

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

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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 *Ocenebrellus 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.

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California Marine Life Protection Act Initiative
Mariculture Leases and Methods in the MLPA North Central Coast Study Region
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Lessee	Lease Data			Species		Cultivation Methods				
	Total Lease Acreage	Estimated Acreage in Use	Area of Lease	Approved Species	Species Cultured **	Racks	Scattered Bottom Bags	Longline Bottom Bags	Floating Bags	Longlines (mussel)
Charles Friend	62	10	Tomales Bay	Pacific oyster	Pacific oysters					
Cove Mussel Company	10	10	Tomales Bay	Pacific oysters; bay mussels	Pacific oysters; bay mussels	X				X
Hog Island Oyster Company	300	110	Tomales Bay	Pacific, European, and Eastern oysters; Manila clams; bay mussels	Pacific, European, and Eastern oysters; Manila clams; bay mussels	X	X		X	
Point Reyes Oyster Company	92	10	Tomales Bay	Pacific, European, and Eastern oysters; Manila clams; bay mussels; rock scallops	Pacific, European, and Eastern oysters; Manila clams; bay mussels	X	X	X	X	
Tomales Bay Oyster Company	156	60	Tomales Bay	Pacific, European, and Eastern oysters; bay mussels	Pacific, European, and Eastern oysters; bay mussels	X	X	X	X	
Drakes Bay Oyster Company	1060	100	Drake's Estero	Pacific oysters; littleneck and Manila clams	Pacific oysters, Manila clams	X	X	X	X	

* Data in this table is updated information from Table 21 of the California Marine Life Protection Act Initiative's *Regional Profile of the North Central Coast Study Region (Alder Creek/Point Arena to Pigeon Point)*, October 8, 2007

** Only Hog Island Oyster Company actively cultures bay mussels; other growers glean feral mussels from oyster growing equipment