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Re: Shellfish aquaculture presentation to the Sierra Club, November 19, 2009.

Dear Bill and Robin:

Thank you for your presentation on shellfish aquaculture in Washington State. Like you, we support limiting upland development, eliminating sewage outfalls and septic problems, and we support clean water. We are also open to the use of shellfish for habitat restoration but this letter does not address restoration.

The Sierra Club strives to review information from all stakeholders and scientific resources, and develop a position that balances interests while protecting our natural resources. Our aquaculture team has discussed your presentation in depth, reviewed the information you sent along with other information from your industry, and have the comments outlined as follows.

Comments Related Specifically to Your Presentation

Shellfish as a food source: Your presentation pointed out that shellfish are a food source, which of course we would agree. We would suggest that shellfish are generally a premium luxury food and not a staple food of the same magnitude as wheat, apples or soybeans. As a point of comparison, six medium oysters contain about the same protein as one large egg according to most sources of this information. Six oysters retail for about five or six dollars, while one egg retails for about 22 cents – a significant difference of about 95 percent. Shellfish are generally available in premium restaurants, and not widely available in most grocery stores. The high price of geoduck in Asian markets appears to stem from the cultural perception related to the geoduck’s appearance, and perhaps to a lesser extent to its flavor and texture, rather than to its actual food or nutritional value.

The report *The World Geoduck Market and the Potential for Geoduck Aquaculture on Washington State Lands* prepared for DNR by Northern Economics Inc., 2004 states that

> *"...geoduck is a super luxury item which only the rich can afford. The product's price in the Chinese market can reach $60. to $100. per pound. If the price of the product were to fall by 50 percent, it will still be out of the price range of most of the population."*

Another important difference that contrasts terrestrial farming with shellfish aquaculture: shellfish culture obviously takes place in the aquatic and intertidal environments, which are very important ecosystems in a number of ways. The Shoreline Management Act states: *"Legislative findings set out in RCW 90.58.020, that the shorelines of our State are the most valuable and fragile of its natural resources and that it is of great concern to all throughout our State relating to its utilization, protection, restoration and preservation."*

The Nearshore Partnership states that nine out of ten species listed as threatened or endangered in the Puget Sound region rely on the nearshore. The nearshore is also much more limited in scope than the terrestrial. The waters of the State and the resources in those waters are public property, plus the public has *jus publicum* rights in the intertidal, whether public or privately owned, through the Public Trust Doctrine established under the Equal Footing Doctrine at statehood.

Bush/Callow Acts: Your presentation states on page 2: *"In Totten Inlet, the State of Washington transferred 30 miles of tidelands to shellfish farmers over 75 years ago, for the express purpose of farming shellfish".* This is somewhat technically incorrect. These tidelands were conveyed by the state for the purpose of oyster culture only. The tidelands were commonly referred to as "oysterlands", and were originally only used for oysters. As you know, the state did this to try to revive the oyster industry after the native Olympia oysters had been harvested to near extinction. We do not agree that the state was intending to create the situation we have now in Totten Inlet, where over 90 percent of Totten has now been converted to aquaculture, mostly geoduck in the intertidal, utilizing PVC pipes, nets, oyster bags, mussel rafts, etc. This is not comparable in any way to the situation there 75 years ago.

Monterey Bay Seafood Watch: On page 3 and 4 of the presentation, The Monterey Bay Seafood Watch is promoting mussel and oyster aquaculture as environmentally sound. Seafood Watch lists are normally basing their ratings on general industry information and not the more current industrial methods or scales of operations. Monterey Bay is not addressing the fact that the severities of ecological impacts are fundamental to the locations and techniques. Are they aware that the shellfish industry has previously removed eelgrass, microalgae, sand dollars and other organisms from intertidal areas, and covered large areas of intertidal substrate with plastics and nets? They do not appear to understand geoduck aquaculture, nor have they likely seen eagles caught in predator exclusion nets. In addition, it is interesting to note that the Monterey Bay Seafood Watch only includes "wild caught" geoduck and does not consider farmed geoduck as acceptable.

NOAA and USFWS: On page 5 of your presentation, the following statement is made: *"Extensive review by NOAA and USFWS both Biological Opinions conclude existing shellfish farming activities will not jeopardize listed species".* Our review of the NOAA NMFS biological opinion is not in agreement with this. The biological opinion does state that existing aquaculture is not likely to result in any take, (harass or harm) of an individual endangered salmon. However, the opinion:

- Initially found that existing shellfish aquaculture is likely to adversely affect endangered Puget Sound Chinook salmon, but later changed this position due to uncertainty (page 3).

- The opinion states that the Army Corp of Engineers determined that existing shellfish aquaculture activities would generally not adversely affect critical habitat (CH), but would adversely affect essential fish habitat (EFH) (p 1), including EFH for groundfish (p 17).

- Both the NMFS (p 72, 85) and ACOE (p 1) concur that the action would adversely affect EFH.

- The opinion states that the proposed action is likely to adversely affect CH for Puget Sound Chinook salmon (p 25). Conversely, the opinion also states that the action will not appreciably reduce the conservation value of designated critical habitat in general. (p 57).

- According to the NMFS opinion, the BRT (biological review team) majority opinion is that the naturally spawned component of Puget Sound Chinook is likely to become endangered within the foreseeable future. The number two limiting factor is the degradation and loss of estuarine habitat (p 21).

In sum, the biological opinion states that existing shellfish aquaculture is likely to adversely affect critical habitat for endangered Puget Sound Chinook salmon and Hood Canal Summer run Chum salmon per the Endangered Species Act. The opinion also states that existing shellfish aquaculture is likely to adversely affect essential fish habitat for all fish species per the Magnuson Stevens Act. Since the activities are damaging to the habitat, then this would jeopardize listed species.

Another potential problem is the imminent listing of Puget Sound Rockfish, which is undergoing a DEIS at this time. Rockfish rely on a functioning intertidal ecosystem for juvenile rearing. Part of the efforts for Rockfish restoration will involve habitat restoration, including restoring eelgrass and other native aquatic plants.

Environmental Defense and Pew: On page 6, you quoted from Environmental Defense and Pew. We also offer several quotes from those same publications:

- *"Aquaculture is commonly presented as a clean industry. Nevertheless, intensive (densely stocked) aquaculture systems can produce large quantities of polluting wastes, as with other forms of intensive animal production."* [1]

- *"New diseases and parasites can be spread by the introduction of new stocks of non-native and native fish for aquaculture. For example, the Japanese oyster drill and a predatory flatworm were introduced with the Pacific oyster and have contributed to the decline of native West Coast oyster stocks."* [2]

[1] Environmental Defense Fund, 1997, Murky Waters, Environmental Effects of Aquaculture in the U.S.
[2] ibid.

- *"U.S. aquaculturists are increasingly using "lethal controls" for predatory birds. According to U.S. Fish and Wildlife Service (USFWS) data, between 1989 and 1993 more than 51,553 birds representing 38 species or groups were killed at U.S. aquaculture facilities under legal permits. Some experts speculate that many more birds were killed illegally."* [3]

- *"Aquaculture facilities constructed or operated without environmental protection in mind can cause serious environmental degradation..."* [4]

- *"In some instances, mollusk farming has harmed the marine environment by depriving wild filter feeders of food (FAO, 1991) and generating anoxic sediments through feces deposition."* [5]

Clam Filtration: Page 7 of the presentation is a short video of clams filtering the water. Is this video originally from Roger Newell? If so, we would like to see this video again showing the bio-deposition (feces/pseudofeces) accumulating in the bottom of the tank. Page 8 also points out the filtering of shellfish, but these quotes are not specific to Puget Sound. DNR states that the filtering capacity of native geoducks harvested from sub-tidal areas (up to 4 million pounds annually) are insignificant in terms of filtering. There are studies suggesting that unnatural densities of shellfish can consume too much phytoplankton, along with zooplankton, crab zoeas and fish eggs, thus endangering other species.

Shellfish Gear as Habitat: Page 9 refers to shellfish gear as being better than eelgrass as habitat according to literature by DeAlteris. Andrea LaTier, fisheries biologist with USFW, addresses this precisely in the USFW biological opinion starting on page 21:

> 4.7.9.1 Aquaculture Structures as a Surrogate for Eelgrass Beds
>
> According to the literature (Everett et al. 1995, p. 205; Everett et al. 1995; Carlton et al. 1991; Pregnall 1993; Peterson et al. 1987; Waddell 1964; all as cited in Landry et al. 2006, p. 98) there is a reduction in density and abundance of eelgrass associated with shellfish aquaculture plots. However, it has been suggested by some that this loss is not significant to the functioning of the intertidal community, because the physical structures supporting shellfish aquaculture (including the shellfish themselves) provides equivalent ecological functions to eelgrass beds. We reviewed the literature to determine if this supposition is borne out by observations in the field.
>
> DeAlteris et al. (2004) compared modified rack and bag shellfish aquaculture gear (SAG) submerged aquatic vegetation (SUV) and nonvegetated seabed (NVSB). Specifically, they compared habitat structure in terms of emergent surface area (cm2) per m 2 of seabed, species abundance and richness on a seasonal basis between eelgrass, oyster cages and unvegetated substrate (DeAlteris et al. 2004, p. 869). They found that species abundance was significantly greater on the SAG than the SAV and NVSB (DeAlteris et al. 2004, pp. 869-870).

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[3] ibid.
[4] ibid.
[5] Grant et al., 1995; Kaspar et al., 1985). Pew Oceans Commission, 2001, Marine Aquaculture in the United States, Goldburg.

Although DeAlteris et al. (2004) found a significant difference in species abundance between SAG, SAV and NVSB, there was no significant difference in species diversity. In fact they point out that although species abundances may be greater in the SAG it is dominated by few species (DeAlteris et al. 2004, p. 873). It is clear that SAG, at least large structural gear such as rack and cage culture, provides habitat for large numbers of organisms. However, the community attracted to these structures was dominated by a few species while the SAV supported a more equal distribution of organisms. Therefore, although SAG provides similar habitat functions to SAV for some species, it may not, at least according to this study, satisfy the habitat needs of as great an assemblage of species as SAV.

Dumbauld et al. (2009, p. 18) present a summary of the literature describing the role of shellfish aquaculture as structured habitat for fish and invertebrates. They point out that the majority of studies investigate the role of natural assemblages of shellfish rather than aquacultural settings. In these studies oysters and mussels form 3-dimensional reefs that moderate water flow allowing colonization of algae and invertebrates and providing refugia and food resources. In most cases however, in standard aquacultural settings, shellfish are suspended or planted directly on the substrate and not allowed to form 3-dimensional reefs. Therefore, their role (particularly nonnative species) in providing habitat should not be inferred from the studies of bivalve reefs (Dumbauld et al. 2009, p.18).

Pinnix et al. (2005) compared fish use between oyster longline culture areas, eelgrass, and mudflats in Humboldt Bay, California. They caught 49 fish species representing 22 families using six different types of capture gear. Depending on the capture gear type, species diversity was either greater in oyster long-line plots or in eelgrass. Clearly, there were gear type influences on the species collected (Pinnix et al. 2005, pp. 17, 19). While it is apparent that oyster long-line plots provide some of the same habitat functions as eelgrass, it is unlikely that they provide the same nursery functions. To the best of our knowledge, no one has evaluated juvenile fish use of eelgrass versus aquaculture plots.[6]

Shellfish aquaculture plots also attract less mobile species as well. Suspended aquaculture (oyster long-line and rack culture, mussel rack culture) provides habitat for a group of organisms which make up what are termed fouling communities. Fouling communities consist of algae (red and brown), tunicates, sea squirts, annelids, mollusks and other sessile species. O'Beirn et al. (2004, p. 827) examined the species assemblage associated with floating mussel rafts. They consisted of worms, crabs, tunicates, sponges and fishes. No copepods, gammarids, or other prey species common to the eelgrass food web and important in the diets of forage fish and juvenile salmonids were listed. However, the mesh size of the collection baskets was larger than these microinvertebrates. Therefore, they may have escaped collection.

It is unlikely that these fouling communities and the species they attract provide the same trophic function that eelgrass beds provide to juvenile salmonids and forage fish. The species composition of these fouling communities is substantially different than the eelgrass community depicted in Figure 4.19 (eelgrass food web). According

[6] A study was done in Willapa Bay to determine whether juvenile Chinook preferred eelgrass, oyster clusters, or cord grass. The study found that juvenile Chinook were only attracted to eelgrass. See Semmons B.X. 2006

to McKindsey et al. (2006, p. 29) "…with respect to the infaunal and epifaunal organisms associated with bivalve culture, the installation acts more or less like a normal benthic hard-bottom community, what we refer to as a "pelagic hard-bottom community." Other authors also describe the conversion of the area under floating structures from soft bottom to hard bottom communities, and they note that hard bottom communities are more productive (Kaspar et al. 1985; Ricciardi and Bourget 1999; Cusson and Bourget 2005; Iglesias 1981; Chesney and Iglesias 1979; all as cited in McKindsey et al. 2006, p. 35). This may indeed be the case when the comparison is made between un-vegetated soft-bottom communities and hard-bottom communities. Eelgrass beds growing in soft bottom substrate such as sand or mud support a different biotic community than the benthic hard-bottom community mentioned above. The productivity of eelgrass beds is widely understood, leading to its preservation, conservation and restoration according to the Washington Administrative Code.

When comparing long-line mussel beds, un-vegetated sandy bottom substrate and eelgrass, Clynick et al. (2008, p. 207) found large difference in the fish and macroinvertebrate assemblages between mussel plots and eelgrass. Clynick et al. (2008) observed that a number of other species of fish, including the white hake (U. tenuis), and Atlantic herring (C. harengus), were also almost exclusively present in eelgrass beds "suggesting that these species also have specific habitat requirements that seagrass beds provide and that are not mimicked by suspended mussel culture sites."

Some farming practices appear to provide some habitat function for fish and sessile species. These include long-line culture and raft, rack and cage culture. Long-line culture provides some habitat for adult demersal fishes and macrophytes. Aquaculture apparatus that forms a 3dimensional structure (rack, raft and cage) provides significant surface area for colonization of sessile species, pockets of refugia for small fishes, and food resources. However, there tends to be high numbers of individuals from few species associated with this type of gear.

A UW progress report observes "*direct negative effects of disturbance and of geoducks on eelgrass*" and "*little evidence of indirect positive effects of geoducks*" on eelgrass. [7]

We have some concerns with this false assumption that shellfish gear is equal to or superior to eelgrass or unstructured habitat; or that it functions as an artificial reef. This is dangerously misleading, because it can lead to the mistaken idea that shellfish gear or artificial reefs actually function as breeding, spawning or rearing habitats. These structures can attract some species of fish into unnatural densities, thereby exposing them to increased fishing pressures or unnatural additional predation pressures.

From the Georgia Straights Alliance:

"Reefs attract sea creatures, but don't necessarily cause an increase in living matter. And there may be some environmental harm." [8]

[7] Sally Hacker, OSU, and Jennifer Ruesink, UW, 2005.
[8] Bill Summers, Oceanography Professor at Western Washington University. http://www.georgiastrait.org/?q=node/604

From the Oceans Conservancy:

> *"Although most artificial reefs offer potential habitat for certain kinds of marine life, these are not always happy homes. Artificial reefs can cause damage to natural habitats during their construction and can displace naturally occurring species and habitats. They also tend to concentrate fish unnaturally, making them more vulnerable to overfishing. In some cases, they introduce toxins and other pollutants into the ocean."* [9]

Newsweek:

> *"Ultimately, artificial reefs are no replacement for natural ecosystems*." [10]

Predator Exclusion Nets: On predator exclusion nets, Heather Deal from the David Suzuki Foundation states: "Making changes to existing states of ecosystems must be avoided, especially when those ecosystems have not been highly altered in the past." "Nets change beach dynamics by preventing natural movement of substrate by waves and wind. Nets encourage algal growth, which alters beach nutrient levels. Nets with algal growth shade substrate, affecting the benthic community below. Use of anti-predator nets should be minimized or eliminated."

Thousands of dead herring were trapped in predator exclusion nets from Denman Island, 3 photos documented below:

[9] http://www.oceanconservancy.org/site/PageServer?pagename=issues_artificialreefs
[10] Jack Sobel, director of conservation science and policy at the Ocean Conservancy. http://www.newsweek.com/id/142534

Benefit to Birds: Page 12 of the presentation relates to benefits to birds. Below, we provide a quote from the recent study by California Fish and Game:

> "Our results suggest a net decrease in *total* shorebird use in areas developed for aquaculture." [11]

[11] California Fish and Game, Effects of Aquaculture on Habitat Use.

Eagle trapped in North Bay geoduck netting:

Another trapped eagle picture can be seen at http://www.caseinlet.org/uploads/Aquaculture-Eagle_Seattle_Shellfish_Nets-Henderson_Bay_1_.pdf

We have seen several letters from citizens that document additional eagles trapped in predator exclusion netting, suggesting that the picture referenced during your presentation was not an isolated incident. We can document 5 individual cases of eagles trapped in predator exclusion nets in South Puget Sound at present.

List of Environmental Impacts Not Addressed by Shellfish Industry Documents, Websites

While we recognize that you had a limited time for your presentation, we did not find where your presentation or the information submitted addressed the following environmental or social impacts that are well documented in scientific reports:

1. Limited native species habitat (coves, bays, pocket estuaries) converted to perpetual aquaculture on a permanent basis with no expansion limits in any of the shoreline designations, including natural areas.
2. Planted densities that are significantly greater than natural shellfish densities in expansion areas that create unnatural competition for space with wild benthic organisms.
3. Extensive use of invasive species as defined by the scientific community, such as Pacific oysters and Gallo mussels that threaten natural ecological functions.
4. Industrial or intensive scale techniques that are replacing more traditional sustainable practices.
5. Clearing methods of nearshore rocks, wood and vegetation that are essential fish habitat.

6. Dredging, liquefying, dragging of nearshore tidelands and thus altering natural ecological functions.
7. Removal of wild populations of targeted species (clams, geoducks) to prepare the aquaculture site for commodities resulting in a single monoculture.
8. Elimination of Puget Sound native species such as Dungeness crabs, red rock crabs, starfish, moon snails and various fish that are considered to be predators.
9. Increased suspension of sediments, release of nutrients resulting in turbidity/siltation that adversely impacts fish and other native species.
10. Elimination, altering and disruption of aquatic organisms that are essential to nearshore ecological functions.
11. Alteration of the hydrodynamic regime (current speed, turbulence).
12. Food web effects: Competition with other filter feeders for phytoplanton and zooplankton (Ecological carrying capacity), increasing recycling speed of nutrients, removal of eggs and larvae of fish and benthic organisms that are consumed by cultured bivalves.
13. Feces and pseudofeces from high densities of shellfish in low current areas overwhelming the natural functions in the sediments.
14. Nitrification and depletion of oxygen below and down current of rafts from dense hanging mussels and scallop lines in low flushing embayments.
15. Use of nets that restrict feeding of native species, entangle aquatic life and serve as a matrix for fouling organisms that interfere with natural processes.
16. Destruction of eelgrass beds and impairment of expansion of existing beds.
17. Disturbance of native and migratory bird feeding, rearing and breeding areas.
18. Disturbance and alteration of forage fish spawning and rearing habitat.
19. Cleaning of nets/gear, use of chemicals that destroy natural algae, fish eggs and other marine matter that would normally be attached to natural beach substrate and debris.
20. Introduction of tremendous amounts of PVC plastics that are not designed for exposure to wind, waves and UV, and that are known to leech dioxins over time as they wear down.
21. Use of pesticides and herbicides applied to control burrowing shrimp, "pests" and Spartina grass. Utilizing unemployed citizens to hand dig the Spartina would be financially and environmentally responsible.
22. Increased levels of noise that disturbs native species, birds and adjacent residents.
23. Increased light that disturbs native species, birds and adjacent residents.
24. Recognition of the economic value of Puget Sound natural resources for all of the various Puget Sound stakeholders.
25. Commercial privatization of shorelines and waterways protected by the Public Trust Doctrine and the Shoreline Management Act.

Conclusion

Given that shellfish industry expansion is aimed at our most limited pristine nearshore habitat areas and the industrial practices are increasing, we cannot support your expansion plans or many of your current practices. We continue to stand by our policy and actively support aquaculture regulation, clean water efforts, sustainable building practices, adequate shoreline buffers and the retention of trees and riparian vegetation throughout Puget Sound. A balanced approach must include improved water quality, habitat and native species protections in order to achieve a healthy Puget Sound. As additional studies become available, please feel free to send them to us for review.

Sincerely,

Elaine Packard
Chair, Water and Salmon Committee
Sierra Club Cascade Chapter