”. The long history of large-scale OCS oil and gas activity in the Gulf has led to “over-adaptation” to these rigs as fishery enhancement structures.

Why was complete removal of offshore rigs a “perceived problem”? There are many reasons, some of which are introduced below:

- Field studies show the lack of “natural” habitat for fish in the Gulf region. Field studies also show the link between offshore rigs and marine life, including commercially and recreationally valuable fisheries and oysters.
- Social scientists show the link (in terms of recreation days and levels of use) between offshore rigs and sports fishing. State, regional and local economies

benefit from offshore oil and gas activity, and artificial reef building (in Florida, Alabama, Louisiana, Mississippi, and Texas).

- In the Gulf, commercial and recreational fishery groups have been receptive to the oil industry (Freudenberg and Gramling 1994; Gramling 1996). Special interests in the Gulf sought out a Federal OCS policy that could provide guidance, coordinate local, state, and federals efforts as well as streamline the permitting process for the rigs-to-reefs alternative.
- Gulf state governments had artificial reef programs in place, many of which were operated by local and regional administrators on a part-time basis or as volunteers. There was no major state-based funding or private source to develop and implement artificial reef programs. Alabama established the first program in the Gulf of Mexico in 1954. Alabama's program started with the sinking of 250 car bodies and now includes several thousand individual artificial reefs in state waters (Harrison 2000).
- A number of policy entrepreneurs and advocates campaigned for the rigs-to-reefs alternative, basing their preferences on available scientific information, and fishery values associated with offshore structures.

The passage of the National Fisheries Enhancement Act (NFEA) was followed by the creation of formal state artificial reef programs in Louisiana (1986), Texas (1989), Florida (1990), and Mississippi (1999).

The Problem Stream: The Perceived Lack of "Natural" Habitat

The reliance of commercial and recreational fishers on OCS oil and gas structures contributed to a perceived problem --- complete removal of structures would have significant economic impacts on the fishery industries. Policy entrepreneurs defined the problem based on the perceived lack of natural fishery habitat in the Gulf, and the link between the development of offshore oil and commercial and recreational fishing. As Villere Reggio, Jr. (1987: 2) from the MMS, Gulf of Mexico Region, writes, "Since the inception of the federal offshore leasing program in 1954, the Gulf of Mexico OCS Region has led the nation in offshore energy production and has retained its pre-eminence in offshore fishery production." The ecology of the Gulf, the history of Gulf OCS oil development, the relationship between offshore oil development and fishing (such as commercial hook-and-line fishing) and scuba diving were also factors associated with the problem stream.

The Ecology of the Gulf

The Gulf of Mexico is a semi-enclosed oceanic basin that is bound by the North American continent and Cuba. It stretches nearly 900 km from north to south and approximately 1595 km from east to west with a total surface area of 564,200 km2 (Darnell and Defenbaugh 1990). Driven by offshore winds, warm tropical and subtropical Caribbean waters enter through the Yucatan Channel (176 km wide) into the eastern portion of the Gulf (Darnell and Defenbaugh 1990). Larvae, juveniles, spores, pelagic fishes and plant materials are transported into the eastern Gulf, and become part of the Gulf stream (Rezak, *et al*. 1990).

The Gulf basin was created by sea floor spreading and seismic faulting in pre-Cretaceous time (240-170 million years ago) during the Permian and early Jurassic period (Darnell and Defenbaugh 1990). The continued accumulation of sedimentary layers since the beginning of the Tertiary period created a continental slope (0 to 200 m) that now makes up nearly 35% of the bottom habitat, with 25% being very deep water (>3000 m) and reaching a maximum depth of 3850 meters (Darnell and Defenbaugh 1990).

The northern shelf and slope offshore Texas and Louisiana receive extensive accumulations of sediment from stream, estuarine, and river discharges. River-borne sediments composed of silt, sand, clay and anthropogenic pollutants create a soft bottom habitat that stretches from the coastline to the middle and outer shelf off most of Louisiana and Texas (Darnell and Defenbaugh 1990). In some areas, the sediment is over 17 km thick, creating an unconsolidated and unstable benthos that tends to slump into the deep Gulf waters (Darnall and Defenbaugh 1990).

Biological production is generally high near river outfall areas that deliver nutrients directly into coastal waters. The Mississippi River accounts for nearly 64% of the freshwater input into the Northern Gulf, bringing a high annual volume (4.1 x 10^8 metric tons) of sediments, nutrients and anthropogenic pollutants to the delta and the surrounding continental shelf (Darnell and Defenbaugh 1990). The Texas-Louisiana shelf experiences annual hypoxic episodes during the summer months (June to August) when river-borne nutrients cause phytoplankton blooms and subsequent biological decomposition starves surrounding bottom waters of essential dissolved oxygen. More importantly for offshore development, the delta supplies silt and mud to the broad, flat shelf area where many offshore structures are located.

Although occasional small shoals and rocky ridges occur throughout the Gulf OCS, the broad and vast area is relatively barren with little habitat diversity. Only one-third of the natural reef habitat estimates are located offshore Texas and Louisiana where more than 95% of the platforms stand. The nearest natural hard-bottom habitat is located approximately 92 km offshore Louisiana (Sonnier, *et al*. 1976).

The History of Oil Development

Texas and Louisiana initiated offshore oil and gas development in the Gulf region[19] in lease sales in 1920 and 1922, respectively (Howe 1985; Wermund 1985). These leases were developed two decades later. On August 14, 1945, the Louisiana Minerals Board held its second lease sale (Howe 1985). Kerr-McGee acquired 43,000 acres in shallow water, nearly 43 miles south of Morgan City, Louisiana. In 1947, Kerr-McGee drilled the first commercially successful offshore well in 18 feet of water, and approximately eleven miles from shore (Howe 1985).

Gulf OCS oil and gas activity intensified in the 1940s and 1950s (Blalock 1985; Howe 1985; Miller 1985; Wermund 1985). From 1942 to 1999, more than 5700 platforms were installed in the Gulf OCS compared to 24 in the Pacific OCS. By 2000[20], the Gulf of Mexico OCS (eastern, central, and western regions) had a total of 7,595 active leases covering 7,612,048 producing acres (MMS 2000). Today, well drilling is occurring in over 8,000 feet of water (Villere, personal correspondence, 2001).

Table 7 identifies the installation and removal of production platforms on the OCS.

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[19] For a complete review of the history and politics of offshore oil development in the Gulf of Mexico, see W.R. Freudenberg and R. Grambling, *Oil in Troubled Waters* (State University of New York Press. Albany, New York, 1994) and R. Grambling, *Oil on the Edge: Offshore Development, Conflict and Gridlock* (State University of New York Press. Albany, New York, 1996).

[20] Number of leases and acreage as of July 31, 2000

Table 7. Installation and Removal of Production Platforms on the Federal Outer Continental Shelf

	GULF OF MEXICO		PACIFIC	
YEAR	Installed	Removed	Installed	Removed
1942-1960	459	0	0	0
1961	108	0	0	0
1962	123	0	0	0
1963	89	0	0	0
1964	127	0	0	0
1965	129	0	0	0
1966	118	0	0	0
1967	133	0	1	0
1968	109	0	3	0
1969	112	0	1	0
1970	117	0	0	0
1971	102	0	0	0
1972	132	0	0	0
1973	95	1	0	0
1974	56	5	0	0
1975	102	36	0	0
1976	115	30	1	0
1977	114	17	1	0
1978	166	26	0	0
1979	162	35	2	0
1980	175	36	3	0
1981	168	24	3	0
1982	195	15	0	0
1983	179	38	1	0
1984	226	53	1	0
1985	212	55	3	0
1986	115	34	1	0
1987	116	23	1	0
1988	169	99	0	0
1989	197	94	2	0
1990	177	108	0	0
1991	156	117	0	0
1992	92	105	0	0
1993	126	171	0	0
1994	179	124	0	1
1995	138	117	0	0
1996	159	121	0	0
1997	155	176	0	0
1998	142	75	0	0
1999			0	0
Totals	5,744	1,735	24	1

Sources: Gramling 1996, Minerals Management Service, 2000.

The 4000[21] platforms of the Gulf supply 25% of the nation's natural gas and 13% of its oil production (MMS 2000). Nearly 4,000 offshore production platforms and 22,000 miles of oil and gas pipelines exist (MMS 2000). Ranging in size and structure, the average depth

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[21] Number of platforms as of July 31, 2000.

of these platforms is 100 to 300 feet in state and federal waters. Roughly 95% of the existing oil and gas platforms exist off the coasts of Texas and Louisiana.

The Political Ecology of Gulf Oil Development

Most of the oil and gas structures are set in the soft, sandy bottom of the Gulf where there exists very little hard substrate for natural reefs (Sonnier, *et al*. 1976). In addition to natural reefs, studies have shown that offshore structures attract bacteria, algae, invertebrate and fish species. Filter feeding organisms proliferate in the pelagic environment, providing food and shelter for economically valuable and commercially and recreationally sought fish species (Sonnier, *et al*. 1976; Gallaway and Lewbel 1982; Gallaway, *et al*. 1988).

The platforms of the Texas-Louisiana OCS have created a web of artificial habitats for some marine life. There is some indication that platform development increases the amount of habitat available for marine species that depend on hard bottom substrates (Continental Shelf Associates 1982; Gallaway and Lewbel 1982; Sonnier, *et al*. 1976). Underwater platforms structures serve as a point of concentration for many biofouling organisms. Marine studies describe the biofouling community associated with platforms as rich and diverse (Sonnier, *et al*. 1976; Gallaway and Lewbel 1982; Gallaway, *et al*. 1988). Microorganisms, algae and invertebrates drifting through the pelagic environment attach and grow on the underwater structures. Filter feeders such as anemones and bivalves tend to proliferate, feeding on the plankton carried by currents through the water column. The shells of invertebrates are covered by colonial species such as hydroids, bryozoans, and tunicates who exploit the habitat and/or food provided. The colonial species provide additional habitat for small and motile, cryptic organisms such as ophioroids and caprellid and gammarind amphipods who feed on the abundant food supply (Gallaway, *et al*. 1988; Gallaway and Lewbel 1982). Other colonial invertebrates found on offshore rigs include hydroids, bryozoans, ascidians, and sponges (Gallaway, *et al*. 1988; Gallaway and Lewbel 1982).

Although the overall biomass is similar for nearshore and offshore platform structures, the composition of the biofouling community differs (Gallaway and Lewbel 1982). Nearshore platforms are typically dominated by one to several barnacle species including *Balanus reticulates, B. eburneus,* and *B. improvisus* (Gallaway and Lewbel 1982). Offshore platforms are similar but are dominated by pelecyods such as *Ostrea equestris, Crassotrea virginica*, and *Hyotissa thomasi* instead of barnacles (Lewbel, *et al*. 1997).

Organisms typically found on platforms are restricted to a depth range that may be inconsistent with their "natural" range. Habituation on a natural reef exposes the organism to predation and competition by other species that may not be present on a platform. Fishers remain the primary predator for the marine species that are found on or near offshore platforms.

The increased biological activity associated with platforms attracts a wide variety of fish species along a vertical zone in the water column (Continental Shelf Associates 1982; Gallaway and Lewbel 1982; Gallaway, *et al*. 1988; LGL and SAIC 1988; Sonnier, *et al*. 1976). Following the installation of a new platform, fish colonization can occur in as little as 15 months (Lukens 1983) in search of food and/or shelter (Gallaway and Lewbel 1982). Dressen (1989) estimates that nearly 20-50% more fish occur beneath or adjacent to platforms compared to nearby soft bottom areas in the Gulf. Fish assemblages vary from a few hundred individuals to a few thousand, depending on platform, size, location and season (Continental Shelf Associates 1982).

Based on the associated bio-fouling community and fish indicator species Gallaway and Lewbel (1982) classify platforms in the Gulf into three separate biological zones. These classifications are coastal (shoreline to 98 feet), offshore (98 to 197 feet) and blue-water (>197 feet). These authors also found that the location and assemblages of the associated communities are influenced by environmental factors such as turbidity, seasonal temperature changes, amount of primary productivity and degree and of exposure to Caribbean water (Gallaway and Lewbel 1982).

Stanley and Wilson (1990) surveyed catch records from recreational and charter boat anglers in the northern Gulf and found that the fish species and number caught varied with season, platform size and structural complexity, and water depth.

The Perceived Problem

More than one-quarter of the remaining platforms in the Gulf are over 25 years old, and may be removed within the next ten years (MMS 2000). This means that nearly one thousand structures may be removed in the next ten years.

Offshore oil and gas activity over the past fifty years has contributed to the development of commercial and recreational fishing. For this reason, a number of government and non-government organizations began to "campaign for changes in public attitudes and existing laws to facilitate use of petroleum platforms as artificial reefs for fish concentration" (Harville 1983: 5). The oil and gas industry was also anxious to cooperate with responsible reef developers willing and able to accept future responsibility and liability for rigs-to-reefs projects (DuBose 1985; Reggio 1987). A strong coalition of fishery and oil interest groups had emerged during a long history of oil development in the Gulf OCS region (Freudenberg and Gramling 1994; Gramling 1996).[22] In addition, many coastal inhabitants of the Gulf regularly fish coastal and marine waters for recreation, sport, commerce, and subsistence.

Table 8 is a list of fish species associated with Gulf OCS platforms.

Table 8. Identified Fish Species Associated with Platforms in the Gulf of Mexico OCS

Common Name	Scientific Name	Common Name	Scientific Name
Atlantic bonito	*Sarda sarda*	Atlantic croaker	*Micropogonias undulates*
Atlantic cutlassfish	*Trichiurus lepturus*	Atlantic spadefish	*Chaetodipterus faber*
Bearded brotula	*Brotula barbata*	Black drum	*Pogonias cromis*
Blackfin tuna	*Thunnus atlanticus*	Bluefish	*Pomatomus saltatrix*
Blue marlin	*Makaira nigricans*	Blue runner	*Caranx cyrsos*
Cobia	*Rachycentron canadum*	Crevalle jack	*Caranx hippos*
Cubbyu	*Equestus umbrosus*	Dolphin	*Coryphaena hippurus*
Florida pompano	*Trachinotus carolinus*	Flounder	*Paralichthys* sp.
Gafftopsail catfish	*Bagre marinus*	Great barracuda	*Sphyraena barracuda*
Greater amberjack	*Seriola dumerili*	Grey triggerfish	*Balistes capriscus*
Grouper	Family Serranidae	Grunts	*Hamulon* sp.
Hake	*Urophycis* sp.	Hardhead catfish	*Arius felis*

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[22] Notice the dramatic difference between OCS oil and gas activity in the Gulf and the Pacific found in Table 7. This is one reason why the history and political relationships that exist between fishery and oil interests is very different in California, see Molotch and Freudenberg (1996).

Table 8. Identified Fish Species Associated with Platforms in the Gulf of Mexico OCS (continued)

Common Name	Scientific Name	Common Name	Scientific Name
Kingfish	*Menticirrhus* sp.	King mackerel	*Scomberomorus cavalla*
Ladyfish	*Elops saurus*	Leopard toadfish	*Opsanus pardus*
Little tunny	*Euthynnus alletteratus*	Lookdown	*Selene vomer*
Other jacks	*Caranx* sp.	Other seatrout	*Cynoscion* sp.
Other snapper	Family Lutjanidae	Pinfish	*Lagodon rhomboids*
Porgy	*Calamus* sp.	Puffer	Family Teradontidae
Rainbow runner	*Elagatis bipinnulata*	Rays	Family Dasyatidae
Red drum	*Sciaenops ocellatus*	Red snapper	*Lutjanus campechanus*
Scamp	*Mycteroperca phenax*	Sharks	Order Selachii
Sheepshead	*Archosargus porbatocephalus*	Shrimp eel	*Ophichtus* sp.
Silver/sand seatrout	*Cynoscion* sp.	Skipjack tuna	*Euthynnus pelamis*
Spanish mackerel	*Scomberomorus macatulatus*	Spotted seatrout	*Cynoscion nebulosus*
Squirrelfish	*Holocentrus* sp.	Tarpon	*Megalops atlanticus*
Tripletail	*Lobotes surinamensis*	Wahoo	*Acanthocybium solanderi*
White spotted soapfish	*Rypticus maculates*	Yellowfin tuna	*Thunnus albacares*

Sources: Dugas *et al*. 1979, Stanley and Wilson 1990, and LGL Ecological Research Associates, Inc. and SAIC 1988.

The southeastern recreational fisheries are the largest in the nation. Between 1955 and 1980, participation in saltwater recreational fishing increased 2.7 times and related expenditures grew sevenfold. In 1998, 5.8 million anglers took 53 million trips and caught 284 million fish, nationwide (NMFS 1998). The increased interest in sport fishing is attributed to advances in technological design of recreational motorboats, outboard motors, navigational equipment and gear (NMFS 1999). Recreational fishermen operate from private boats, charter boats, head boats and shore using fish traps, hooks and lines, longlines, spears, trammel nets, bang sticks and barrier nets (NMFS 1999).

As the number of platforms dominated the Texas-Louisiana shelf, commercial and recreational harvest efforts became more concentrated around the structures. Studies document the levels of fishing activity near or around rigs. During the 1960s, Gulf newspapers and magazines featured the “fabulous” sites associated with rig structures (Reggio and Kasprzak 1991). Gunter (1963) describes the area between Pascagoula, Mississippi and Port Arthur, Texas as the “Fertile Fisheries Crescent” claiming it contains the most productive waters on earth. Oil platforms became a principal fishing destination for many local recreational fishermen (Ditton and Graefe 1978; Dugas, *et al*. 1979). In Louisiana, over 70% of all recreational angling trips occur near the platforms in Federal waters (Reggio 1987).

Ditton and Graefe (1978) showed that 87% of registered sport-fishing boats from Galveston, Texas target the platforms for fishing. One half of the 66,924 offshore fishing trips by resident boat owners in Galveston and eight adjacent counties, were primarily to the platforms (Ditton and Graefe 1978). A MMS (1980) survey of offshore platform personnel on 300 platform structures offshore Texas and Louisiana shows that employees also fish off the structures. Stanley and Wilson (1989) found that the average distance traveled by recreational users was at least 62 km to the platform, and the distance increased from east to west and from anglers to divers.

Commercial fisheries harvest in the Gulf of Mexico lead the nation. Table 9 depicts the commercial fishery landings in the Gulf between 1955 and 1998.

Table 9. Commercial Landings Summary from 1955-1998.

Region	Metric Tons	Dockside Revenues
Gulf of Mexico	34,651,841.80	$18,075,538,997
Louisiana	22,890,187.10	$7,004,094,328
Texas	2,727,795.30	$5,302,623,472

Source: National Marine Fisheries Service.

From 1950 to 1998, commercial landings totaled more than 34 million metric tons and generated more than $18 billion in dockside revenues. Louisiana accounted for nearly 65 percent (22 million metric tons) of the landings and 38 percent ($22 million) of the revenues. Texas holds the second largest fishery, contributing 2.7 million metric tons of commercial landings and generating $5 million in dockside revenues.

Overall, the recreational fishing industry has grown significantly since the first platform was placed in Louisiana waters in 1947 (Howe 1985). Fishers have benefited from the increased biological activity associated with offshore rigs. As the number of removals increased from one year to the next, fishers became alarmed by the loss of habitat and reduction in fishing opportunities (Kasprzak, personal communication, 2000). The reduction in available habitat from the removal of platforms has unknown consequences to fish populations. At the very least, a huge amount of biomass is lost and fishes disperse to other places. As regular users of offshore platform structures, the sport fishing clubs, local artificial reef committees and dive clubs actively advocated the benefits of converting obsolete rigs into artificial reefs for fishery enhancement.

The Political Stream

The Gulf of Mexico contains approximately two-thirds of the world's offshore oil and gas structures, and 95% of the production platforms in waters off the coast of the US (Reggio and Kasprzak 1991: 11). This level of development has been followed by significant levels of use by commercial and recreational fishers of these offshore oil rigs. In particular, fishing off Louisiana and Texas, where a majority of Gulf OCS oil production occurs, has contributed to rigs-to-reefs policy development.

A coalition of oil and fishery interest groups, federal and state resource agency personnel, and other individuals, such as Congressional representatives, favored a rigs to artificial reef alternative to complete removal of Gulf OCS oil and gas facilities. For example, in 1979, the Sport Fishing Institute initiated action by urging a resolution to the Secretary of Commerce and the Secretary of the Interior to develop policies, procedures and guidelines to convert platforms to artificial reefs. The Sports Fishing Institute also pointed out the importance of existing artificial reefs in the Gulf to fisheries.

Before the Act: Early Artificial Reef Program Development

Existing artificial reef programs in the Gulf are carried out by local governments, private parties and individuals. In 1954, Alabama initiated the first artificial reef program in the Gulf. Natural reefs are virtually nonexistent in Alabama waters. As a result of artificial reef building, the state is now referred to as the "Red Snapper Capital of the World", because Alabama waters provide the highest catch of red snapper in the Gulf (Harrison 2000).

Since the late 1940s, the Texas Parks and Wildlife Department has also been involved in artificial reef activities, such as the development of oyster reefs in Texas bays since 1947 (Joyce 1981; Osburn and Culbertson 1993). Some of the materials used during the 1940s and 1950s were not durable enough to withstand the shifting currents and eventually dissolved or moved to an unknown location. Used cars and vessels have also been used (Joyce 1981; Osburn and Culbertson 1993).

In Louisiana, small artificial reef sites were created by local fishermen in an effort to increase their personal fish catch (Kasprzak, personal communication, 2000). Early artificial reef development in this state was not part of a state artificial reef program. Unwanted materials such as old automobiles, large appliances, and concrete rubble were dumped in secret locations in estuaries and coastal waters to create personal fishing areas (Kasprzak, personal communication, 2000).

Since 1978, several divisions with the Florida Department of Natural Resources have been involved with artificial reef activities to enhance fishery habitat (Joyce 1981). In 1980, the State of Florida set the precedent and made an important step toward the development of a rigs-to-reefs alternative. Through the cooperative effort between the Southeastern Fisheries Association, the Gulf and South Atlantic Fisheries Development Foundation, Exxon Corporation and the State of Florida, an oil production template was removed and transported from Louisiana waters to Florida offshore waters for use at an artificial reef site (Joyce 1981; Wilson and Van Sickle 1987). The oil industry has also contributed offshore structures to fishery enhancement projects. In 1980, a joint effort between Exxon and Florida's Department of Natural Resources permitted the towing of a 2,200 ton submerged production system from Louisiana waters to a pre-selected site in Florida (Wilson and Van Sickle 1987). The structure was placed without an underwater survey of the site before placement (Mathews 1985).

Two years after the Exxon project, Tenneco Oil donated a production platform removed from offshore Louisiana. The structure was towed 275 miles and placed offshore Pensacola, Florida (Frishman 1982; Bohnsack and Sutherland 1985). The following year, the Alabama Department of Conservation and Natural Resources permitted Marathon Oil Company to tow a 1,650 ton oil platform 220 miles from Louisiana waters to southeast Mobile, Alabama (Wilson and Van Sickle 1987).[23]

By the end of 2000, many materials such as used automobiles, refrigerators, derelict ships, concrete rubble and other structures (such as military tanks and oil structures) have been used to construct over 150 permitted artificial reefs off Florida, Alabama, Mississippi, and Texas (Reggio personal communication, 2000). Three-fourths of all the existing, dedicated, or permitted reefs sites in the Gulf are off the west coast of Florida and the Florida Keys (Reggio and Kasprzak 1991). Advocacy of artificial reef building has a long history in the Gulf. In 1979, the American Fisheries Society and Sport Fishing Institute supported artificial reef building in the Gulf (Harville 1983).

Federal Resource Agencies

Federal involvement in artificial reefs began in 1966 with a research project at the U.S. Bureau of Sport Fisheries and Wildlife's Sandy Hook Laboratory in New Jersey (Lukens and

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[23] On October 2, 1985, two more Tenneco structures were towed 920 miles from Louisiana to 1.5 miles off Dade County, Florida (Wilson and Van Sickle, 1987).

GSMFC 1993). The seven-year study included an evaluation of the use of artificial reefs as a fishery enhancement tools (Lukens and GSMFC 1993). Existing artificial reefs were evaluated for their efficacy, building materials were tested through the construction of new reefs, and biomass impacts associated with reef sites were assessed (Lukens and GSMFC 1993). Ten reef sites were built along the Atlantic coast but the most successful reef sites were offshore South Carolina and Florida waters (Lukens and GSMFC 1993).

Since the late 1970s, the National Marine Fisheries Service (NMFS) has supported artificial reef research through technical and financial assistance to states, counties, and private interests (Harville 1983). NMFS has participated in artificial reef planning, design, permitting, construction, monitoring and evaluation (Lukens and GSMFC 1993).

The MMS also supports converting obsolete oil and gas structures to artificial reefs. MMS sponsored “Information Transfer Meetings” in 1982, 1984, 1985, 1986, and 1987 which included sessions on present and potential fishery uses of oil and gas structures. Reflecting on these public forums and information transfer meetings, Reggio and Kasprzak (1991: 10-11) write:

> Public forums organized and sponsored by the MMS in a series of annual information transfer meetings during the 1980s elicited additional information on the present and potential fishery uses of oil and gas structures. Federal and state conservation officials, private conservation groups, fishing organizations, oil and gas companies, university researchers, and others encouraged the conversion and use of oil and gas structures as artificial reefs.

Workshops included a review of data available and information on Gulf fisheries, and explored the economic, social, political, biological and technical benefits of a rigs-to-reefs alternative.

In August 1983, Secretary of Interior, James Watt created the Recreation, Environmental Enhancement and Fishing in the Sea (REEFS) task force to “pave the way for aggressive movement towards a national Rigs-to-reefs program which will enhance fishery resources and improve recreational and sport fishing opportunities within America’s offshore marine environments.” (DuBose 1985). The primary agenda of the REEF task force was to assess the use of obsolete platforms as artificial reefs as a means to enhance local fisheries and to develop policy that set national standards for artificial reef building.

The Policy Stream

Most ideas never find the light of day. Ideas that survive to shape public policy in a dynamic intergovernmental process must meet several criteria, including their scientific merit, their fit with dominant values, and the political support or opposition that ideas may experience.

The Role of the Scientific Community

As the number of platforms increased in the Gulf, the number of scientific studies on the economic benefits of offshore platforms also increased. Since the 1950s, a number of field studies have described the invertebrate species, fish species and the impact of potential pollutants on waters and biota associated with offshore rigs. Gunter (1963) described the bio-fouling community on the legs of an oil platform in the northern Gulf. Nearly two decades later, the *Offshore Ecological Investigation* (1972 to 1974) by the Gulf Universities Research Consortium (GURC) investigated the sedimentology, hydrography, microbiology, plankton, benthos, bio-fouling communities, trace metals, and hydrocarbons associated with platforms sited in Louisiana bays and inner shelf. Shinn (1974) described the composition and vertical zonation of fishes around Louisiana platforms. Sonnier, *et al*. (1976) compared natural reef fish assemblages to fish fauna associated with offshore platforms in the Gulf of Mexico.

Interest spread to government agencies, particularly the MMS, who funded a number of large-scale, multi-year scientific projects. Table 10 summarizes the major government related research projects associated with offshore petroleum development from 1960 to 1990.

Table 10. Major Broad-scale and Interdisciplinary Investigations of the U.S. Gulf of Mexico Conducted Since 1960 by State and Federal Government Agencies.

Dates	Sponsor, location, and nature of study
1961-1965	National Marine Fisheries Service (NMFS). Rio Grande to Mobile Bay. Monthly transects across shelf. Hydrography, plankton, and trawl fishery survey.
1965-1967	State of Florida. *Hourglass Cruises*. Monthly transects across Florida shelf off Tampa and Charlotte Harbor. Hydrography, plankton, trawl, dredge, trap, and handline survey.
1970-1976	Texas A&M Univ. *Defenbaugh dissertation*. Gulfwide except west Florida and Yucatan. Trawl survey of benthic invertebrate fauna of U.S. and Mexican continental shelves.
1972-1974	Gulf Universities Research Consortium (GURC). *Offshore Ecology Investigation.* Louisiana bays and inner shelf. Sedimentology, hydrography, microbiology, plankton, benthic flora and fauna, bio-fouling communities, trace metals, and hydrocarbons.
1974-1979	BLM. *Mississippi-Alabama-Florida (MAFLA) Baseline Study*. Continental shelf off Mississippi, Alabama, and Florida. Sedimentary, geological mapping, hydrography and physical oceanography, plankton, neuston, benthos, demersal fishes, and trace metals and hydrocarbons (in water, sediments and biota).
1975-1980	BLM. *South Texas Outer Continental Shelf Baseline Study*. Transects off south Texas (Rio Grande to Matagorda Bay). Sedimentology, geologic mapping, hydrography, plankton, neuston, benthos, demersal fishes, histopathology, and trace metals and hydrocarbons (in water, sediments and biota).
1975-1985	BLM/MMS.* *Topographic Features Program*. Study of submarine banks off Texas, Louisiana, and Florida (Florida Middle Grounds). Geologic mapping and hydrographic and biological surveys.
1977-1980	NMFS, EPA. *Buccaneer Gas and Oil Field Program*. Inner shelf off Galveston, Texas. Sedimentology, hydrography and circulation, benthos, bio-fouling communities, artificial reef study, and toxicology.
1978-1981	BLM. *Central Gulf Outer Continental Shelf Platform Study*. Continental shelf off Louisiana. Sedimentology, microbiology, benthos, trace metals and hydrocarbons (in water, sediments, and biota), histopathology, and platforms as artificial reefs.
1980-1987	BLM/MMS. *Southwest Florida Shelf Marine Ecosystems Study*. Continental shelf off south-west Florida from Fort Myers to 25th parallel (below the Everglades). Sedimentology, geologic mapping, hydrography, biological survey, benthos, biological processes, and productivity.
1981-1985	U.S. Department of Energy (DOE). *Strategic Petroleum Reserve Studies*. Nearshore shelf off Cameron. Louisiana, and Freeport, Texas. Hydrography, plankton, benthos, demersal fishes, sediment chemistry.
1981-present	BLM/MMS. Northern Gulf Continental Slope Study. Outer Continental Shelf and upper slope, Gulfwide. Biological surveys, and benthos and chemosynthetic communities studies.
1983-present	MMS. Mississippi-Alabama Shelf Marine Ecosystems Study. Continental shelf from Mississippi River Delta to DeSota Canyon. Geologic mapping, and hydrographic and biological surveys.

*The Minerals Management Service (MMS) was formed by merger of units from the Bureau of Land Management (BLM) and the U.S. Geological Survey (USGS) in 1981-1982.
Source: Darnell and Defenbaugh 1990.

For example, MMS sponsored a $4.4 million study in cooperation with Texas A&M University and the oil industry to assess the environmental impacts on the benthos surrounding oil platforms. The study, known as the Gulf of Mexico Offshore Monitoring Experiment (GOOMEX), was intended to provide detailed information on the biological, geological, and chemical impacts of discharged effluents on the surrounding marine biota. Indeed, MMS remains the primary source of funding for marine science research in both the Pacific and Gulf OCS region.

The Move to the Federal Level: Congressional Activity

The heightened awareness of converting rigs-to-reefs for fisheries enhancement among commercial and recreational user groups and the need to coordinate state and local efforts initiated hearings before the Congressional Subcommittee on Fisheries and Wildlife Conservation and the Environment on September 11, 1981. Members of Congress from Louisiana (John Breaux), New Jersey (William Hughes and Edwin Forsythe) and Rhode Island (Claudine Schneider) introduced two bills, H.R. 1041 and H.R. 1897, to: (1) develop marine artificial reefs in U.S. waters and, (2) provide funds to develop, maintain, and monitor offshore artificial reef sites.

The two bills, H.R. 1041 and H.R. 1897, designated the NMFS the primary responsibility to fund, develop, and monitor Gulf state artificial reef activities. The two bills stipulated that any construction of a "fishery conservation zone" (3 to 200 nautical miles) could only be constructed by the NMFS. Despite the fact that both of these bills were defeated, the bills demonstrate the idea for the need of federal backing for an artificial reef plan. One important policy entrepreneur Congressman John Breaux expressed his support for the development of a comprehensive artificial reef program for the Gulf as follow:

> We are missing a golden opportunity. There is, for example an oil and gas industry out there that has thousands of rigs that are going to have to be dismantled and towed in and broken up at a great deal of expense. It would be cheaper to be able to cut those and use them as artificial reefs. I think a coordinated policy could be greatly beneficial to both the fishing industry and the people who own those structures. If we need to change, or draft new legislation that would allow them to do that, I believe we should.

Two years later, on July 18, 1983 Congressman John Breaux of Louisiana along with 17 other members of Congress introduced H.R. 3474 in an effort to establish a national artificial reef policy. Testimony from federal, state and local agencies as well as user groups and environmental organizations supported the establishment of a comprehensive federal artificial reef program that included the rigs-to-reefs option. Some portions of the bill were amended and it was reintroduced as H.R. 5474. The amendments were approved and passed on April 12, 1984.

The political stream included Congressional representatives, federal and state resource agency personnel, members of the oil and fishery industries who supported the idea of the rigs-to-reefs alternative to complete removal of offshore oil structures in the Gulf. Various studies of the marine ecology and socio-economic uses associated with commercial and sports fishing also supported the idea of the rigs-to-reefs alternative. MMS personnel (such as Villere Reggio) and other resource managers and scientists played a major role in promoting the use of rigs as artificial reefs to enhance fisheries. These individuals acted as policy entrepreneurs, pushing and advocating their particular proposals and ideas in the intergovernmental policymaking process.

For the Gulf region, the idea of "rigs-to-reefs" is less an invention and more a mutation of an old idea. The rigs-to-reefs idea represents the coupling of an already familiar activity of building artificial reefs in the Gulf. The use of familiar ideas (such as artificial reef building) by policy entrepreneurs and experts is described by Kingdon (1995: 201) as the "act of recombination". The rigs-to-reef policy idea represents a recombination of an old solution (the reliance on artificial reefs to enhance fisheries) to a perceived new problem (the lack of natural habitat and potential economic impacts associated with complete removal of OCS oil and gas structures).

The Window of Opportunity: Passage of the National Fisheries Enhancement Act of 1984

The National Fishing Enhancement Act (NFEA) of 1984 (Title II of Public Law 98-623) was passed by Congress and signed into law by President Reagan on November 8, 1984. The NFEA defines an artificial reef as "a structure which is constructed or placed…for the purpose of enhancing fishery resources and commercial and recreational opportunities." The NFEA states the following:

> Properly designed, constructed, and located artificial reefs…can enhance the habitat and diversity of fishery resources; enhance recreational and commercial fishing opportunities; increase the production of fishery products in the United States; increase the energy efficiency of recreational and commercial fisheries; and contribute to the United States coastal economies.

The NFEA consolidated several decades of localized and state laws to maximize the potential benefits of artificial reefs as fishery enhancement mechanisms. State governments are responsible for carrying out the general goals of the NFEA in federal and state waters by funding, promoting, and maintaining artificial reefs. The NFEA provides a foundation for the establishment of a national artificial reef program based on the following goals:

- To enhance fishery resources;
- To facilitate access for recreation and commercial fishing;
- To lessen conflicts between users of marine resources;
- To minimize environmental risks;
- To follow principles of international law;
- To prevent unreasonable obstruction to navigation; and
- To promote consistency with the National Artificial Reef Plan.

The NFEA directed the NMFS to develop the National Artificial Reef Plan within one year. The Plan was published one year later through the combined efforts of fishermen, divers, scientists, state and federal resource agencies (Stone 1985; Harrison 2000). The Plan serves three purposes:

1. To provide guidance to individuals, organizations, and government agencies on technical aspects of artificial reef planning, design, siting, construction, and management for effective artificial reef development;
2. To serve as a reference for federal and state resource agencies involved in artificial reef permitting; and
3. To ensure that the national standards and objectives established by the NFEA are met.

The Plan serves as one guide to develop state artificial reef programs. It includes information on design criteria, permit compliance, management methods, and ideas for increasing artificial reef development. In addition, the Plan emphasizes the need for research and monitoring of artificial reef activity.

Federal Guidance and Assistance

Since the NMFS developed and published the Plan, they have continued to support regional, state, and local artificial reef development activities. The NMFS provides technical consultation, resources, and contributes to various regional artificial reef management committees established by interstate marine fisheries commissions.

The U.S. Fish and Wildlife Service administers the Federal Aid in Sport Fish Restoration Program (16 U.S.C. Sec 777), which provides funding for important recreational fisheries work. Coastal states in Region 4 (North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana) and Region 2 (Texas) of the Service can apply for funds from the Federal Aid for sport fish restoration and boating projects. Money for this program is collected from taxes placed on fishing tackle and motorboat fuel. In 1984, the Wallop Breaux amendment to the Sport Fish Restoration Act allocated funds for use in artificial reef programs.

MMS amended its guidelines on the "Disposal of Oil Platforms" to reflect the goals of the NFEA. MMS's new policy statement encourages the "reuse of obsolete offshore petroleum structures as artificial reefs in US waters" so long as the structures do not "pose an unreasonable impediment to future mineral development". MMS also provides information to state programs, such a geophysical data, offshore area/lease block maps, bathymetric maps, pipeline and platform location maps, numerous technical reports and environmental impact statements, and visuals (maps that illustrate bottom sediment types, oceanographic currents, shrimp trawling areas, etc.) (MMS 2000).

The Permits and Evaluation Branch of the Corps of Engineers (COE) regulates planning and development activities in OCS under the jurisdiction of the Rivers and Harbors Act of 1899, the National Environmental Protection Act of 1969, the Clean Water Act of 1972, and the Marine Protection Research and Sanctuaries Act of 1972. It is the lead federal agency that permits and monitors artificial reef development under NFEA. All state natural resource agencies must obtain a COE permit before any construction of an artificial reef site. The COE reviews the permit, inspects the materials and then issues the appropriate permit or makes recommendations to improve the permit application.

State Artificial Reef Programs[24]

In the Gulf, the primary purpose of the rigs-to-reefs policy is to enhance fisheries (Murray 1994). Since the implementation of the Plan of 1985, most state marine fisheries agencies have assumed the lead in developing artificial reefs through state developed programs. State natural resources agencies currently direct or coordinate with local agencies in obtaining permits, maintaining liability, financing, constructing, researching and monitoring marine artificial reefs. Many coastal states have adopted state-specific plans based on the guidance of NFEA.

Louisiana was the first among the Gulf states to create a formal artificial reef program. Passed in 1986, the Louisiana Fishing Enhancement Act (Act 100) is the most comprehensive

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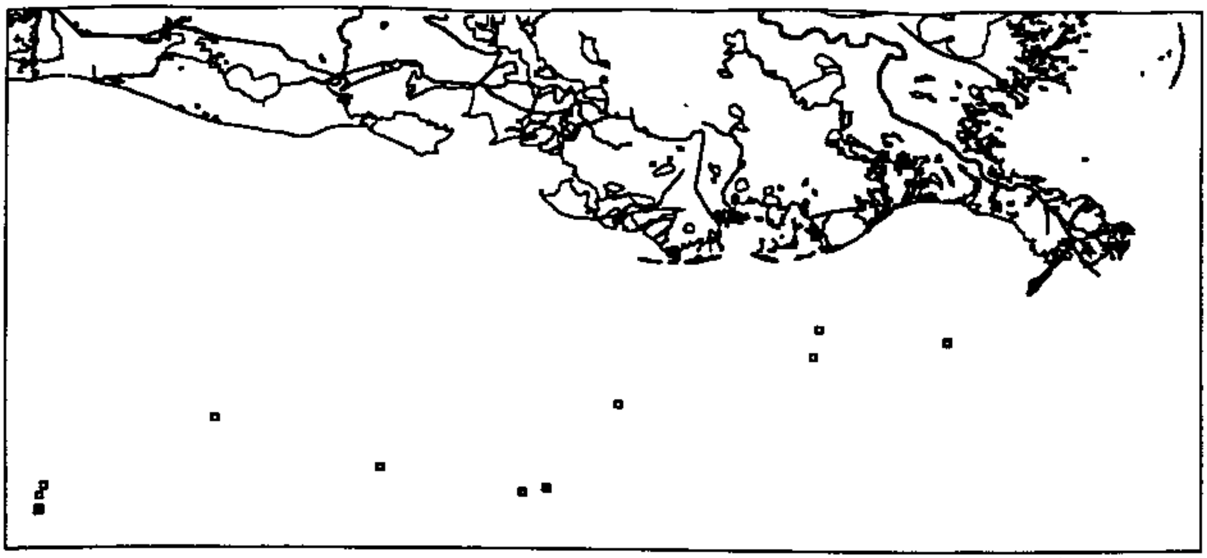
[24] This section is not intended to provide a comprehensive review of Gulf State artificial reef programs but rather a characterization of the historical development of the rigs-to-reefs alternative. In addition to the state programs that are described in this section, Alabama and Mississippi have artificial reef programs.

reefing policy and program in the Gulf (Murray 1994). The Act provides for: 1) establishment of the artificial reef program, 2) creation of the Louisiana Artificial Reef Council, 3) establishment of a Louisiana Artificial Reef Development Fund, 4) development of a reef plan, 5) establishment of the state as the permittee for artificial reefs developed under the plan, and 6) relief from liability (Wilson and Van Sickle 1987). The Louisiana Act sets up a means to transfer the ownership and liability of the platforms from the oil and gas companies to the State when the platform ceases its production. The Plan established an Artificial Reef Trust Fund for funding costs associated with each artificial reef project (Kasprzak, personal communication, 2000). When oil and gas companies donate platform structures, they are asked to donate half of the cost savings for participation directly into the trust fund. As of 2000, the Artificial Reef Trust Fund has accrued $13 million and uses the 5% interest to fund the artificial reef program (Kasprzak, personal communication, 2000).

Since 1987, the Louisiana Artificial Reef Program has created 25 artificial reef sites that utilize 85 obsolete platform jackets and/or parts. Map 3 shows the artificial reef sites offshore Louisiana.

Map 3. Location of artificial reefs in Louisiana waters.



Source: Gulf States Marine Fisheries Commission

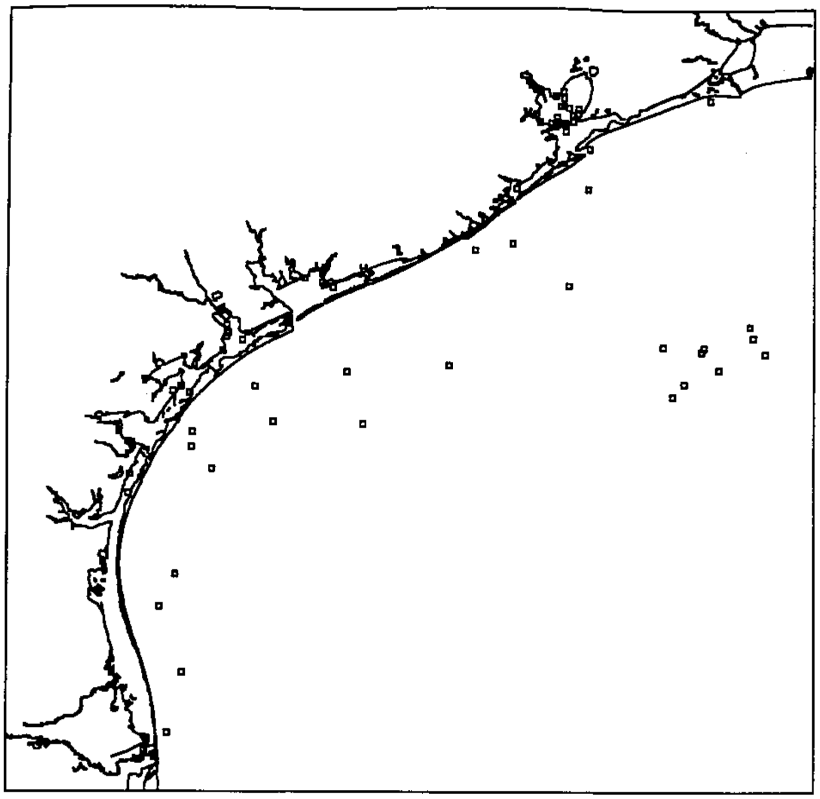
Approximately 7-10 platforms are donated per year as platforms become available (Kasprzak, personal communication, 2000). Most of the reef development spans between 30 to 70 miles offshore and extends down a minimum of 50 feet from the surface to satisfy Coast Guard navigational guidelines.

To fulfill its monitoring requirement, hydroacoustic surveys are taken yearly to monitor fish populations at standing rigs versus toppled rigs (Kasprzak, personal communication, 2000). Results from these surveys have shown that standing rigs provide more vertical profile and a higher biomass results when compared to toppled rigs that provide less habitat area (Kasprzak, personal communication, 2000). Side scan sonars are used to make sure reef sites remain in place and do not pose any dangers to health or property (Kasprzak, personal communication, 2000).

The Texas legislature passed the Artificial Reef Act of 1989, which directed the Parks and Wildlife Department to promote, develop, maintain, monitor and enhance the offshore artificial reef potential (Osburn and Culbertson 1993). The following year, the Department introduced the Texas Artificial Plan that was adopted by the Parks and Wildlife Commission.

To maximize accessibility for commercial and recreational fishermen as well as divers, reef sites are located across a wide range of depths and distances from shore. The Texas Program currently maintains 33 developed artificial reef sites, located 6 to 87 miles offshore in 36 to 288 foot depths (Osburn and Culbertson 1993). Construction materials used to develop reef sites range in size, structure, and durability. These "materials of opportunity" are donated to the program for use in artificial reef sites and include: 45 oil and gas structures, 12 Liberty ships, 5 barges as well as a tugboat, concrete culverts, fly ash blocks, reef balls, quarry rocks, and a welded pipe. Map 4 shows the artificial reef sites located offshore Texas.

Map 4. Location of artificial reefs in Texas waters.



Source: Gulf States Marine Fisheries Commission

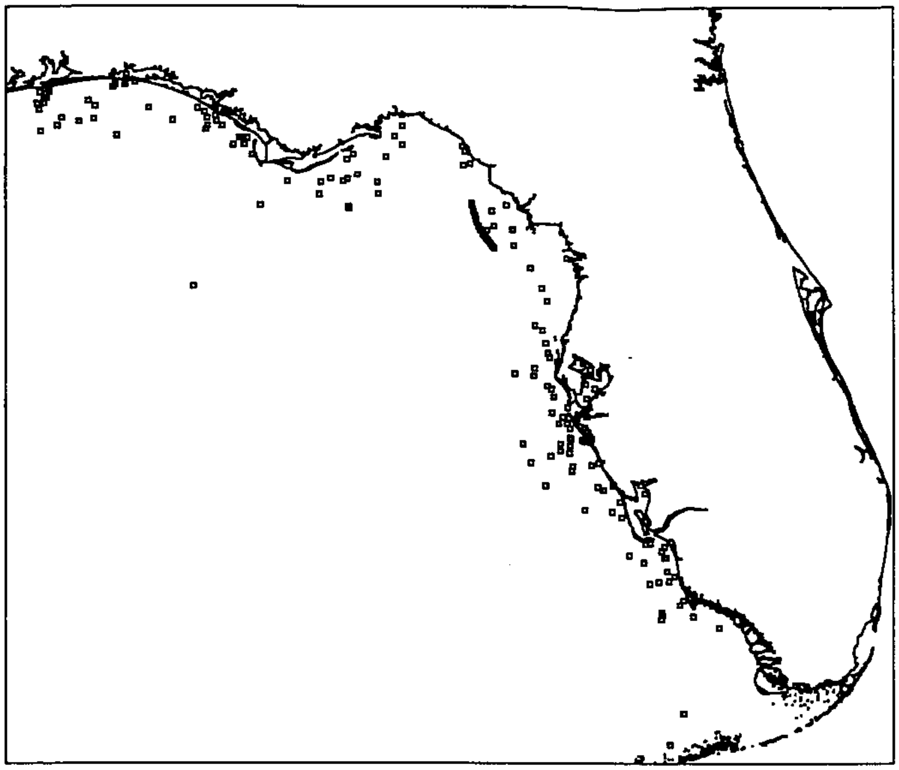
Twelve of the sites are nearshore to allow accessibility to small boat owners. Efforts to create reefs close to shore include the Star Reef, a cluster of six oil rigs that were placed in the shape of a star approximately 33 nautical miles from Freeport (Texas Parks and Wildlife 1999). For a complete listing of Texas artificial reefs, see http://www.tpwd.state.tx.us/fish/reef/artreef.htm.

The Texas Artificial Reef Program includes the use of a citizen-based Artificial Reef Advisory Committee. The committee is comprised of at least one representative from major user or stakeholders from: (1) salt water sports fishing organization, (2) offshore oil and gas company, (3) Texas tourist industry, (4) General Land Office, (5) Texas Shrimp Association, (6) Texas diving club, (7) Attorney General's office, (8) Texas A&M University, (9) environmental group, (10) Texas antiquities committee. The committee meets regularly to discuss and resolve conflicts as well as provide guidance for the placement of future artificial reef sites to maximize user benefits. Oil companies are required to pay a fee equal to the company's removal and cleanup costs.

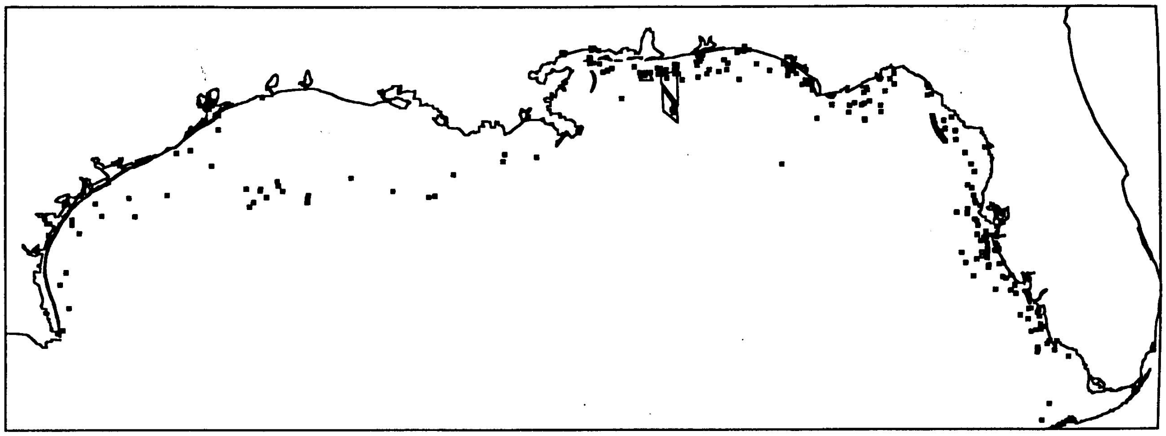
Florida established its Artificial Reef Program in 1982 through the joint collaborative effort between the Department of Environmental Resources Management and Florida Fish and Wildlife Conservation. However, it is different from the Louisiana and Texas state programs in that artificial reef sites are typically the result of coordinated efforts of county or city agencies and private individuals. The Florida Artificial Reef Plan provides guidance and direction for reef planning, and development activities, *yet al*lows each county to develop its own artificial reef program according to each region's fishery needs. Each of the 35 participating counties serve as the primary permit holders and project managers utilizing volunteer groups to serve on reef advisory boards, conduct site assessments, complete documentation necessary for permitting, obtain donations of suitable materials and periodically monitor the reefs.

The Florida State Reef Program drafted a State Reef Monitoring Plan that provides basic guidance and data for the biological, physical, oceanographic and socio-economic evaluations of artificial reefs. Map 5 shows the location of artificial reefs off Florida while Map 6 shows the location of artificial reefs in the entire Gulf.

Map 5. Location of artificial reefs in Florida waters.



Map 6. Location of artificial reefs in the Gulf of Mexico.



Source: Gulf States Marine Fisheries Commission

Discussion: Unresolved Issues and Concerns

Despite the NFEA, there remain a number of issues and concerns associated with the use of rigs as artificial reefs. In an analysis of interviews with state artificial reef managers, Murray (1994) describes the current status of artificial reef programs in relation to administration, budget, siting, promotion, education, evaluation, future trends and major concerns. The major issues and concerns that state artificial reef managers raise are as follows (Murray 1994):

(1) *The Liability Issue.* Since the publication of the National Artificial Reef Plan, which recommended that the US Army Corps of Engineers develop specific permit standards and conditions, the issue of liability remains vague and unclear. The Corps has developed a policy requiring the permit holder of an artificial reef to prove adequate liability coverage. States with reefing programs have assumed the role of the permittee. This has necessitated a close review of the role of the states and localities in implementing the NFEA (Murray 1994). As Murray (1994: 965) writes in an analysis of the interviews with state artificial reef managers:

> Because most private fishing associations cannot afford the insurance premium, many states have assumed the role of the permittee. Although many state managers welcomed this as a way of gaining control of artificial reef activities, it has necessitated a closer inspection of each state's liability. The level of concern varied widely, but the general consensus was the clarification is needed from the state's attorney general's office. Most reef managers felt that even this would be vague and subject to interpretation until a case comes before a court.

Clarification of this issue would improve operational procedures and potentially reduce uncertainty about exposure on the part of state artificial reef managers (Murray 1994: 968).

(2) *Scientific Uncertainty: Production versus Aggregation.* State artificial reef managers remain concerned about the production versus aggregation question. It remains unclear if rigs attract or produce fishes. As Murray (1994: 966) writes, "One troublesome issue is related to the inability of artificial reefs to assist fishery production at all stages of the life cycle."

Artificial reef managers are concerned that too much emphasis has been placed on adult fishery enhancement activity and not enough on restoring essential coastal processes, such as estuarine habitats and wetland ecosystems (the "nurseries of the sea").

(3) *Limited Funding*. State artificial reef program funding remains a major concern of administrators and managers. In 1988, the average reported annual budget for reef programs was $139,000, with a range of 0$ to $400,000 (Murray 1994: 962). Most funds are generated from either state appropriations or Wallop-Breaux funds, which refer to the 1984 Wallop-Breaux Amendment to the Federal Aid in Sport Fish Restoration Act (16 U.S.C. sec. 777 (1988)).

Oil companies that "donate" structures are asked to contribute half of the disposal savings realized to the Fund. In a description of this process, Reggio and Kasprzak (1991: 15) write:

> Negotiations to obtain platforms and to determine the amount of donation are done on a case-by-case basis between the oil and gas operator and the state. The size, location, distance from shore, water depth, resale value, and proximity of the platform to the permitted reef site all affect the cost of converting a rig into a reef; thus, it is not always cost-effective for operators to participate.

State artificial reef programs maintain an average staff size of 1 full-time employee. In addition, monitoring of existing artificial reefs and regulatory compliance issues remain important concerns of state artificial reef managers in the Gulf. State artificial reef programs have not received adequate funding (Murray 1994: 967).

Conclusion

This section described the political, problem and policy streams that met to form a policy window of opportunity for the rigs-to-reefs alternative in the Gulf region. In the case of the Gulf, an advocacy coalition that combined the interests of the oil industry, recreation and commercial fishing, scientists, and resource managers supported the use of offshore rigs as artificial reefs. The development of oil and gas in the Gulf OCS led to an increase in commercial and sports fishing activity. Scientific reports and workshops spoke to the benefit of artificial reefs in the Gulf. States and local artificial reef programs had been established before the passage of the NFEA. In passing the NFEA, the federal government granted discretionary authority to states to create their respective rigs to artificial reef program. Many of these programs were based on existing artificial reef programs.

Despite the passage of the NFEA, there remain a number of management issues and concerns that have not been clearly addressed by federal and state resource policymakers who are interested in artificial reef development and building.

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The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.