Potential Impacts of Mariculture Activities in the MLPA North Central Coast Study Region

Prepared for the MLPA Master Plan Science Advisory Team by
SAT support staff and Mark Carr
Revised January 4, 2008

Summary

Mariculturists in Tomales Bay and Drake's Estero culture several bivalve species using four main methods. Impacts vary according to method, but a general list of potential negative impacts is as follows:

- Bivalves and associated farming equipment can reduce eelgrass cover, change species distributions in eelgrass beds, create anoxic conditions, and alter sediment deposition patterns
- Farming equipment preempts space in the intertidal, impacting shorebird foraging and marine mammal haulout behavior
- Maintenance operations can trample sediments, damage eelgrass beds, and disturb shorebirds and marine mammals
- Wooden culturing racks are commonly treated with a highly toxic preservative that can leach into the environment and accumulate in organisms and sediments
- Bivalves and associated farming equipment provide large amounts of hard substrate habitat that may not be naturally present, altering species communities
- Almost all cultured species are non-indigenous species, and past shipments of live animals from their native range have accidentally introduced other species to mariculture areas, some of which have had negative impacts.

Issue

Mariculture in the MLPA North Central Coast Study Region (NCCSR) is currently confined to two estuaries in the Point Reyes region (Tomales Bay and Drake's Estero), and farms in these locations are licensed to raise a variety of bivalves. The most extensively farmed species is the Pacific oyster (*Crassostrea gigas*), but several other oyster species are farmed. Oyster mariculture methods are described in the following paragraphs. Manila clams (*Tapes philippinarum* or *Venerupis philippinarum*) are also grown in the study region using the bottom bag technique used for oysters. In most of the Pacific Northwest, Manila clams are cultured using open plots and raking, but this technique is not used by growers in the NCCSR. Bay mussels (*Mytilus galloprovincialis*) are also harvested by many growers in Tomales Bay, but the species is not actively cultured. Instead, mariculturists harvest naturally-seeded mussels from their oyster culturing equipment and piers. One grower (Cove Mussel Company) uses longlines placed in the subtidal zone to encourage mussel settlement, but does not actively seed the lines. Point Reyes Oyster Company is licensed to farm rock scallops, but does not currently do so.

Oysters are cultured in the NCCSR using four methods. All methods currently use mesh bags to contain the oysters, but growers can use cultch methods as well, in which cleaned shells with larval oysters attached are spread on the ground or attached to lines in clumps. In mesh bag culture, bags of oyster spat are either 1) placed above the substrate on wooden racks, 2) scattered by hand haphazardly on intertidal substrate, 3) tethered in lines on intertidal substrate, or 4) suspended from buoyed lines that float at high tide but rest on intertidal substrate at very low tides.

In the first method, oyster racks are frequently placed in eelgrass beds, although they may be placed in the intertidal or in subtidal regions without eelgrass. Oyster mariculture operations in eelgrass beds can have negative impacts, including preempting eelgrass habitat (Wechsler 2004), altering sedimentation and scour patterns (Forrest & Creese 2006), and altering sediment nutrient content through biodeposition (De Casabianca 1997, Bertin & Chaumillon 2006). Rack operations also create novel three-dimensional habitats that could influence the distribution of mobile species (Dixon 2007), and many racks are built with treated lumber containing highly toxic compounds that can leach into the water and be accumulated in marine organisms or sediments (Weis & Weis 1992, Weis & Weis 1996).

Oyster bags not placed on racks usually rest on intertidal substrate during low tide, which could have several negative impacts. One potential impact is that bags isolate the sediment from the water column and add nutrients to the sediment, which could potentially change infaunal communities near the sediment-water interface and create anoxic conditions (Dixon 2007). Another concern is that haphazardly scattered bags could be placed or moved into subtidal regions containing eelgrass beds, where they would exclude eelgrass by preempting space.

Bags also preempt space when placed in the intertidal, and both hand-scattered and tethered bags could have negative impacts on shorebirds and marine mammals. Intertidal bags and racks reduce the available foraging habitat for shorebirds, and although willets appear to be attracted to oyster mariculture in Tomales Bay, western sandpipers and dunlins actively avoid it (Kelly et al. 1996). If large amounts of intertidal foraging areas are covered by oyster mariculture, it could have a negative impact on shorebird foraging success. Likewise, mariculture equipment placed at or near marine mammal haulout sites could reduce the available space for resting and create barriers to movement.

Like the equipment itself, human activities associated with mariculture operations could have very serious impacts on the marine environment. Placing, maintaining, and collecting bivalves and their associated equipment create disturbances to the substrate through trampling and boat propeller scarring (Zieman 1976). Scarring is particularly damaging in eelgrass beds, where scars could take years to heal (Dawes et al. 1997). Additionally, humans and boats involved in routine mariculture operations could disturb birds and marine mammals, increasing energy demands (Stillman et al. 2007) and decreasing the haulout period (Suryan & Harvey 1999).

Oysters and their associated culturing equipment can also impact marine systems by providing extensive areas of hard substrate that would not otherwise be present in an area. Non-indigenous species are attracted to unnatural hard surfaces such as oyster racks, floats, and pilings, and thus mariculture equipment could help maintain populations of non-indigenous sessile organisms, such as *Didemnum* sp. in Drake's Estero (Bullard et al. 2007). Another consideration is that almost all of the species currently farmed are non-indigenous species; *Mytilus galloprovincialis*, the bay mussel, is considered highly invasive around the world and has been shown to displace native congeners in California (J. Shinen, pers. comm.). This species was imported to mussel farms in Tomales Bay in the 1930's, and is so widespread in that body of water that mussel farmers have stopped seeding their equipment and instead rely entirely on larval recruitment from established feral populations.

The Pacific oyster, *Crassostrea gigas*, is native to Japan, as are Manila clams (*Tapes philippinarum* or *Venerupis philippinarum*). The European oyster, *Ostrea edulis*, is native to most of Europe, and the Eastern oyster, *Crassostrea virginica*, is native to the East Coast of the United States. All of these species are cultured in Tomales Bay. Shipments of non-indigenous oysters have historically contained numerous associated non-indigenous species, some of which have had serious negative impacts on native species. In the NCCSR, the non-indigenous mud snail *Batillaria attramentaria* was introduced through non-indigenous oyster shipments and has led to a serious decline in a similar native species, *Cerithidea californica*, due to exploitative competition (Byers 1999). Likewise, two oyster drills, *Urosalpinx cinerea* from the Atlantic coast and *Ocinebrellus inornatus* from Japan, have been inadvertently introduced with non-indigenous oysters along the Pacific coast, where they consume not only the introduced oysters, but native (and relatively rare) Olympia oysters as well.

References

Bertin, X. and E. Chaumillon. 2006. The implication of oyster farming in increasing sedimentation rates in a macrotidal bay: the Marennes-Oleron Bay, France. Cah. Biol. Mar. 47: 19-22.

Bullard, S.G., G. Lambert, M.R. Carman, J. Byrnes, R.B. Whitlatch, G. Ruiz, R.J. Miller, L. Harris, P.C. Valentine, J.S. Collie, J. Pederson, D.C. McNaught, A.N. Cohen, R.G. Asch, J. Dijkstra, and K. Heinonen. 2007. The colonial ascidian Didemnum sp A: current distribution, basic biology and potential threat to marine communities of the northeast and west coasts of North America. J. Exp. Mar. Biol. Ecol. 342: 99-108.

Dawes, C.J., J. Andorfer, C. Rose, C. Uranowski, and N. Ehringer. 1997. Regrowth of the Seagrass *Thalassia testudinum* into propeller scars. Aquat. Bot. 59: 139-155.

De Casabianca, M.-L., T. Laugier, and D. Collart. 1997. Impact of shellfish farming eutrophication on benthic macrophyte communities in the Thau lagoon, France. Aquacult. Int. 5: 301-314

Dixon, J. 2007. Effects of oyster mariculture on the natural resources in Drake's Estero. California Coastal Commission memorandum: Sept. 11.

Forrest, B.M. and R.G. Creese. 2006. Benthic impacts of intertidal oyster culture with consideration of taxonomic sufficiency. Env. Mon. Assess. 112: 159-176.

Kelly, J.P., J.G. Evens, R.W. Stallcup, and D. Wimpfheimer. 1996. The effects of aquaculture on habitat use by wintering shorebirds. Cal. Fish Game 82: 160-174.

Stillman, R.A., A.D. West, R.W.G. Caldow, S.E.A. Le V. Dit Durell. 2007. Predicting the effect of disturbance on coastal birds. Ibis 149: 73-81.

Suryan, R.M. and J.T. Harvey. 1999. Variability in reactions of Pacific harbor seals, *Phoca vitulina richardsi*, to disturbance. Fish. Bull. 97: 332-339.

Wechsler, J.F. 2005. Assessing the relationship between ichthyofauna and oyster mariculture in a shallow coastal embayment, Drakes Estero, Point Reyes National Seashore. M.S. Thesis, Department of Geography, University of California at Davis.

Weis, J.S. and P. Weis. 1992. Transfer of contaminants from CCA-treated lumber to aquatic biota. J. Exp. Mar. Biol. Ecol. 161: 189-199.

Weis, J.S. and P. Weis. 1996. The effects of using wood treated with chromated copper arsenate in shallow-water environments: a review. Estuaries 19: 306:310.

Zieman, J.C. 1976. The ecological effects of physical damage from motor boats on turtle grass beds of southern Florida. Aquat. Bot. 2: 127-139.