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Impact of seafarming: Fish farms vs. mussel farms

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Impact of seafarming: fish farms vs. mussel farms

Solid waste production

Intensive fish culture such as for salmon produces solid wastes, including uneaten feeds, feces, and smaller quantities of fish scales, mucus and other detritus. Fish feed wastage is 1-5% for dry feed, 5-10% for moist feed and 10-30% for wet feed or trash fish. Feed losses from cages is greater than in land-based tanks and ponds. Fish feces are the second largest source of solid wastes in fish farms. An estimated 25-30% of the dry weight of consumed feed is voided as feces. The wastes can amount to 820 kg dry solids per ton of fish in freshwater sites. No estimates are available from marine fish culture other than for salmonids (see box next page). Wastes from farms using moist or wet feed may be greater than in those using dry feeds.

Mollusc farming also produces solid wastes -- organic feces, pseudofeces, shells and other detritus -- although amounts are smaller than from fish culture. A typical oyster raft containing 420 000 oysters produces 16 tons dry weight of feces and pseudofeces. A significant proportion of mollusc solid waste is intercepted and consumed by epifauna living at the farm.

Water flow and sedimentation

Mariculture structures can impede water flow and modify the sediments, particularly in the intertidal zone. Accumulation of silt and erosion of the bottom have been noted beneath oyster racks and mussel poles in France. However, offshore hanging culture has lesser effects. Fish culture is unlikely to cause similar effects, because nets are flexible, permeable and normally positioned above the sea bed.

Sedimentation rates vary with current speed. Sediments accumulate at low-speed sites, but the effects are usually limited to near the farm within about 50 meters.

Sedimentation affects the productivity of the bottom-dwelling organisms and increases the oxygen consumption. If the additional oxygen demand exceeds oxygen supply, both the natural populations and the fish farming operation suffer. Below salmon cages, such effects range from undetectable in well-flushed locations to severe. However, the solids from below cages may be carried to and accumulated in other locations.

In the absence of oxygen, hydrogen sulfide, ammonia and methane are generated within the sediments and may be released to the water column. Ammonia levels below freshwater fish cages may be 3x higher than in unfarmed areas. About 65-82% of nitrogen waste is discharged directly in the water column; the rest comes from sediment nitrogen.

There have been several reports of outgassing of hydrogen sulfide and methane from sediments below marine cages. Hydrogen sulfide is highly toxic to fish, causing gill damage and death. Incidence of diseases in Japanese yellowtail farms have been correlated with sulfides in sediment. Greater problems occur in farms located in sheltered, poorly flushed, and shallow waters.

Effect on native bottom fauna

The sediments and the fauna under and around fish and mussel farms may be classified into zones:

- Azoic zone — if present, usually restricted to sediments directly below the cages
- Opportunistic zone — normally restricted to the immediate vicinity of the cages up to 30 meters from the site.
- Return to background — normally at 30 meters away from the farm, but sometimes at 100 meters.

Below salmon net cages, extreme organic enrichment reduces the numbers of molluscs and crabs. It is interesting to note, however, that commercial catches of crustacean have improved in the vicinity of cage operations in the USA.

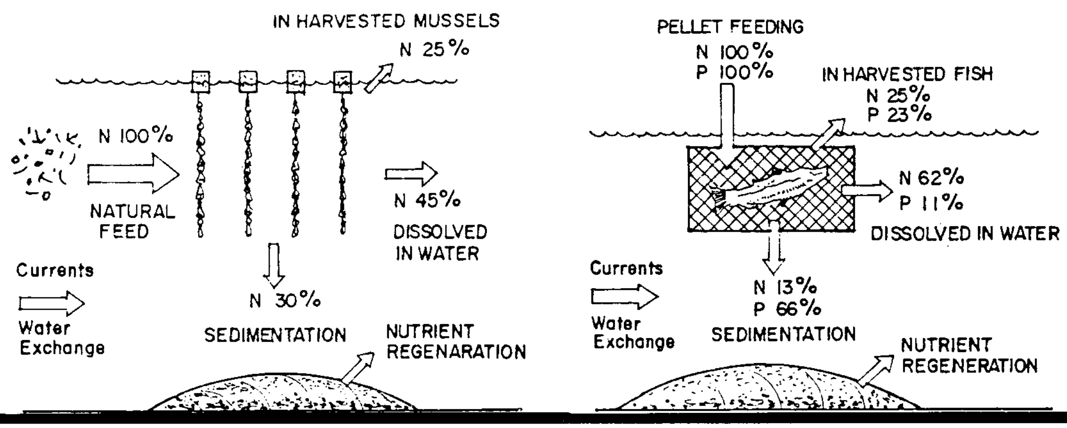
The effects of mussel farms on the bottom organisms are similar to those under salmon cages but are generally less severe. Within 6-15 months of mussel farming, brittle stars, bivalves, and sea urchins disappear from below the farm and are replaced by opportunistic polychaetes typical of organic enrichment. The affected area may extend 20 meters beyond the farm. Communities below the mussel rafts consist typically of a few kinds of pollution-resistant animals such as polychaetes and nematodes. Thus, both salmon farming and mollusc farming may result in the loss of native fauna.

Benthic communities will return to normal after the source of organic enrichment has been removed. The rate of return is site-specific. Disappearance of the actual wastes may be quicker than benthic recovery. Benthic oxygen consumption returns to normal within 2 months of the removal of salmon cages, and deposits disappear within 4-6 months. Physical changes in the seabed take longer to reverse.

Further readings:

(1) N de Pauw and J Joyce (eds.). 1992. **Aquaculture and the Environment**; Reviews of the International Conference AQUACULTURE EUROPE '91; Dublin, Ireland, 10-12 June 1991. European Aquaculture Society Spec. Publ. No. 16. Ghent, Belgium.

(2) DP Weston. 1991. The effects of aquaculture on indigenous biota. In: DE Brune and JR Tomasso (eds.). **Aquaculture and Water Quality.** South Carolina, USA, World Aquaculture Society. Advances World Aquaculture 3: 534-567.



Mussel culture represents a self-regulated natural system. It does not need feed since mussels live on plankton naturally occuring in the water. The net effect is that nutrients are removed from the environment.

In contrast, fish cage culture is a strongly man-regulated system that needs large inputs to function, both from the economy and the ecosystem. It requires artificial feeds that contribute to organic enrichment.

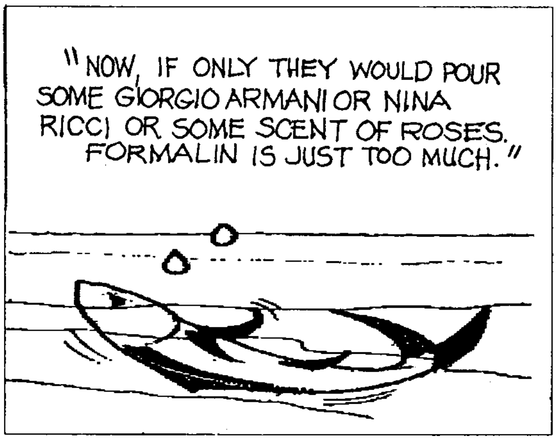
In general, the more a culture system resembles a natural ecosystem, and the less subsidized it is by inputs of energy and manpower, the less serious the effects on the environment.

Source: N Kautsky and C Folkė. 1990. *Environmental and ecological limitations for aquaculture.* p. 245-248. In: R Hirano and I Hanyu (eds.). **The Second Asian Fisheries Forum.** The Asian Fisheries Society. Manila.

Effects on wild fish populations

It is inevitable that some of the farm stock escape. Fish escape through nets damaged by predators, floating objects, or rough weather. In this way, a foreign or exotic species is introduced to an environment. In a lake in Poland, an estimated 4 tons of trout escaped in one year. There are many records of the impacts of escaped or deliberately transplanted fishes on indigenous fish stocks. These include the extermination of local fishes through predation or competition, interbreeding with native fishes and adulteration of the genetic pool, habitat destruction, and the outbreak of disease epidemics.

Diseases. The large stocks in aquaculture can harbor and foster disease agents. Diseases can easily be introduced by seed from other areas in the country, or by fish imported without proper precautions. Recent surveys have shown that the numbers and species of parasites in wild fish differ markedly from expected. Although some parasites may have been imported, others may have been present in wild fish but only reached abnormal numbers under overcrowded conditions and after the environment changed with the introduction of cages. Little is known about the transmission of parasites from cage to wild fish, or vice versa. Caged fish in several farms have become severely infested with cestodes, resulting in heavy mortalities. Those infections were traced to wild fish populations carrying the parasites.



Predation. Cages and pens act as magnets to many kinds of fish-eating fishes, reptiles, birds, and mammals. Many of these species are also attracted by the feeds at the farms.

Damage to nets by unsuccessful predators such as birds, turtles, monitor lizards, and rats has been reported from several cage farms. Predation on wild fish may increase through the attraction of predators to the farm site. Another serious, although as yet little studied, impact of the immigrant predator population, is their contribution to disease. Certainly, birds and mammals play important roles in the life cycles of many parasites and other disease agents. For example, birds act as intermediate host for the nematode *Contracaecum,* and fish-eating mammals such as the otter act as final host for the digenean *Haplorchis,* both common parasites of tilapia.

Toxic chemicals and drugs

The use of chemicals and drugs to control disease is not widespread in cages. Water flow can rapidly dilute the chemical used and render the treatment ineffective. The addition of large amounts of chemicals to compensate for losses can make the treatment too costly.

Many farmers enclose cages in polythene sheets during treatment, or transfer diseased fish to an especially modified enclosure to minimize loss of chemicals. Both are labor-intensive. Thus, chemicals are employed much less frequently in sea farms, and the addition of foreign substances to the sea is small.

Source: MCM Beveridge. 1984. *Cage and pen fish farming, carrying capacity models, and environmental impact.* **FAO Fisheries Technical Paper**: 255.

Multi-use conflict

Multi-use conflicts surrounding aquaculture in the marine environment take as many forms as there are vested interests. In the Bay of Fundy in Canada, for example, the steady expansion in number and size of salmon farms

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has irritated some upland owners and navigational and recreational interests. Most of the heat has come from the fisheries industry, which includes herring, lobster, scallop and some groundfish. The latter three involve vessels of various size that require access to fishing grounds that -- some claim -- are being pre-empted by salmon cages with their extended mooring systems.

Source: ***World Aquaculture***, Vol. 21 (2), June 1990.

In Laguna de Bay in the Philippines, about 70,000 fisherfolk dependent on the lake are losing their livelihood. The introduction of fish pens in the lake and its expansion beyond legal limits have displaced the fisherfolk. "Piracy" in the lake has also driven the fishermen away from the fishing grounds. There are reported thefts of fish nets, motor engines, and catch. With the loss of capital, it is difficult for the fisherfolk to start operations again. The Cavite-Laguna-Rizal Fishermen Federation are looking into land-based livelihood projects to ease the plight of the fisherfolk.

In the next few years, the government's Metropolitan Waterworks and Sewerage System will tap the lake for potable water to supply the growing Rizal and Cavite population. Tied to this plan is the closure of the Napindan hydraulic control structure to prevent seawater from entering the lake. The fisherfolk object to this since seawater backflow maintains the lake's primary productivity, which supports the fishing grounds. Aquaculture and the industries in the lake watershed also contribute to water pollution (see separate story, this issue).

Source: ***The Manila Chronicle***, 28 Mar - 3 Apr 1992.

The potential negative interaction between aquaculture and traditional fisheries in Canada

Fishery	Competition for space	Operational interference	Regulatory conflict
Herring (weir and shutoff)	Conversion of weir sites to aquaculture may cause loss of capacity in weir fishery Limitation of number and size of aquaculture sites by weirs Restricted movement of weirs in response to changes in fish distribution	Physical blockage of fishways Exudates, noise and light may influence or deter fish movement	Inconsistencies created by two levels of government regulations in the same area (leasing and licensing) Maintenance of capacity in traditional fishery Strategy for conversion of one use to another
Lobster, scallop dragging	Loss of area available for fishery	Bottom deposition may reduce habitat Potential accumulation of additives, eutrophication, loss of spawning or nursery areas	As above
Clam		Deposition of exudates on clam flats	As above
Herring seining, groundfish dragging	Loss of area available for fishery	Obstacles to normal fishing patterns	

Source: World Aquaculture, Vol. 21 (2), June 1990.