

Short communication

The status of the California Rigs-to-Reefs Programme and the need to limit consumptive fishing activities

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Planning and policy issues associated with the utilization in California of portions of decommissioned oil platforms as artificial reefs are identified. Problems, solutions, and current progress are discussed. Habitat values of several California rigs were contrasted with other marine habitats. The results suggest that some rigs provide valuable habitat for rockfish, but consumptive activities could nullify their enhancement potential. Legislation has been introduced that requires the rigs to be evaluated on a case-by-case basis. Habitat value and safety are important when determining structure acceptance. A minimum of 40% of decommissioning savings is dedicated to a resource enhancement trust fund. Savings could be used to build new fishing opportunity reefs. The programme is designed to benefit open coastal marine resources, yet critical support from leading environmental organizations may be withheld. Representatives of the Santa Barbara-based environmental and commercial fishing organizations have been hostile to offshore oil drilling for decades and lead the opposition to the programme. Social and economic concerns have overshadowed biological issues.

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Introduction

There are currently 27 offshore platforms in California, 20 off the coasts of Santa Barbara and Ventura counties in the north and 7 off the city of Long Beach in the south. The newest platform was finished in 1990. Water depths range from 7 to 368 m, with 15 platforms located at depths <100 m and 6 located at >200 m. Four platforms are in California State waters (<4.8 km offshore), the others in nearshore federal waters (<18 km offshore). In 1999, the average age of all platforms in both state and federal waters was 24 years. In addition, six small artificial oil islands are located in water <15 m deep. They are composed primarily of rock, concrete, and steel.

Six of the 34 platforms and one island constructed since 1958 have been removed. The 1989 decommissioning of two Texaco platforms in state waters north

of Santa Barbara (26 and 30 m) was the first local large-scale decommissioning project. The California Department of Fish and Game (CDFG) supported their relocation to artificial reef sites, but this plan was defeated by environmental representatives who questioned the value of artificial reefs in general and use of materials from oil platforms in particular. The structures and an estimated 900 t of attached marine life were disposed of on shore (Culwell, 1997).

Chevron's Hope, Heidi, Hilda, and Hazel, located in State waters south of Santa Barbara harbour, were removed in 1996. Liability was a major issue. Chevron reported that state regulatory agencies indicated that a rigs-to-reefs option should not be requested for these '4-H rigs'. The shell mounds from their base were left after the rigs were removed. These mounds contain drilling muds covered by compacted shells and support communities of mussels, crabs, sea stars, sea cucumbers,

anemones, and at least 35 species of fish, including 18 species of rockfishes (*Sebastes* spp.; Love *et al.*, 1999a). Depths range from 30 to 43 m, and the mounds average 60 m in diameter and 6–8 m in elevation (Culwell, 1997).

State agencies encouraged EXXON to completely remove Belmont oil island (located 2.5 km offshore at a depth of 13 m). The island included 14 000 t of quarry rock, a mass similar to that of the largest fishing opportunity reefs in California. The island had an abundance of marine life and was valued by recreational interests. EXXON agreed to move the rock to an existing artificial reef site. Liability was the most frequently expressed problem (Manago and Williamson, 1997).

CDFG has been creating fishing opportunity reefs since 1958 and accepts liability for reefs included in this programme. The most common materials are quarry rock and recycled concrete. CDFG has also deployed steel structures in both State waters and on the Outer Continental Shelf. Liability has not been a problem where reef construction complies with the National Artificial Reef Plan (Stone, 1985).

Many of the remaining rigs are subject to decommissioning within 10 years. During their operational period, these structures have developed epifaunal communities as well as fish assemblages which depend on hard structure for refuge and/or feeding and include species that have been heavily impacted by overfishing and environmental change. The platforms appear to act as settlement sites and 'mini-reserves' for some species (Stephens, 1998). The commonly reported cost estimate of removing all platforms is US\$2.5 billion. This estimate is based on experience in decommissioning the 4-H rigs, assuming use of current technology and cost rate increases with water depth.

Offshore oil projects were generally unwelcome in southern California, especially in Santa Barbara County, where the first offshore platforms were constructed in 1896. As early as 1899, citizens of Santa Barbara displayed their antagonism by demolishing a derrick erected at Miramar Beach (Nevarez *et al.*, 1998). By the 1920s, wells were commonly drilled from short offshore piers (MBC, 1987). Natural seepage, the origins of which predate oil drilling, is common in the area and shipping lanes are nearby. Determining the source of spilled oil can be difficult, and each new deposit on local beaches adds to the strain in relations between the community and industry. A major spill associated with drilling from Unocal platform A occurred off the coast of Santa Barbara in 1969. Several local anti-oil environmental organizations were founded soon after the spill and have become influential in local politics. The voluminous publicity depicting oil-fouled birds, mammals, and beaches upset many California voters, and the spill triggered passage of the National Environmental Protection Act and California Environmental Quality

Act (Nevarez *et al.*, 1998). Identification with offshore drilling is a serious political liability for coastal legislators in California.

Offshore oil projects disrupted fishing activities of commercial fishers, who have long been an integral part of the Santa Barbara community. Based on damage claims, about 20 small (10–15 m) trawlers fish in the area. They were concerned that lost materials might damage their nets. Platforms are a potential hazard, and avoiding unmarked obstacles is difficult, even with the aid of modern navigational equipment.

An alliance with substantial political support was formed between commercial fishers and anti-oil environmental activists. One of the few exceptions to the statewide ban on trawling was initiated in 1971, opening state waters from 1.7 to 5 km off Santa Barbara to trawling. Also, payments to fishers for inconvenience and damage related to oil projects have become common. More than US\$14 million has been paid for marine environmental mitigation and compensation for damaged fishing equipment. Most of the funds were used for land acquisition and other projects unrelated to marine impacts.

Recreation interests (marine anglers and divers) proposed a research-based rigs-to-reefs decommissioning option for the 4-H rigs in 1994. The anti-oil/commercial fishing coalition immediately opposed the plan. Television and print news coverage of the abundant marine life beneath the platforms resulted in substantial popular support for maintaining the lower part of the jackets as reefs. Chevron was in the process of obtaining regulatory approvals and was concerned that the rigs-to-reefs option would cause long delays in what had increasingly become a contentious permitting process. A major concern expressed by local opponents was the value of the reefs to marine life. This was antithetical to their previous emphasis of oil exploration's interference with fishing activities.

Chevron agreed to remove the platforms as well as unreasonable obstructions to trawling, resulting in the destruction of over 2000 t of marine growth (Culwell, 1997). Chevron estimated decommissioning costs of approximately US\$50 million (Manago and Williamson, 1997). Mitigation for air pollution created during decommissioning required the expenditure of over US\$1 million, by the Santa Barbara County Air Pollution Control District, to purchase more than 60 new efficient engines, primarily for commercial fishing boats. The fate of the shell mounds is currently the subject of controversy, and an attorney for the local environmental community has also represented five commercial fishing organizations. The primary issues raised have been damage to trawl nets, loss of trawling opportunity, interpretation of decommissioning agreements, and potential for pollution from drilling muds. The coalition seeks mound removal and mitigation in the form of

payments to trawlers experiencing past, present, and future losses. Chevron is conducting further studies on the shell mounds.

Chevron sponsored legislation in 1998 that would have been a major step in adopting a decommissioning policy. The bill was treated as a local issue and was defeated in deference to a local legislator.

Recent developments

The sport-fishing industry provided the legislature with an economic study indicating that recreational fishers and divers make a far greater contribution to the economy than do commercial fishers, yet do so while taking a much smaller proportion of the state's marine resources. In 1992, recreational fishing (including fresh water) had a value-added impact of almost US\$5 billion, while the value-added impact of the commercial fishing industry was US\$0.7 billion (McWilliams and Goldman, 1994).

Recreation interests and environmentalists created an alliance during 1998 in support of two controversial and potentially important marine management bills: the Marine Life Management Act and the Marine Life Protection Act. The former emphasized the need for more conservative management and highlighted overfishing of rockfish stocks, while the latter required an evaluation of the role of marine protected areas. The debate focused attention on overfishing, the decimation of some reef-dependent fishes, as well as the need for better scientific analysis of the offshore fisheries. Recreation interests also enlisted the aid of universities to evaluate the currently available ecological information (Stephens, 1998). The US Minerals Management Service (MMS) has supported basic research into the ecological role of California offshore oil platforms for many years. MMS convened a task force of knowledgeable representatives from local, state, and federal agencies having jurisdiction governing decommissioning policy that also encouraged academic involvement in identifying important gaps in current knowledge. In response to a request by the author of the legislation, the University of California convened a scientific panel to further summarize current knowledge concerning the issue (Holbrook *et al.*, 2000).

Stephens (1998) reported that benefits of the rigs-to-reefs programme include:

- platforms and their epifaunal growth serve as hard substrate and high relief in areas where such habitats are lacking
- deposits from the epifauna (shell mounds) form complex habitat, which should enhance survival of juvenile fish recruited to these structures
- platforms support fish species that have been heavily impacted by fishing pressure (e.g. bocaccio and lingcod)
- juvenile rockfishes recruit in large numbers to the midwater parts
- fish biomass and diversity are considerably enhanced compared to the surrounding soft substrate
- platforms interrupt trawling patterns and thus protect nearby soft-bottoms as well.

Stephens' discussion of the three presumptive drawbacks most frequently expressed by those opposed to rigs-to-reefs included:

(1) *Rigs are not "good" habitat and may, in fact, be biological sinks.* Juveniles recruiting to rigs would be better off finding natural reefs, because they cannot complete their life cycle in this marginal habitat and therefore are at a biological dead end, or at least will survive less well. Based on a literature review of habitat as a limitation to fish populations, Stephens (1998) concluded that either habitat or larval supply may be limiting under different environmental conditions, and enhancing both, where possible, is probably an appropriate policy. Love *et al.* (1999b), applying methodology from Bond *et al.* (1999), reported that platforms and associated shell mounds had substantially higher habitat value than the surrounding substrate. Source/sink discussions led Stephens (1998) to conclude that platforms that have been in place for many years could be important fish habitats, but he noted that data describing fish movements after recruitment and/or growth, maturation, and successful reproduction by rig inhabitants are lacking.

(2) *Fishing around rigs would subject resident species to increased exploitation and the rigs would in fact become an attractive nuisance to these species.* Stephens (1998) concluded that rig reefs should not be made available to fishing without experimental evidence that this would not be detrimental to vulnerable species.

(3) *Leaving platforms intact will continue to displace and negatively affect soft-substrate species in the area.* Stephens (1998) considered this objection trivial, as more than 90% of existing benthic substrate off the coast of California is sand or mud and the value of near-reef sand was elevated in the Torrey Pines study (Johnson *et al.*, 1994).

Decommissioning planning followed by the acquisition of equipment and permits takes many years. Enabling legislation must be in place if a company is expected to plan to use part of a structure in an artificial reef programme. At the request of sport-fishing representatives, and with the support of recreational divers, Chevron, and others, a new policy was established in 1999 to provide guidelines for evaluating platforms and their role in the artificial reef programme. Although the legislation is still evolving, it is expected to provide a framework that evaluates the current and potential habitat value of each rig structure on a case-by-case basis, shares potential industry cost savings in the event

that a structure meets acceptance requirements, creates a trust fund for the benefit of open coastal resources and specifies criteria for selecting the trustees. Also, it specifies requirements associated with acceptance, such as rig components to be removed, site augmentation with complex substrate and those relating to navigational safety, and specifies management criteria to maximize benefits, including species to be protected

Criteria which would qualify a structure to be included in the programme are currently under discussion, as is an array of potential open coastal resource enhancement projects that might be funded. Research designed to facilitate future rigs-to-reefs-related decisions is likely to receive priority during the early stages of the programme.

Discussion

California's artificial reef programme has created fishing opportunity reefs for decades. There has been little opposition, and support from the recreational community has been sufficient to enable the legislature to sanction the programme. Taxes on angler purchases provided most of the funding. Unlike states bordering the Gulf of Mexico, in California enhancement of recreational opportunities may be insufficient justification for the rigs-to-reefs initiative. The difference lies in societal perception of the oil companies. The attitude has been strongly influenced by the anti-oil/commercial fishing coalition. The desire of fishers for mitigation funds and the alienation between some proponents within the environmental community and the oil industry eclipse the value of platforms as artificial reefs.

Some environmental leaders share the broader concerns of recreational interests, including the need to reverse the decline of California fisheries. They are receptive to programmes likely to improve management and enhance stocks, are aware of the waste and habitat damage caused by bottom trawling (Engel and Kvitck, 1998; Watling and Norse, 1998), and recognize the incongruity of the support for bottom trawlers by environmentalists. Interest in ecosystem management and habitat protection has led some to view rigs as habitat and encouraged dialogue concerning the constructive aspects of rigs-to-reefs, including the trust fund. Their support is expected to ensure that programme objectives include enhancement of reef-associated stocks. This may require that rig sites be managed as rockfish refugia and possibly be augmented with complex hard substrate. Recreational community trust fund priorities will include construction of new fishing opportunity reefs and support for management of reef-associated stocks.

Stephens' (1998) report provides a foundation for a legislative framework to examine the potential benefits

of maintaining these ecosystems in place, and for requiring thorough assessment of the habitat value of the structures prior to permitting their decommissioning. There is consensus that additional research is necessary. The following discussion of currently identified research topics demonstrates the nexus between: (1) research to improve programme implementation, (2) research concerning management of reef-dependent stocks, and (3) research concerning evaluation and management of marine protected areas.

An understanding of the basic elements of population biology and ecology of important reef fishes making up the assemblage is necessary if we are to seriously approach management of these reef resources. These include inter-reef movements or the opposite, long-term residency, genetic distinctiveness of metapopulation subgroups of recruiting larval units, growth/reproductive rates in differing habitats (source/sink data), and larval longevity, settlement strategies, and the ability of species preferentially to migrate as post-settlement juveniles or sub-adults. The concept of metapopulations in fishes is being actively explored. Reef fishes, with their discontinuous distributions, would seem to be ideal organisms on which to apply these concepts. The accepted rubric is that adult reef fishes are relatively sedentary residents and exchange among subpopulations is largely through larval drift and recruitment. The concept of source/sink populations is derived from differences in the ability of different reef sites to sustain reproduction and larval export. Temperate reefs, however, undergo seasonal changes in productivity and habitability. We know that fish movements occur in conjunction with seasonal change, but there is little evidence to support the common assumption that such shifts are part of a migratory cycle. Most work supporting these concepts is derived from tropical reef fishes and these results are not necessarily applicable to temperate species (Stephens, 1998). Temperate reef fish biology has always suffered from the research done in the more benevolent tropics (but see Ebeling and Hixon, 1991).

Because rigs-to-reefs and rockfish reserve programmes could require limitations on take, they also share important unsolved management challenges: (1) the need to induce consumptive users to take a personal interest in ensuring compliance, e.g. assignment of property rights; (2) effective application of vessel tracking systems and other electronic enforcement tools; (3) controlling take while allowing non-exploitative uses such as no take diving, photography, catch and release fishing or allowing the take of certain species while protecting others (Yoklavich, 1998).

Conclusions

Substantial evidence suggests that some, if not all, California rigs increase regional biological production.

Resource benefits may not be sufficient to prevent the rigs from being removed. Additional incentives including enhancement of recreational opportunity and funding of other programmes will likely be necessary. Although an influential minority view, the creation of artificial reefs as nothing more than a poor method of solid waste disposal, there has been little opposition to California's artificial reef programme. Some of the opposition to rigs-to-reefs is vehement because benefits accrue to the offshore petroleum industry. Commercial fishers desire maximum compensation for lost opportunity. Liability concerns need not be a serious hindrance to the programme. The petroleum industry will require incentives in addition to the goodwill derived from providing enhanced resources and recreational opportunity. All positions are founded on social and economic issues, and they are not likely to be altered substantially by additional biological research. The implementation of the programme may depend upon educating environmental leaders, and they may need to be convinced that take from rig-dependent resources can be sufficiently limited. The value of the research is increased by its relevance to a broad range of fisheries issues. Fortunately, the debate has greatly elevated interest in fisheries research, and regardless of the outcome, knowledge gained during the process could substantially improve fisheries management in California.

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