CENTER FOR FOOD SAFETY

MARCH 2016 FACT SHEET

WORKERS AND PLASTIC GEAR AT SHELLFISH GROWING OPERATION IN ED INLET | COALITION TO PROTECT PUGET SOUND HABITAT

SHELLFISH AQUACULTURE IN THE PACIFIC NORTHWEST

For all of human history, we have been eating shellfish (bivalves like clams, mussels, and oysters and crustaceans like shrimp and lobster), and until recently we relied on wild populations of shellfish harvested from coastal areas. However, due to pressure from human harvest and other environmental impacts, the wild shellfish populations are dwindling, particularly wild bivalves. Shellfish producers are increasingly turning to aquaculture, the farming of aquatic organisms, to supply our increasing shellfish demand. In the U.S., the vast majority (by weight) of saltwater aquaculture consists of shellfish, largely clams, oysters, and mussels. The value of shellfish sold in the U.S. in 2013 was over $413 million.[1] Some view shellfish aquaculture as less environmentally damaging,[2] or even environmentally beneficial.[3] However, as shellfish aquaculture becomes increasingly industrialized several concerns have emerged.[4] This fact sheet will focus on the farming of bivalves (clams, oysters, and mussels) in the Pacific Northwest.

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SHELLFISH FARMING IN THE NORTHWEST

On the West Coast, sales of farmed mollusks (i.e. clams, oysters, mussels) topped $176 million in 2013, with Washington supplying about 85% of that value.[5] Shellfish aquaculture in Washington is not new—people have been farming shellfish in Washington for 150 years, and it is the nation's leading shellfish producer. Much of Washington's shellfish aquaculture takes place is Willapa Bay and Grays Harbor, in the southwest portion of the state, but operations in Puget Sound have expanded greatly in the past few years.

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OFF-BOTTOM SHELLFISH GROWING EQUIPMENT, INCLUDING GEODUCK PVC TUBES IN HENDERSON INLET | COALITION TO PROTECT PUGET SOUND HABITAT

HOW ARE SHELLFISH FARMED?

COMMERCIAL SHELLFISH FARMING involves preparing the ocean bed where shellfish will grow, seeding those shellfish, and then eventually harvesting when they are fully grown. Bivalves are either grown on the ocean floor (tide bed) or they are grown off the ocean floor using a variety of methods. Growing shellfish directly in the tide bed is the closest to how wild oysters and clams grow. On the other hand, growing shellfish off the ocean floor requires the use of cages, rack-and-bags, trays, surface or floating structures, or long lines suspended over the tide bed. These methods all involve gear, often plastic, that must be purchased and maintained. Geoducks, a type of clam, are often grown in the substrate, but using polyvinyl chloride (PVC) tubes stuck into the bed. To prepare the tide bed, growers may "harrow" (using an oversized rake over the tide beds), till, or add crushed oyster shell or gravel to the ocean floor. Once the shellfish are fully grown, harvesting may be done using hand rakes, hydraulic harvesters, or mechanical harvesters. In Washington, the acreage used for shellfish farming has increased in the last 10 years (about 14% to 15,283 acres), while the number of farms has contracted from 175 to 128[6] as small scale farms are replaced by larger-scale industrial operations.

Growing shellfish off the tide bed includes the use of various gear, mostly plastics. Above: Oyster "long line" suspension over tide bed in Willapa Bay, WA. Below: Geoduck polyvinyl chloride (PVC) tubes stuck in tide bed in Totten Inlet, WA.

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WHAT ARE THE ENVIRONMENTAL IMPACTS OF SHELLFISH FARMING?

THE TIDELANDS WHERE shellfish are farmed are home to a variety of fish (including endangered salmon), invertebrates (including native shellfish), birds, and sea grasses. Eelgrass in particular is a highly valued source of shelter and food for these species, and serves as an "ecosystem engineer" by slowing water flow and binding and stabilizing sediments. As a plant, eelgrass also absorbs CO_2 and increases oxygen in the water.

As the production of shellfish in Washington intensifies, more of the natural tidelands are being converted to shellfish production. Often, this farming involves the addition of plastic gear to grow shellfish above the tide bed, as well as plastic anti-predator nets to protect the growing shellfish. The plastic gear used is often dislodged in storms, and may be left derelict on beaches. While wild bivalves are known to clean water, the water quality impacts of intensive shellfish aquaculture may not always be beneficial; in fact, many aquaculture activities negatively affect water quality by the removal of eelgrass, the increase of wastes from concentrated production, and the disruption of sediments. One of the most significant potential environmental impacts from dense shellfish aquaculture is a reduction in shoreline biodiversity. Monocultures of shellfish can fundamentally alter ecosystems by consuming nutrients previously relied on by native species, depositing waste on the seabed, and changing the physical dynamics of an environment.

The use of anti-predator netting excludes native species from their essential tide bed habitat. Left: A juvenile bald eagle is caught in an aquaculture net on Harstine Island, WA. Right: A crab is excluded from its habitat by an aquaculture net.

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PESTICIDES IN SHELLFISH FARMING

PESTICIDES (including herbicides and insecticides) are designed to harm or kill living things, and are widely used in conventional land-based agriculture to kill weeds and insects. However, pesticides do not only kill the target pests, they also contaminate soil, air, and water, harming wild and native species. The same is true for pesticide use with aquaculture, and the use of insecticides and herbicides on tide beds to assist shellfish farming is particularly concerning for these impacts to the biodiversity and health of tidal ecosystems.[7]

While rarely used in other locations, certain synthetic chemical pesticides are allowed and increasing in Washington. While pesticides are not allowed in Puget Sound, growers in Willapa Bay and Grays Harbor have been using carbaryl since the 1960s to control native burrowing shrimp, which loosen the substrate and cause bivalves to sink and suffocate when present in high numbers. Carbaryl, an insecticide known to cause acute and chronic neurological problems in humans, was phased out recently due to a settlement between the Willapa Grays Harbor Oyster Growers Association (WGHOGA) and environmental groups.

To replace carbaryl, the growers have selected imidacloprid, a neurotoxin insecticide in the neonicotinoid family—the insecticides known to be extremely harmful to pollinators like honey bees.[8] Imidacloprid is not approved for use in water anywhere else in the county, and water contamination by neonics is a growing problem for all types of aquatic wildlife.[9] While the Washington State Department of Ecology initially issued the Willapa Bay growers a permit to spray imidacloprid, public outcry in 2015 (especially by prominent chefs in Seattle) lead the largest shellfish company, Taylor Shellfish, to pull out, and eventually the remaining growers followed suit.[10] However, some Willapa growers have recently renewed their application to use imidacloprid to kill burrowing shrimp.

The growers in Willapa Bay and Grays Harbor also have a permit to spray imazamox, an herbicide, to kill non-native eelgrass, which impedes clam growing and harvesting. Although not native, this type of eelgrass has long grown on much of the West Coast and provides many of the same food, shelter, and habitat functions as native eelgrass. These pesticides do not only kill the target shrimp and non-native eelgrass—they also harm other invertebrates living in the substrate, fish, native eelgrass, and the species that rely on them for food and shelter.

Pesticide use in Willapa Bay and Grays Harbor to kill burrowing shrimp and eelgrass adds to the contamination of the water and substrate, which can harm non-target organisms. Above: A high pressure pesticide injector on shellfish bed. Below: Aerial pesticide spraying on shellfish beds.

Polyvinyl chloride (PVC) plastic tubes like those pictured here are used, along with plastic netting, to exclude predators from geoduck beds and increase early survival. PVC has a toxic lifecycle and like other plastics used, such as high density polyethelene (HDPE), it may leach contaminates and break down into tiny particles.

WHAT ARE THE PUBLIC HEALTH CONCERNS?

Because bivalves filter the water, they ingest whatever pollutants or other substances are present. This may include bacteria, viruses, or toxic algae, which can cause food poisoning (if consumed raw), bacterial infections, and in rare cases, death.[11] Recently, the Washington Department of Fish & Wildlife studied the uptake of toxic contaminants in near-shore mussels in the Puget Sound.[12] Focusing on contaminants from terrestrial sources, the study found PCBs, DDTs, PAHs (from fossil fuels), and PBDEs (or flame retardants) in mussels from every site studied. Mussels are used to study contamination levels precisely because they, like other bivalves, concentrate pollutants. Other contaminants in the ocean include microplastics (tiny particles of plastic from degraded larger pieces or manufactured that way for various consumer products). Microplastics are known to absorb chemical contaminants from the water, acting as poison pills to the organisms that ingest them. Filter feeders like oysters, clams, and mussels are also ingesting these microplastics.[13] This means it is particularly important to limit terrestrial sources of water pollution to protect shellfish grown for human consumption.

A REGENERATIVE WAY

Shellfish farming does not have to go the way of industrial land-based farming. Some growers use methods that mirror the natural ecosystem with encouraging results.[14] Growing shellfish directly on the tide bed and foregoing the use of plastic gear and pesticides allows a variety of native species to flourish alongside shellfish (and saves money on gear and maintenance). Some believe that using off-bottom methods like long-lines actually traps sediment, leading to the muddy conditions that encourage burrowing shrimp, so eliminating these methods allows the tide bed to return to its natural state. To combat existing burrowing shrimp, some growers use mechanical methods (like harrowing) to draw out shrimp for consumption by their natural predators: fish, including valued species like salmon and herring. By using methods that harmonize with nature, some growers have been able to control and work around shrimp and eelgrass without resorting to toxic chemicals. Regenerative farming methods also allow native and migratory species to access the essential tide lands and lead to a healthier shellfish product.

The shellfish operation pictured here in Grays Harbor was once overrun with burrowing shrimp. Without the use of any pesticides, the grower was able to return it to a healthy, bio-diverse, and productive oyster bed.

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[1] USDA, Census of Aquaculture (2013), http://goo.gl/Pe44ht.

[2] Madeleine Thomas, *Half Shell Hero*, Grist, http://exp.grist.org/oysters.

[3] *See e.g.* http://pcsga.org/ecosystem-services/.

[4] The Coalition to Protect Puget Sound Habitat, *The Social and Environmental Impacts of Industrial Aquaculture in Washington State*, http://goo.gl/jj4zTm.

[5] *Supra* note 1 at 46.

[6] *Supra* note 1 at 15.

[7] *Supra* note 4; *see generally* CFS Pollinators & Pesticides Reports, http://goo.gl/neyPSy*; see also* EPA Preliminary Pollinator Risk Assessment for Imidacloprid, http://goo.gl/GxdmSx (EPA will release risk assessment for impacts to other aquatic and terrestrial species in December 2016).

[8] *Id*.

[9] CFS, *Water Hazard: Aquatic Contamination by Neonicotinoid Insecticides in the United States*, http://goo.gl/KKpHu2.

[10] WA Dep't of Ecology, http://goo.gl/cp5rBX.

[11] *See generally* WA Dep't of Health, http://goo.gl/UvhhOz.

[12] WDFW, *Toxic Contaminants in Puget Sound's Nearshore Biota* (2014), http://goo.gl/XWZMyC.

[13] Kieran Mulvey, *Oysters Are Munching Our Microplastics*, Discovery News, http://goo.gl/hJn5Ov.

[14] Sandi Doughton, *Back to the drawing board for control of oyster-killing shrimp,* Seattle Times (Aug. 10, 2015), http://goo.gl/JqKQeI.