State of the North Sound and Straits

A Report from RE Sources and the North Sound Baykeeper

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WATERKEEPER ALLIANCE MEMBER

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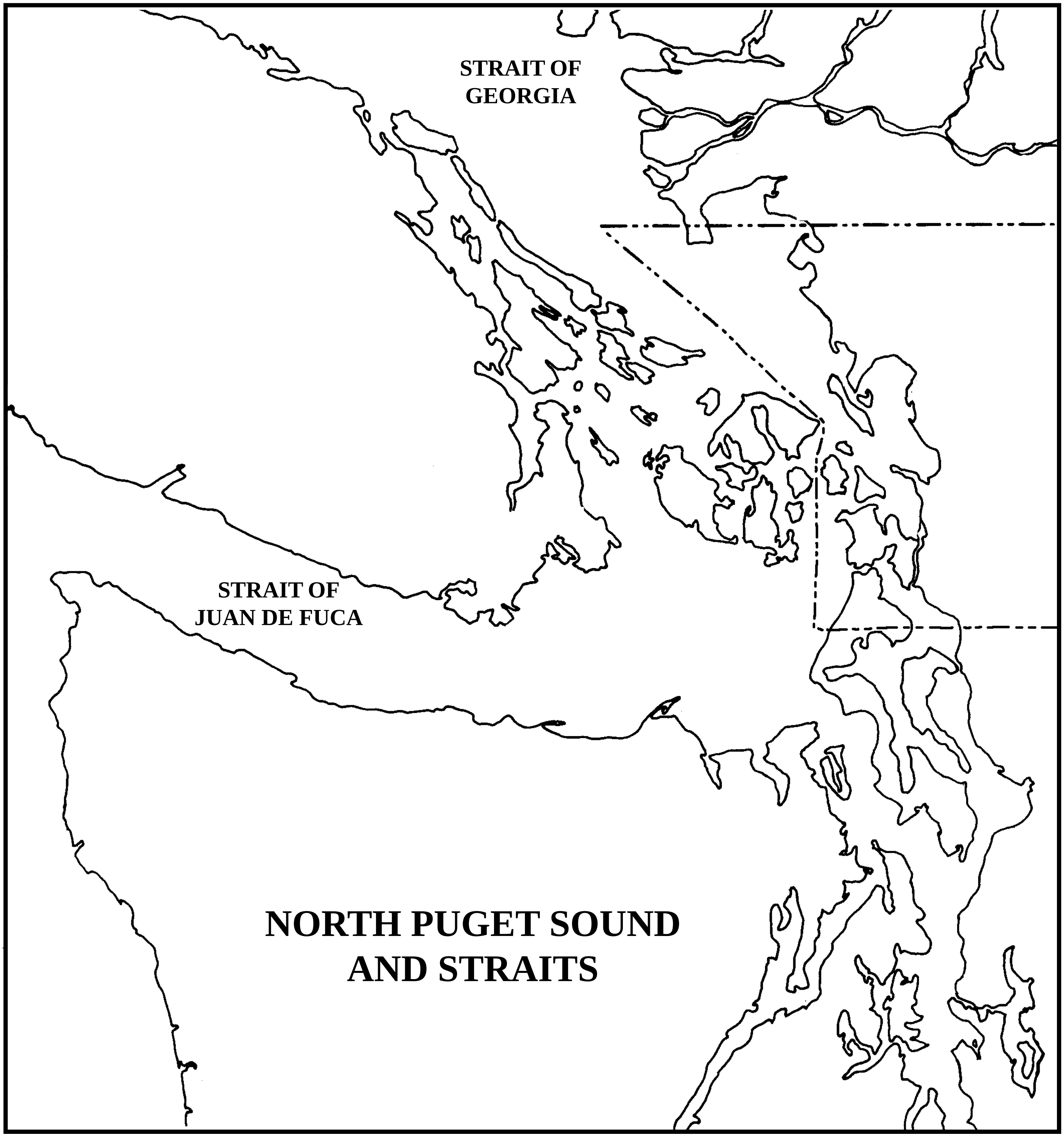


STRAIT OF
GEORGIA
STRAIT OF
JUAN DE FUCA
NORTH PUGET SOUND
AND STRAITS

State of the North Sound and Straits

"To stand at the edge of the sea, to sense the ebb and flow of the tides, to feel the breath of a mist over a great salt marsh...is to have knowledge of things as nearly eternal as any earthly life can be."

– Rachel Carson

The marine waters of northern Puget Sound and Georgia Strait are a diverse ecosystem, rich in beauty and abundant with life. Deep inlets, gravel beaches, mudflat estuaries, bull kelp forests and eelgrass beds are just a few of the various habitats found in this complex waterway. Rocky shores make excellent homes for an assortment of intertidal life. The deep, open waters of the Straits provide rich feeding and breeding grounds for marine mammals and bottomfish. The estuaries, where freshwater meets the sea, offer protected rearing areas for young organisms such as juvenile salmon. But this vital ecosystem is threatened. Dwindling stocks of forage fish, bottomfish, and salmon, as well as declining populations of seabirds and marine mammals, all point to the failing health of these waters. Closures of recreational and commercial shellfish beds, the degradation and losses of eelgrass and kelp beds and other critical marine habitats are warning signs that the protection and restoration of this amazing ecosystem is necessary if we are to share these wonders with future generations.

Many people place tremendous value on the waters of the Sound and Straits. However, these same people also place great stress on this marine environment. Shoreline development and the subsequent loss of habitat; increased runoff from residential, industrial and agricultural practices; and increases in sewage and other sources of waste all pose threats to these fragile waters. As more and more people are attracted to the beauty of the area, negative impacts to our waters increase, and the future of the north Puget Sound and Georgia Strait ecosystem remains in jeopardy.

These human impacts paint a picture of a diverse marine ecosystem in trouble. But just as we have the power to destroy this precious place, we also have the strength and ability to protect and restore our aquatic environment. The beauty and health of the north Sound and Straits in the future will depend upon our willingness to manage our own behavior today.

In this report, we present an overview of the ecosystem of the northern Sound and Straits and endeavor to assess its health. We discuss the open waters, nearshore areas and shorelines of the waters of northern Puget Sound, from the south end of Whidbey Island north to the Canadian border. This includes the U.S. portion of the shared waters of the Strait of Georgia, which reaches into Canada[1] .

We endeavor to present the status of ecosystem health from two different angles: the status of key species and habitats, and total pollution discharges.

The Status of Key Habitats and Species:

We will explore the various species that play pivotal roles in the ecosystem. We'll learn a bit about the species' natural history and the role that it plays in the ecosystem. Each of these key species will then be assigned an overall health indicator:

Ecosystem Health Ratings

= *Healthy and Thriving*: This habitat or species is in great condition and little needs to be done aside from continued care and protection.

= *Outlook Good*: If we are careful, responsible and respectful, this habitat or species could reach healthy and thriving status in the future.

= *Fair:* There is work to be done by all if we are to save this habitat or species from further declines.

= *Serious Trouble*: We will need to act fast and work hard to make up for past actions that have had negative impacts.

= *Critical*: If we don't take strong actions now, we may lose this habitat or species entirely.

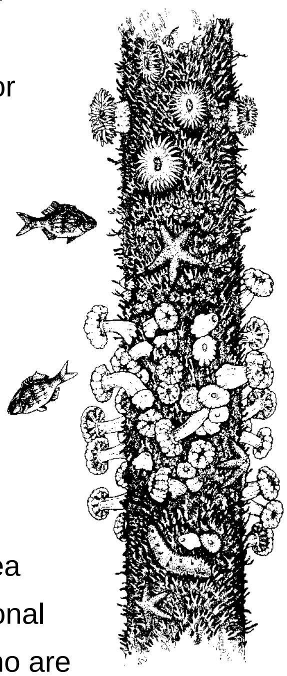
Add It Up: A Study of Pollution Discharges in the northern Sound and Straits:

In this section, we present the results of our *Add It Up* project, wherein we endeavored to tally up the total amounts of key pollutants discharged into area water bodies. This provides a different view of ecosystem health, based on toxicity. As well, it presents an intriguing and maddening view into the regulatory world.

[1] Note: In delineating the waters of Puget Sound, geographers point to the sheltered, inland waters that begin south of Whidbey Island and run south to the estuaries of the Deschutes and Nisqually Rivers. Common nomenclature includes the protected waters of coastal Skagit and Whatcom Counties as part of Puget Sound. From an ecosystem perspective, this is most probably correct. It is this broader definition that we use in this report, referring to this region as the north Sound.

In this rich marine ecosystem, one can find abundant and diverse aquatic life, including:

- More than 200 varieties of red, green, and brown macroalgae (seaweed) and several species of sea grasses;
- Over 2,900 different species of marine invertebrates;
- Over 220 species of fish, including eight species of anadromous fish;
- 116 species of marine birds, including major seasonal concentrations of shorebirds;
- Nine species of marine mammals who regularly inhabit the area with an additional 19 species who are occasionally seen in these waters;
- Octopi of impressive size are also common to these waters, as well as the largest member of the chiton family, found nowhere else in the world.



(Center for Marine Conservation [CMC], 1998)

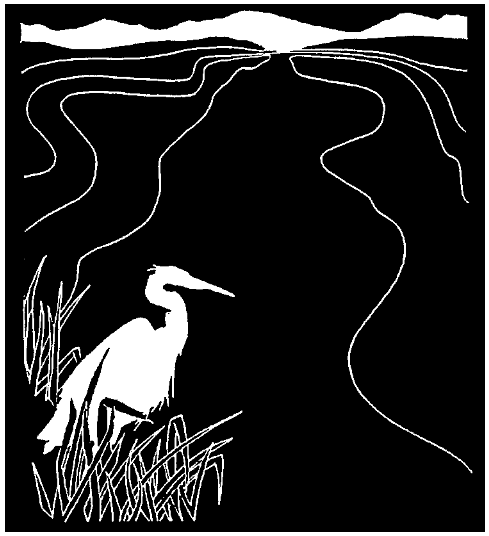
Linking Land and Water

The degradation of our lands and the pollution of our waters are widely recognized as environmental problems. Experts may disagree on the decline in water quality or the rate at which our soils are degraded, few will deny, however, that both are serious threats to a sustainable future.

A decline in the quality of land is often viewed in isolation from the decline in water quality. But, there is an intimate connection between the land and the water. The decline and degradation of our uplands starts a chain reaction with profound consequences for water quality.

Upland vegetation is critical to a healthy aquatic ecosystem, cleaning the air and water, providing protective cover to soils, slowing flood water, filtering pollutants, and contributing to overall biological integrity. As vegetation and soils lose their ability to buffer environmental impacts, water quality declines. Erosion increases, and runoff carries nutrients and contaminants to the water. Pesticides and fertilizers are applied to the land in order to make up for the losses in soil productivity caused by erosion, further increasing contaminant loading. This domino effect of environmental decay continues as wetlands and estuaries are degraded. Once the land is no longer fit to store nutrients, regulate water flow, or filter chemical and biological contaminants, water quality is compromised. Treating these symptoms separately causes us to lose sight of the land and water connection. Healthy uplands are the basis for a thriving aquatic environment.

Estuaries: Nurseries of the Sea



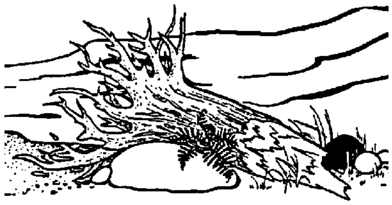
Estuaries are the richest and most productive areas of the coastal environment. They form where freshwater meets the sea. Typically, estuaries consist of mudflats and tidally flooded meadows with grasses, sedges, rushes, and even some wildflowers. However, estuarine scrub-shrub wetlands are now thought to be prominent links in a complicated ecological web. These habitats typically occur at slightly higher tidal elevations and serve as an upland transitional zone for vegetation. Willow, sweetgale, and Sitka spruce may dominate in these areas.

Migrating and native birds, salmonids, and a host of other animals converge at estuaries for the food, shelter, and protection they provide. In an estuary, grasses offer a place for young fish to hide, and insects, worms, and small invertebrates provide food for birds. The estuarine environment is especially valuable for young salmon. As juveniles, salmon migrate to brackish estuaries, where they feed primarily on zooplankton in and around eelgrass beds. Here, they gain the size and strength necessary for life in the open ocean. Young salmon also need the estuary to acclimate to the salt water environment. Upon reaching adulthood, they move out to open marine waters for three to four years to feed on plankton, fish and marine invertebrates.

When the flow of water and sediments is interrupted, the estuary is starved of its necessary building blocks. When such interruptions are permanent, such as channeling and hardening for shipping berths or diking for agricultural land, the estuary starves and begins to shrink. Over 80 percent of our estuaries have disappeared. Lost with them are important habitats and many of the species that can depend on them.

The Nooksack River, which drains to Bellingham Bay, represents one of the last unimpaired mudflat and saltmarsh estuaries in Puget Sound. In fact, the Nooksack River delta is the only major river delta in the Sound that is still growing.

Historically, the waters of the Nooksack flowed into both Bellingham and Lummi bays. In the late 1800s, a two-mile-long log jam diverted the flow of the river so that it all flowed into Bellingham Bay. This diversion was made permanent via a dike at the Lummi River in 1926. The Nooksack River carries a large load of sediment from the foothills of Mount Baker, through agricultural lands of its flood plain and finally to the sea. Annual deposits of 526,000 metric tons of sediment into the bay have caused the delta to extend more than one mile into Bellingham Bay since 1873. Sedimentation from the Nooksack River affects both natural and human systems in the bay. Natural systems are affected because the rapidly growing delta has not yet stabilized, allowing



Everything is Connected: Estuary Building Blocks

Many factors are necessary to build a thriving estuary. Sweetgale is the most common estuarine shrub today and is unique because of its ability to convert atmospheric nitrogen into nitrate (nitrogen fixation), an important nutrient for plants. Because of its nitrogen-fixing ability, sweetgale is a preferred food source for many plant-eating animals. As well, many tiny insects feed on the decomposing leaves of sweetgale. Such insects, in turn, provide food for juvenile salmonids in estuarine marshes. Sweetgale offers food and habitat to beavers in the estuary. In turn, beaver ponds provide havens for small fish, such as juvenile salmon, where they can feed and rest. Without these ponds, the fish would be forced into larger, wider, and deeper tidal channels where they would become vulnerable prey to larger fish and waterfowl not found in the ponds. Sweetgale thickets bordering and hanging over the channels help keep out wading predators, such as great blue herons.

Large woody debris is also a crucial player in the tidal marsh. It provides shelter for salmon. These large logs are also very important to the presence of sweetgale and allows them to grow at lower elevations in the estuary by providing small islands of elevated logs upon which the shrub can grow.

Sweetgale is not the only shrub or tree that uses large logs as substrate upon which they can grow. Where do these important logs come from? This is where the linkage between land and water becomes critical. Through careful study, the Skagit Systems Cooperative has concluded that these large logs do not come from the spruce trees common in the South Fork tidal marshes, but from outside the estuarine marsh, from coastal or riverine forests. This implies that management of these forests has significant consequences for the vegetation composition of estuarine tidal marshes, and for the distinctive ecological functions that vegetation provides, such as protecting juvenile salmon and providing habitat for beavers.

(Adapted from an article written by W. Gregory Hood, PhD, in Skagit River Tidings 2002 Newsletter)

for the development of a range of estuarine vegetation that provides important feeding and rearing habitat for a variety of organisms. Human systems are affected because sedimentation along the industrial waterfront interferes with navigation.

By contrast, the Skagit River delta has lost the majority of its estuarine habitat. Historically, the river flowed through approximately 25,766 acres of tidally influenced wetlands. By the 1880s, however, estuarine areas were already being diked to drain the land for agricultural use. Today, estimates are that the Skagit has lost more that 23,825 acres of estuary habitat – a loss of 93%. (People for Puget Sound, 2001).

The Skagit once hosted some of the largest salmon runs in Puget Sound. The extreme loss of estuarine habitat in what is the largest watershed draining to the Sound has had profound implications for chinook salmon. This salmon species relies heavily on the estuary, spending up to a month in the estuary before heading out to sea. Loss of this important transitional habitat has been implicated in the decline of chinook populations throughout the Sound.

Restoring this watershed's estuary will be a challenging endeavor. Much of the land in the former delta is in private ownership, making any sort of restoration project expensive, given the purchase costs. As well, without a continual flow of water, sediment, and woody debris into the estuary, restoration efforts will meet with marginal success. Restoration efforts will have to look upstream into issues surrounding forest management, farming, and residential development.

In addition to the two major river deltas discussed above, many small rivers and streams drain to the marine waters of the north Sound and Straits. These small creeks and their estuaries are vital links in the nearshore ecosystem. Their estuaries are especially important to a variety of salmon species, such as coho, pink, chum, and steelhead salmon, as well as coastal cutthroat trout, that rely on small streams or spend large amounts of time in the estuary. Additionally, the small estuaries provide habitat connectivity for migrating salmon as they migrate in and out from the sea. As with the larger estuaries, these smaller deltas are also important breeding and feeding habitat for a variety of other species.

There are 25 year-round streams between the Skagit River and the border, each with its own small estuary that existed historically. Some of these creeks still have most of their original estuary intact, but most have seen their deltas impacted by human activity, such as channeling, dredging, diking, or even culverting right at the outflow. Other deltas in Whatcom and Skagit counties have been altered due to upland activities. Forestry, agriculture, and development activities (sometimes in combination with one another) can result in increased sediment loads in streams and their estuaries. Conversely, other river deltas have been starved of necessary sediment and nutrients as the land is increasingly covered with impervious surfaces. Paving increases the volume and flow of these small creeks while removing the slow addition of sediment needed to maintain the delta.

Estuary Habitats Health Rating:

Nooksack River Estuary:

Outlook Good: The Nooksack River delta is not the thriving system it could be because it has not stabilized. But the delta is undeveloped and, perhaps with a little help, could become a showpiece estuary.

Skagit River Estuary:

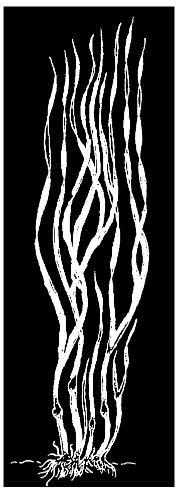
Fair: The Skagit has lost 93% of its estuary. Restoration efforts are underway, but they are confounded by the high amount of property in private ownership.

Small Estuaries:

Fair: the small estuaries are in mixed condition. While a few are relatively healthy, most have been degraded to some extent. These smaller drainages may, however, be easier to address due to their smaller scale.

Marine Vegetation

The marine environment is rich with vegetation that provides the basis of the marine food web. Not only does it provide food for many marine organisms, but marine vegetation provides refuge and rearing habitat, as well as habitat for many commercially and recreationally significant species. While there are over 200 varieties of macro-algae (seaweed) and sea grasses in area waters, we'll focus on two cornerstone species: eelgrass and kelp.



Puget Sound is home to approximately 26,000 acres, or almost 41 square miles, of **eelgrass**. Eelgrass is a true flowering vascular plant that supports a wide diversity of aquatic organisms. This important grass grows in the intertidal and shallow subtidal zone in depths of up to 22 feet deep. Eelgrass meadows provide a home for many small organisms at the base of the food chain and are optimal spawning habitat for Pacific herring. These meadows provide protective cover for migrating salmon and other marine life, as well as critical winter feeding habitat for birds and ducks. Brant, for example, depend on eelgrass beds for feeding grounds during migration and travel from extensive beds in Alaska to Padilla Bay every winter (Boulthuis, 2002). Eelgrass is also extremely important in absorbing the impact of waves and currents, thus preventing coastal erosion and stabilizing shorelines.

In Whatcom County, fifty-five percent of our shorelines have nearshore eelgrass. Fifty-one percent of Skagit County's shores also host eelgrass (Puget Sound Water Quality Action Team [PSQWAT], 2002). The most extensive eelgrass meadows in the area are found in Padilla Bay. The extent of eelgrass in the bay was mapped in 1989. At that time, Padilla Bay held 7,900 acres of eelgrass, making it the second largest continuous meadow of eelgrass of the Pacific coast (Boulthuis, 2002). Current acreage is assumed to be the same, since no major marine development projects have been allowed in the area for the over the last 20 years (Pentilla, 2002).

Eelgrass beds throughout the rest of the state have not fared as well. Washington State has lost an estimated 33 percent of its eelgrass beds (Washington Department of Fish and Wildlife [WDFW]). Bellingham Bay has lost fifty percent of its eelgrass as a result of dredging and filling (Department of Natural Resources, 2000).

Bull kelp is one of the largest seaweeds in the world and can grow up to 70 feet in one growing season.
(Lichen, 2002)

Large **kelp** beds are often referred to as "forests." Similar to their terrestrial counterparts, kelp forests have tall plants that form a canopy, with understory plants that grow beneath. The canopy layer of a floating kelp bed is formed by two species – giant kelp and bull kelp. These plants have float-like structures to hold the upper portion of the plant at the surface and a small "holdfast" that anchors the plant to the sea bottom. Other kelp species dominate the understory level, providing a dense layer of vegetation used as shelter for small invertebrates and larval fishes, including various species of forage fish and rockfish.

In Skagit County, 38 percent of the shoreline is home to floating and non-floating kelp. Twenty five percent of Whatcom County's shorelines host various kelp species. Extensive kelp beds are also found in the San Juan Islands. (PSQWAT, 2000)

Kelp populations in the Northwest vary from year to year. While the overall numbers seem stable, some local losses have occurred. For example, historically a large kelp bed flourished north of Protection Island National Wildlife Refuge. In 1989, there were 181 acres of kelp in this area, but by 1997 the kelp had completely disappeared. The reason for this relatively sudden shift in habitat type is unknown. (PSQWAT, 2000)

Threats to marine vegetation:

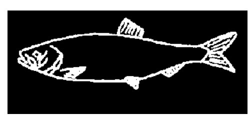
Human influences such as sewage and fertilizer runoff are major threats to marine vegetation. Fertilizers promote the growth of algae in the water. This algae reduces the amount of sunlight that can reach kelp and eelgrass. Excess nutrients can also cause algae to grow on eelgrass leaves, again reducing the amount of sunlight that reaches the plant. Herbicides and pesticides used for the control of unwanted plants and invertebrates can kill or damage marine vegetation, while boat propellers can also destroy kelp beds and eelgrass meadows. Rising ocean temperatures, oil spills, and chemical contamination also negatively impact marine vegetation.

Perhaps the most destructive impact to marine vegetation is the industrial, commercial, and residential development that continues to exert pressure on shoreline areas. Dredging sediment for navigation can destroy marine vegetation, while shoreline construction and nearby logging increases erosion and clouds the water and limits photosynthetic activity. Structures built over the water, such as industrial and residential piers, can prevent marine vegetation from getting the sunlight they require for growth.

Marine Vegetation Health Rating:

Outlook Good: Although losses have occurred, eelgrass meadows and kelp beds in north Puget Sound and the Straits seem to be doing well. There is a growing awareness of the importance of these habitat types, and more emphasis is being placed on maintaining and restoring these key vegetative types.

Forage Fish



Forage fish, such as Pacific herring, surf smelt, and Pacific sand lance, serve as prey for a wide variety of larger fish, marine mammals, and seabirds, while providing a valuable indicator of the health and productivity of our marine environment. Forage fish are popular as recreational fishing bait and are also important to commercial and subsistence fisheries. The habitats that forage fish use, such as eelgrass beds and rocky and sandy beaches, are designated as a critical resource by the state of Washington.

Pacific herring are a vital part of Puget Sound's food web, as they comprise some 71 percent of the diet of lingcod, and 62 percent of the diet of chinook salmon. Many other species in the Puget Sound food web feed heavily on herring, including coho salmon, Pacific halibut, and a number of seabirds and marine mammals. At least 20 stocks spawn in the Puget Sound area, depositing their eggs on intertidal and shallow subtidal eelgrass from late January through early June. (WDFW, 1997)

"When a unique population is in trouble that's always cause for concern; when that stock is a key link in the Puget Sound food web we feel even more urgency."

– WDFW Director Jeff Koenings, PhD, about herring at Cherry Point

While fluctuations in herring spawning stock sizes are normal, major stocks in the region are declining. Stocks that spawn at Cherry Point, north of Bellingham, Port Susan, and Discovery Bay, on the Strait of Juan de Fuca, are at historically low levels, and have been listed by WDFW as critical or depressed. (WDFW, 1997)

Surf smelt, another important forage fish, spawn year around on beaches on and around Whidbey Island, Camano Island, Fidalgo Bay, Birch Point, Cherry Point, and the islands (WDFW, 1997). Until recently, relatively little was known about these fish. The spawning behavior of the fish has only been understood by scientists for the last 20 to 30 years, and very little is known about the rest of the fish's lifecycle.

Surf smelt spawning habitat requires coarse sand and pea gravel beaches as well as a specific tidal elevation. In a unique event, surf smelt come up to the waters edge at highest tide. Several males will align themselves with one female, vibrating in unison, causing her to release her tiny eggs to the surface of the beach. The waves then gently cover the eggs with sediments. Over 200 miles of smelt spawning beaches are known to exist along Puget Sound. Many other beaches are assumed to have been used by these fish, but the extent of the loss of surf smelt spawning beaches is unknown. All known surf smelt spawning sites have been given "no net loss" protection by the state. (WDFW, 1997)

Pacific sand lance can also be found within Puget Sound, the Strait of Juan de Fuca and the coastal estuaries of Washington. Similar to the other forage fish, sand lance are a significant component in the diet of many economically important species of fish in Washington. The Washington Department of Fish and Wildlife estimates 35 to 60 percent of juvenile salmon diets are composed of sand lance (WDFW, 1997). In 1998, recognition of the important role of sand lance as forage and the lack of information on their abundance resulted in the Washington Fish and Wildlife Commission ending all commercial fishing for the species.

Threats to Forage Fish:

Habitat alteration is a major threat to all of the forage fish found in this region. Because they spawn in intertidal and subtidal habitats, these species are especially vulnerable to shoreline development. Commercial and recreational harvesting has also contributed to the decline in herring populations in north Puget Sound, while changes in water temperature, salinity, and dissolved oxygen can also negatively impact forage fish food supplies and increase the abundance of predators.

Forage Fish Health Rating

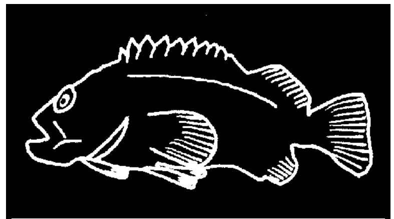
Serious Trouble: The sharp declines in Pacific herring stocks in north Puget Sound point to a species in trouble. Continual nearshore development has destroyed critical forage fish spawning habitats while past over-harvesting has led the WDFW Commission to end all commercial fishing of sand lance.

Bottomfish

True to their name, bottomfish live mainly on or near the bottom of the Sound and Straits. The most-well known groups of bottomfish include rockfish, lingcod, Pacific hake, and sole. Most bottomfish, especially lingcod and true cod, tend to be relatively long-lived and rather sedentary, often not straying far from their home territory. These traits, along with the fact that many species reach sexual maturity relatively late, make bottom fish species vulnerable to over-harvest and habitat destruction that may occur during drag-fishing and the construction of underwater structures such as pipelines.

Lingcod prefer rocky bottoms and reefs as their habitat. Because of their size and flavor, lingcod are considered a favorite among recreational fishermen. Currently, stocks of lingcod are considered very low, and the Department of Fish and Wildlife has listed lingcod populations in north Puget Sound as depressed.

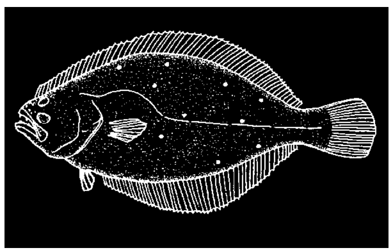
Various **rockfish** species can be found in rocky bottom and reef environments ranging from the shallow saltwater near shore to depths of over 3,000 feet. These fish do not lay eggs, but give birth to live young and reproduce year after year. Recent losses of larger-sized fish from rockfish populations in North Puget Sound has resulted in a 75 percent decline in their spawning potential since the 1970s (Eisenhart, 2002). Rockfish reach sexual maturity relatively late, ranging from four to 14 years, depending on the species. Losing the older females from the population results in a decrease in reproductive ability of the species as a whole that is greater than simply the number of fish taken. (Huhtala, 2002)



Rockfish are the elders of the West Coast fish society. Tests done on one rougheye rockfish revealed the fish was 205 years old. (Huhtala, 2002)

Like lingcod, stocks of rockfish are considered very low and have been listed as depressed by WDFW. A recent stock assessment indicates that the yelloweye rockfish population has declined over 80 percent from natural levels (WDFW) . Some of these populations have declined so much, that today even a one-fish-per-day catch limit may be unsustainable. Even so, these fish have been denied federal protection under the U.S. Endangered Species Act. The National Marine Fisheries Service (NMFS) claimed that Puget Sound populations are not distinct enough from relatives in other regions, however they did acknowledge the obvious changes occurring throughout the ecosystem leading to their sharp decline.

English sole stocks in Puget Sound and the Northwest Straits are also considered very low. Like other bottomfish, English sole feed in bottom sediment, and use nearshore habitats as nursery or breeding grounds. Because of their close proximity to human uses, nearshore habitats are often the locations where environmental degradation is the greatest. Many contaminants issuing from runoff and industrial sources tend to settle out of the water column, accumulating in the sediments where bottom-feeding organisms such as English sole are then exposed to them. Two recent studies have shown English sole from industrialized areas in Puget Sound take up and accumulate chemical contaminants, such as polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenols (PCBs) (Johnson, 1998 & Collier 1997). These studies present evidence of increased incidence of liver lesions and cancers, altered immune function and increased susceptibility to infectious disease[2].



Harvest of bottomfish has averaged around 70,000 pounds per year from 1995 to 2000. This harvest level is at the lowest it's been in 55 years, and today some bottomfish are estimated at only five percent their natural populations. These harvest levels are viewed by many as unsustainable, and WDFW is considering further restrictions. (WDFW)

"We've been harvesting groundfish faster than they can reproduce. . .Some very popular and valuable stocks, such as lingcod, are in poor condition in the ocean. Rebuilding them is going to take more sacrifices from fishers, processors and our coastal communities." (Phil Anderson, Pacific Fishery Management Council member and special assistant for Intergovernmental Affairs to Jeff Koenings, director of the WDFW).

Over-harvesting of another species of bottomfish, Pacific hake, led the state to close commercial harvesting in 1987(WDFW). Stocks of two close relatives of hake, Pacific cod and walleye pollock, have also declined to the point of a 'critical status' rating. Varying environmental conditions, such as changes in water temperature and marine mammal predation, may be contributing to the low stock numbers. Unsustainable harvest levels, however, have been the major factor in the decline of these bottomfish stocks.

Restrictions on harvest in order to help bottomfish species rebound have not yet led to successful recovery rates. This is probably because many of these species are slow growing and mature very late in their lives. Long-term restrictions on harvest of these bottomfish are necessary in order to give these slow-growing fish time to rebound.

Recognizing this issue and the relatively sedentary nature of these fish, many in the scientific and conservation communities are now exploring the efficacy of Marine Protected Areas (MPAs), or no-harvest zones, for species recovery. Research indicates that setting aside productive bottomfish habitat as protected serves an important role in species recovery. As the populations inside MPA boundaries grow, juvenile fish leave the MPA to establish their own territories, positively affecting population abundance in surrounding areas. This phenomenon has caused some to refer to MPAs as "nurseries of the sea."

2 For more information on the impacts of toxic substances on sediments and marine organisms, see the RE Sources report, *Toxic Legacy: Toxic Chemicals and Marine Life in Puget Sound* (2001).

Bottomfish Health Rating

Serious Trouble: Over-harvest has already almost completely depleted some rockfish stocks, while contaminated sediments contribute to the declining health of species such as English sole. Serious efforts must be made to bring regional populations of many bottomfish species back from the brink.

Salmon

Five species of salmon are native to the waters of Puget Sound: sockeye, pink, chum, coho, and chinook. In addition to playing a key role in both marine and freshwater ecosystems, Salmon are an integral part of north coast Indian culture and support our economy by providing jobs and recreation for fishermen throughout Washington.

Fluctuations in yearly catches caused by a variety of factors, such as changing ocean conditions, complicate but do not mask the overall decline of salmon populations in the region (CMC, 1998). As the situation becomes more critical each year, salmon have become symbolic in representing the decline in the health of aquatic ecosystems in the Northwest.

Currently, the Puget Sound chinook has been listed as 'threatened' under the U.S. Endangered Species Act. In the late 1970s, nine of 25 Puget Sound chinook stocks were in poor condition. Today, 22 of the 25 stocks fail to meet spawning goals. The chinook stocks from the Nooksack (north and south forks) are among the worst in the state. The Skagit River has also failed to meet spawning goals for several consecutive years. (WDFW, 1998)

Many factors have led to the salmon's decline. Logging results in increased siltation of streams and loss of important overhanging streamside vegetation. Dams block salmon from migrating upstream or harm salmon as they travel downstream towards the ocean, while road construction often creates impassable culverts and impervious surfaces. Water diversion from streams for use in agriculture, power generation, or as drinking water, has also severely impacted salmon runs.

Competing demands among commercial, tribal, and sport fisheries create pressures for an unsustainably high catch. As well, wild stocks of salmon face competition from the many salmon bred in hatcheries that compete for limited food and habitat in inland waters. Wild stocks and hatchery salmon also intermingle on their return home to spawn, resulting in the further decline of wild salmon stocks, as they are caught in the same nets as hatchery salmon and compete for limited migration corridors and spawning habitats.

Loss of marine habitat is another threat to salmon in the region. Some species, such as chum, require eelgrass for forage and protection. Shoreline development can destroy eelgrass and other essential habitat by altering the natural beach and creating deep water close to shore. Pollution from urban runoff, industrial and municipal wastewater, pesticide runoff, and household chemicals all degrade the water salmon rely on for spawning[3].

3 For more information on salmon habitats and life cycles, see the RE Sources report, *The Journey Home: Following the Path of Migrating Salmon in Whatcom County* (2000).

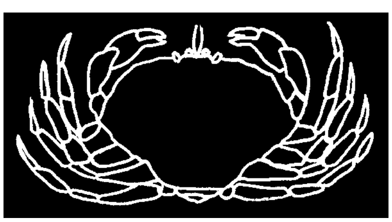
Salmon Health Rating

Serious Trouble: Many salmon stocks have already been listed as threatened. Habitat continues to be degraded and destroyed, while harvest rates are at unsustainable levels. Restoration efforts are promising, but only deal with small portions of the complex habitat needs of these anadromous fish.

Shellfish

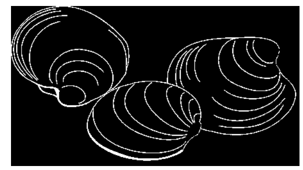
A diverse population of shellfish, including crabs, oysters, clams, and mussels, hold tremendous value in the area. Shellfish are an important economic resource, and occupy key ecological niches in marine and estuarine waters. Shellfish have long sustained native populations and helped to define local customs and cultures.

Dungeness crab can be found in kelp and eelgrass beds and on sandy or muddy substrates of the intertidal and shallow subtidal areas. This crab serves as both predator and prey in marine and estuarine waters and is food to many aquatic species such as salmon, halibut, octopus, and shorebirds and waterfowl.



This tasty and abundant crab is very popular among commercial and recreational harvesters. In Puget Sound, harvest has increased steadily from more than 2 million pounds in 1992-93 to a record 7.7 million pounds in 1999-2000. This large increase in harvest can be attributed to a growing number of recreational crabbers, easy access to crabbing areas, and the decreasing availability of other harvestable shellfish. (PSWQAT, 2000)

Despite increased harvest and sediment contamination in many areas, Dungeness crab populations in the region appear to be thriving. However, harvest pressures are sure to continue especially while many other species are in decline.



Clams, mussels, and oysters are also important resources in the Pacific Northwest. Puget Sound harvests make Washington State the largest producer of cultured clams and one of the top two producers of cultured mussels in the western United States. The oyster industry in the Sound is one of the two most significant sources of commercial oysters nationwide.

Unfortunately, this industry, along with the enjoyment of recreational shell fishers has been seriously impacted by fecal coliform contamination. Among the Sound's most contaminated sites for fecal coliform bacteria are Drayton Harbor, South Skagit Bay and Portage Bay, near the mouth of the Nooksack River. Since 1980, almost one quarter of the area available for commercial harvesting has been downgraded in classification because of bacterial contamination. These classifications are based on an examination of potential pollution sources and measured levels of fecal coliform bacteria in marine waters. This bacterial indicator reflects the presence of human or animal waste, potentially carrying disease-causing bacteria and viruses. (Washington Department of Health [WDOH], 2002)

In the year 2000, the entire embayment of Drayton Harbor was downgraded to Prohibited to Harvest due to poor water quality, and approximately 2,550 acres are currently closed to harvesting there. Portage Bay has been placed on the Department of Health's "threatened area list" due to fecal coliform pollution. Approximately 150 acres are currently closed to harvesting in Portage Bay. At Drayton Harbor, dairy and farm waste, sewage system leaks, contaminated urban stormwater and other non-point source pollution, as well as boat wastes and other activity in the vicinity of the Blaine Marina all contribute to fecal contamination. Major fecal contamination in Portage Bay can be attributed primarily to drainage from livestock operations along the Nooksack River. (WDOH, 2002)

In South Skagit Bay, nine of 14 shellfish growing stations have exhibited increasing levels of fecal contamination, and in Dungeness Bay on the Strait of Juan de Fuca, 11 of 13 stations are getting worse. These downgrades are due primarily to agricultural practices and septic system issues.

Shellfish are filter feeders, filtering many times their weight in water. With this capacity come significant problems when pollutants, such as heavy metals and bacteria, are present. Industrial pollutants, farm runoff, and septic system failures all pose a substantial threat to these shellfish populations. Increased urbanization and agricultural practices have had a detrimental effect on shellfish beds. Contaminated runoff from farms, streets, home landscapes and parking lots, as well as discharges from sewer and septic systems, all threaten the health of shellfish beds in the area.

Shellfish Health Rating:

Outlook Good: Many shellfish-growing areas are contaminated beyond state health standards, and increasing incidences of red tide and excess nutrients also negatively impact shellfish beds. But, this contamination does not appear to affect the health of the shellfish themselves – only our ability to safely eat them. However, in addition to making shellfish inedible to humans, fecal coliform contamination is an indicator of generally poor water quality. We'll need to clean up our act, but shellfish can thrive and we will once again harvest them.

Marine Mammals

Nine mammalian species are commonly found throughout the sheltered inland waters of the North Puget Sound and Strait of Georgia, along with some occasional visitors. (Shepard)

Cetaceans

orca whales, gray whales, minke whales,
Dall's porpoise, harbor porpoise,
humpback whales*(endangered species),
pacific white-sided dolphins*,
pilot whales*

Pinniped

harbor seals, California sea lions,
Stellar (Northern) sea lions,
elephant seals*

Mustelids

River otters, sea otters*

* Occasional visitors

Of the cetaceans in Puget Sound, **orcas** are the most well known. Both resident and transient populations can be found in area waters. Transient orcas feed predominantly on harbor seals and other large marine animals, while the diet of resident orcas consists primarily of salmon. Being top-level predators, orcas bioaccumulate fat-soluble toxins in their bodies. Blubber taken from orcas off the coasts of Washington and British Columbia was found to have very high concentrations of PCBs. The results of this study place area orcas amongst the most contaminated marine mammals in the world. This poses a serious threat when food supply is limited and orcas are required to utilize their fat reserves (Blue Voice, 2002). PCBs, and other fat-soluble toxins can weaken the immune system, cause skin diseases, reproductive failure, liver damage, nervous system disorders, and cancer.

Between 1995 and 2000 the number of resident orcas dropped by nearly 20%, from 98 to 78 individuals.

(Environmental News Service, 2002)

Orca populations are once again in serious decline. Between 1995 and 2000, the number of resident orcas of the inland marine waters of Washington and British Columbia dropped from 98 to 78 individuals. Scientists suggest a combination of factors have led to this precipitous decline, including dwindling salmon stocks, heavy boat traffic, and toxic contamination. (Shepard)

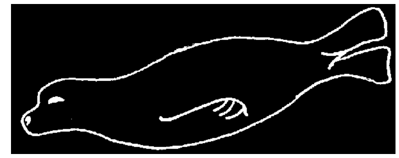
A petition for listing the South Puget Sound resident orca population under the Endangered Species Act was submitted to the National Marine Fisheries Service (NMFS), but was denied in July 2002. NMFS contended that it is an “insignificant” population and is instead considering listing the population as “depleted” under the Marine Mammal Protection Act (MMPA). This would provide less protection than a listing under the ESA. (Environmental News Service, 2002)

Dwarfing the orca, **gray whales** are the largest visitors to the region. They feed on bottom-dwelling crustaceans, small schooling fish, and ghost shrimp. Once hunted to near extinction, the gray whale population has rebounded, and evidence suggests there is now a summer resident population in Washington waters that forego the migration to the Bering Sea (CMC, 1998). Gray whales visit Chuckanut Bay, and have been sighted in Bellingham Bay in recent years (Anchor, 2000). The gray whales’ presence can be linked to the health of the marine habitat that produces their prey. Gray whales feed by diving to the ocean bottom and scooping up large amounts of sediments and bottom-dwelling organisms into their mouths. They then filter out the sediment through baleen (screen-like plates on the side of the mouth) while keeping the crustaceans and fish inside. This feeding style lessens competition with other whales but puts gray whale populations in jeopardy if the sediment is contaminated. A decline in ghost shrimp or destruction of their sand-flat habitat could also pose serious threats for gray whales. Other threats include net entanglements, boat collisions, orca attacks, and starvation.

Minkes are the smallest and most numerous baleen whales in the world. At least twenty individuals have been counted in the region during all months of the year, pointing to the possibility of a resident population. They primarily feed on squid, herring and other small fish that they filter out of the water column through their baleen. Because Pacific herring are a primary food source, the decline of herring populations and of the eelgrass upon which herring spawn, are a threat to the minke population. Currently, minkes are not listed under the ESA, but are classified as protected under the Marine Mammal Protection Act. The small population in area waters appears healthy and stable.

Dall's porpoise are the fastest cetaceans in the inland waters, being clocked at up to 30 knots (Osborne, 1988). They are present year-round and breed in local waters. **Harbor porpoises** are also year-round breeding residents of inland Washington and British Columbia waters (Marine Ecosystem Health Program [MEHP], 2002). Both porpoises have a similar diet of squid, shrimp, and small schooling fish. Harbor porpoise were once considered common, but now are rarely seen. The decline in harbor porpoise populations makes them a candidate for an ESA listing in Washington State (MEHP, 2002). More research is needed to pinpoint causes for their population decline, but they are generally boat-shy and, therefore difficult to study. Entanglement in fishing nets is the most significant known threat to Dall's and harbor porpoise. In addition, increased ship traffic drives harbor porpoises out of our waters (Osborne, 1988).

Year-round resident **harbor seals** make up the largest population of marine mammals in the Northwest Straits. They have made an impressive comeback from their decimated numbers prior to implementation of the Marine Mammal Protection Act in 1977. A 1999 census indicated that approximately 14,600 harbor seals lived in Puget Sound and the Strait of Juan de Fuca.



There has been an apparent slowing of harbor seal population growth in the Sound (PSWQAT, 2000). This slowing of population growth suggests the harbor seal population may have reached the limits that can be supported by the ecosystem. Because they are higher-level predators, there are concerns about bioaccumulation of toxics in seals. A recent study compared the levels of Persistent Organic Pollutants in harbor seals throughout the Puget Sound and Northwest Straits. It shows that harbor seals in southern Puget Sound have higher levels of Polychlorinated Biphenyls (PCBs) than those of the Strait of Georgia. Conversely, the harbor seals in the Strait of Georgia showed higher levels of dioxins and furans, both of which are by-products from pulp and paper mills in Britsh Columbia (Transboundary GB-PSEIWG, 2002). Further research is needed to determine the effects of these pollutants on seal populations.

North Puget Sound and the Strait of Georgia are at the northern range of **California sea lion** habitat. In the past twenty years, they have become more abundant and can be seen in winter months hauled out on rock ledges in the region. This might be due to warmer ocean temperatures and a northern migration of some of their prey. California sea lions feed primarily on hake and herring. California sea lions are classified as wildlife of state significance. Little research has been done to assess their population status in regional waters.

Stellar (or northern) sea lions are similar in appearance and behavior to the California sea lion. Their diet consists of squid, octopus, cod, rockfish, and other fish. Due to declining population levels, Stellar sea lions have been listed as threatened under the Endangered Species Act. The population in British Columbia waters is low, but stable. The most immediate threat to sea lions is entanglement in fishing nets and injury while eating fish off of long lines. While salmon make up just ten percent of their diet, some fishermen still consider sea lions a problem and kill them illegally (CMC, 1998).

River Otters are the only Mustelids found in area waters, with the rare exception of a visit from the ocean-dwelling sea otter. River otters depend on healthy intertidal and coastal habitats for the many small crustaceans and other invertebrates upon which they feed. They also eat amphibians, fish, and birds. Little research has been done on river otters in Washington, but declines in the closely related European river otter populations have sparked some concern. Habitat loss, decreased water quality, and increased pollution are potential threats to otters (MEHP, 2002). River otters are included on the "watch list" in British Columbia, but have no listing status in the United States.

Marine Mammal Health Rating

Serious Trouble: The drastic decline in our resident orca population points to alarmingly high levels of toxic contamination in the waters of north Puget Sound and the NW Straits. Declining populations and bioaccumulation of toxic substances in the fat of many other marine mammals point to an ecosystem-wide problem. However, rebounding populations of harbor seals and gray whales show us that these species can come back, even after serious population declines.

Marine Birds

The health and abundance of seabirds, shorebirds, and waterfowl are key indicators of health in the north Puget Sound marine ecosystem. Changes in critical habitat, entanglements in fishnets, and human disturbances have all led to the decline of marine birds in the area. Of the 116 species of marine birds that utilize area waters, some populations appear relatively stable. Several species, however, are in danger.

Scoters are a common visitor to the area and represent the largest diving duck population in Puget Sound. Various species can be found in the winter months on the salt waters around Point Roberts, Birch, Lummi and Bellingham bays, the outside of Semiahmoo Spit, Drayton Harbor, at Point Whitehorn and along the eastern shoreline of Georgia Strait, where they forage on herring spawn in the spring (Wahl, 1995). In Skagit County, they can be found off of March Point at Fidalgo Bay, Washington Park in Anacortes, and Rosario Head at Deception Pass (Skagit Audubon 2002). Department of Fish and Wildlife scientists have concluded that over-wintering scoter numbers in greater Puget Sound have declined by 57% percent over the last 20 years (Getchell, 2002). During that same period, populations of 13 out of 18 other marine diving bird species in Puget Sound and the Northwest Straits declined as well.

Western grebe populations appear to have fallen even more precipitously over the last 20 years, showing an alarming 95 percent decline. Large flocks winter on Bellingham Bay and Boundary Bay, and smaller numbers winter in Drayton Harbor, Birch Bay, Lummi Bay, and Chuckanut Bay (Wahl, 1995). In 1978-79, 38,000 western grebes were present in greater Bellingham Bay (Wahl et al, 1981). Yet between 1993 and 1999, the Puget Sound Ambient Monitoring Program (PSAMP) conducted aerial surveys and never recorded more than 5,700 birds in that area. While we do not have such detailed data for Skagit County, this trend appears to hold throughout the Puget Sound region.

Other declines in area marine bird populations include scaup down by 72 percent, long-tailed ducks down by 91 percent, and marbled murrelets down by 96 percent. In contrast, harlequin duck populations are up by 190 percent (Getchell, 2002).

A variety of human activities have led to the decline in numbers of many marine birds. Habitat loss and shootings have both contributed to the decline of western grebe and scoter populations. Oil spills and reductions in prey base have detrimental effects on various species of seabirds and waterfowl. As well, a surprising number of birds are killed each year via entanglements in fishing nets. Diving birds, such as the threatened murrelet, are especially prone to entanglement and drowning in fishnets. In 1994, the Washington State Department of Fish and Wildlife estimated that 3,569 seabirds were caught in commercial fishing nets, with 90 percent taken around the San Juan Islands (WDFW, 2002).

Habitat disturbance is a major threat to marine birds and waterfowl. Changes in habitats occur because of physical alterations to the land, various types of pollutants, and from increasing human activities, such as recreational and commercial vessel traffic. Recreational

Birds and Boats Don't Mix!

Like all animals, birds spend the summer months feeding and building up reserves for the harsh winter months. This caloric reserve is relied upon later for warmth and energy, when food supplies are low. When birds are disturbed by a passing motor boat or a kayaker paddling too close to the flock, they often fly up, circle and land, or fly off some distance, only to fly back when the offending boat has passed. This sort of activity can be particularly harmful to over-wintering and nesting birds as it requires that they burn important reserve energy. When they are forced to burn this stored energy needlessly, necessary survival resources are gone, potentially costing the bird its life. Please be aware of your impact on waterfowl when boating. Even a quiet kayaker who paddles too close can cause birds to take flight. Give birds plenty of room, so that they can survive to fly another day.

boaters can be a particular problem as growing numbers of Washingtonians take to the water each year. Certainly, motorized vessels such as motorboats and jet-skis, are great disturbances to waterfowl. But even kayakers who paddle too close to resting and nesting flocks can pose a disturbance. (Wahl, 2002)

Dwindling numbers of forage fish at many over-wintering sites might be a contributing factor to the decrease in marine bird populations. Bird species that either eat fish or depend upon specific spawning events of Puget Sound forage fish appear to have declined more than bird species that have a more generalized diet.

Marine Birds Health Rating

Serious Trouble: In general, marine bird populations are declining, some precipitously. Destruction of habitat, reductions in food sources, entanglement in fishing gear, and disturbances by boaters all contribute to the continued decline of marine bird populations in area waters.

Invasive Species

New species entering the marine environment pose a growing threat to ecosystem health. Often these invaders come without the natural predators with which they co-evolved in their native ecosystems, and can quickly dominate a new system (CMC, 1998). The impacts of non-native, or exotic, species moving into and becoming established in a new ecosystem are difficult to predict. While some are seemingly harmless, others can have catastrophic effects. Impacts from invasive species can include: increased predation upon native species, competition with native species for the same food sources or habitats, changing the nature of the habitat itself, the introduction of new parasites into the system, and interfering with human infrastructure.

In the year 2000 alone, ten non-indigenous species were found that had not been previously reported in Puget Sound. These discoveries increased the number of known non-natives in area salt and brackish waters to 56 species (PSQWAT, 2000). Two exotic species of concern here in the north Sound and Straits are the cord grasses, *Spartina* spp, and the European green crab, *Carcinus maenus.*

Spartina alterniflora is a perennial marsh grass that severely disrupts native saltwater ecosystems, alters fish, shellfish and bird habitat, and increases the threat of floods. Spartina transforms productive mudflats into marshy areas, trapping sediments and changing the elevation so that the area is often no longer intertidal. This can be particularly problematic for migrating shorebirds and waterfowl that rely on mudflat habitat for feeding and resting whilst on their journey along the Pacific flyway. As well, it can rob the estuary of important nursery habitat for small fishes, and make the area unsuitable for clams and oysters.

Local infestations of *Spartina* are known to occur along the Strait of Juan de Fuca and in numerous areas along the shorelines of Skagit County. These have been small to medium

Partial list of non-native aquatic species in Washington state and British Columbia

The following is a partial list of introduced species with established populations in Washington and British Columbia. Some were introduced intentionally, such as game fish and aquaculture species, while others came as a result of unintentional release, such as in ballast discharge or disposal of packing materials. A number of these introduced species are considered beneficial, but many are classified as nuisance species. In all cases, we can be sure that these introductions have had some influence on the ecosystem in which they now live. This list includes fish living in fresh, brackish and marine water habitats.

Aquatic Plants

Brown alga or Japanese weed *Sargassum muticum*
Japanese eel grass *Zostera japonica, Lomentaria hakodatensis*
Purple Loosestrife *Lythrum salicaria*
Brazilian Elodea* *Egeria densa*
Parrotfeather Milfoil* *Myriophyllum aquaticum*
Fanwort* *Cabomba caroliniana*
Eurasian Watermilfoil *Myriophyllum spicatum*
Hydrilla* *Hydrilla verticillata*
Spartina/Cordgrasses* *Spartina alterniflora, anglica, patens*
Yellow Iris *Iris pseudacorus*
Agar weed** *Gelidium*

Fish

American shad *Alosa sapidissima*
Grass carp* *Ctenopharyngoden idella*
Striped bass *Morone saxatilis*
Common carp *Cyprinus carpio*
Goldfish *Carassius auratus*
Largemouth Bass *Micropterus salmoides*
Smallmouth Bass *Micropterus dolomieui*
Bluegill*, Green Sunfish*, Pumpkinseed Sunfish *Lepomis spp.*
Black Crappie, White Crappie* *Pomoxis spp.*
Walleye *Stizostedion vitreum*
Yellow Perch *Perca flavescens*
Channel Catfish, Blue Catfish *Ictalurus spp.**
Flathead Catfish* *Pylodictis olivaris*
Black Catfish, Brown Catfish**, Brown Bullhead, Yellow Bullhead*, Black Bullhead* *Ictalurus pp.*
Northern Pike, Tiger Musky* *Esox spp.*

Invertebrates

Varnish or mahogany clam *Nuttallia obscurata*
Manila clam *Tape philippinarum*
Asian clam *Corbicula fluminea*
Soft-shell clam *Mya arenaria*
Japanese trapezium *Trapezium liratum*
Japanese littleneck clam *Venerupis philippinarum*
Pacific oyster *Crassostrea gigas*
Eastern oyster** *Crassostrea virginica*
Japanese or green mussel *Musculista senhousia*
Slipper shell *Crepidula fornicata*
Mud snail *Nassarius obsoletus/Ilyanassa obsoleta*
Eastern oyster drill *Urosalpinx cinerea*
Japanese oyster drill *Ceratostoma inornatum*
Red beard sponge *Microciona prolifera*
Boring sponge *Cliona spp.*
Bowerbank's halichondria *Halichondria bowerbanki*
Asian copepod* *Pseudodiaptomus inopinus*
Bivalve intestinal copepod *Mytilicola orientalis*
Mud worm *Polydora ligni*
Wood-boring gribble *Limnoria tripunctata*
Shipworm *Terredo navalis*

**not established in B.C.*
***not established in Washington state*

(Reproduced from "Bioinvasions - Breaching Natural Barriers by Washington Sea Grant, 1998.)

infestations, allowing for effective control efforts. *Spartina* covered approximately 17 acres in Padilla Bay, but eradication efforts have brought the infestation down to less than 1/2 acre. Eradication efforts in Padilla Bay have included hand digging and pulling by volunteers, cutting off the tops before the seeds mature, and limited spraying of herbicide. Spartina occurs in various locations along the shore of Skagit County, including a notable infestation in Alice Bay (Riggs, 2002).

Spartina has not yet been found in Whatcom County waters, but the rich, shallow mudflats of the Nooksack River delta are prime habitat.

As of the beginning of 1999, control efforts of the Washington Department of Agriculture and its partners have significantly reduced the size of Puget Sound *Spartina* infestations. As smaller, outlying populations of this weed are reduced or eliminated, larger areas of infestation, such as South Skagit Bay, will become a bigger priority.

Watch for *Spartina*:

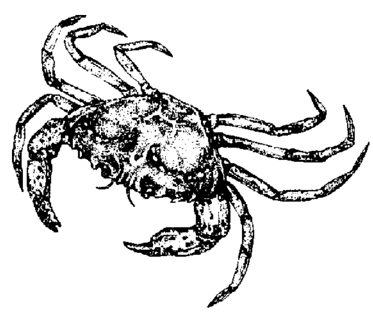
- It is a striking grass, growing in roundish clumps 2-6 feet tall.
- It grows in the intertidal zone along salt water shores.
- The leaf blades are 1/4 to 2/3 inches wide and branch from the smooth stem at a steep angle.
- When the leaf is pulled down and off the stem, the ligule (the joint where the leaf meets the stem) is somewhat hairy.

Local residents are encouraged to call their local Noxious Weed Board if *spartina* is suspected in any local estuary.

One invasive species that has not yet been sighted in local waters, but is of great concern to biologists, is the **European green crab** *Carcinus maenas*. A federally recognized nuisance species, it first appeared on Washington's coast in June 1998. A relatively small crab, this voracious predator preys upon a wide variety of plants and animals, but prefers the commercially and recreationally important clams, oysters, mussels, and juvenile Dungeness crab. Green crab are found in water up to 30 feet deep and in the high intertidal zone and in salt marshes. To date, green crab have not been found in the marine waters of the northern Sound and traits, but local agencies are certainly on the lookout.

Watch for Green Crab:

- Adult green crab measure 3 to 4" across
- Look for five spines on either side of the front of the shell.
- Green crab have three rounded lobes between the eyes.
- Color is deceptive, as the crab's shell can be a variety of colors. Adults, however, are often a dark greenish color, with yellow markings on the top of the shell.
- Their underside tends to be bright red or yellow.



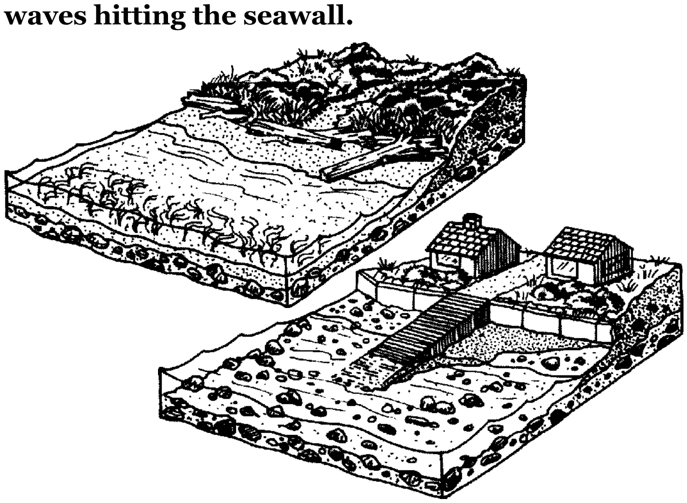
If you sight what you suspect to be European green crab, make note of the time, date and location of the sighting. Do not try to trap the crab, as it is illegal to possess or transport live specimens. Contact the Washington Department of Fish and Wildlife to report the sighting.

Shoreline Modification

Channel dredging and shoreline armoring through the use of riprap and bulkheads lead to changes in the bathymetry (the topography or depth) of nearshore marine environments, affecting the kinds of vegetation that can grow there. For example, dredging and armoring can create deep water near the shore. This may allow for the growth of bull kelp, but perhaps at the exclusion of eelgrass, which requires shallow, sandy substrate. This kind of change will affect the kinds of organisms that can use the area for resting, feeding, hiding or breeding. Migrating salmon are particularly challenged by the loss of shallow nearshore areas.

Bulkheads and seawalls interrupt natural shoreline processes, such as erosion, deposition, sediment transport, and forage fish spawning. Instead of wave energy being dissipated as the wave rolls up the beach, it hits the bulkhead, causing the wave to turn back on itself. Over time, this action causes a scouring of the beach, as fine sand and gravels are pulled out with the waves. The large rocks and hardpan beneath are not suitable for beach-spawning fish such as sand lance. The loss of fine substrates can also result in the loss of eelgrass beds, which are used by herring for spawning. Docks and jetties can also interrupt the flow of sediments along the shore, robbing some beaches of much-needed gravels.

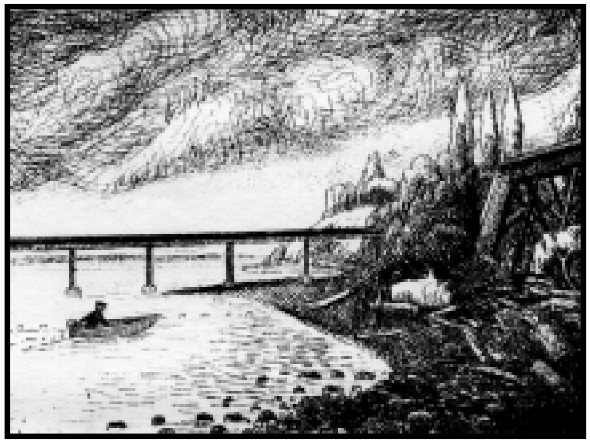
Before and after bulkheading:
Sand and fine gravels have been scoured away by waves hitting the seawall.



Because shoreline modification is so detrimental to the marine environment, a variety of state and federal statutes regulate shoreline modification projects. However, some state statutes exempt projects associated with single-family residences, or subject them to less stringent criteria. Approximately half of all shoreline modification in Washington State is associated with single- family residences. This suggests that single-family residences are a major component of total shoreline modification, and perhaps state regulations should be extended to account for the impacts these residences may have.

Shoreline structures, such as a bulkheads or riprap, have been built along approximately one-third of all shorelines in Washington State. In Whatcom County, 49 of 147 miles of shoreline have been altered. In Skagit County, 81 of 229 miles of shoreline, or 35 percent, have been modified (PSWQAT, 2002).

There are many reasons the people of Whatcom and Skagit counties have altered the shoreline. The majority of shoreline modifications in Skagit County are in the form of dikes that drain estuarine lands for agriculture. In Whatcom County, the shoreline has been altered for agricultural, industrial, and residential uses. Perhaps the greatest single impact on the nearshore environment in Whatcom County is caused by the railroad line by that circles the Bellingham and Chuckanut Bays and continues south into Skagit County. The line is built on rip-rap that, in many places, completely obscures the original shoreline, creating long stretches of relatively steep banks where there were once mudflats. As well, the railroad cuts across the head of Chuckanut Bay, severely impeding the transport of sediments out of the bay. Because of the railroad rip-rap, this area is now known as "Mud Bay" due to the extensive mudflats that appear, even at a moderate-to-low tide.



Toxics in the Marine Environment

Numerous toxic contaminants are released into the environment and reach our waterways. While some of these chemicals can result in immediate problems, such as fill kills during a sudden release of a chemical, they often act in ways that are not as fast acting. Concentrations of some toxic chemicals become magnified through the food web when predators eat contaminated prey. Over time, these contaminants accumulate in the tissues of organisms at ever higher concentrations, triggering a variety of health problems and death. This means that high-level predators, such as the resident orcas in the Sound, are exposed to higher concentrations of contaminants than organisms that feed lower in the food web.

Many of these toxic chemicals, such as dioxins, PCBs, chlorinated organic pesticides and some PAHs, are known to cause or promote the development of cancer in humans and other animals. Organic compounds and metals can cause neurological problems. In recent years, scientists have found that some environmental contaminants interfere with hormone functioning and can cause reproductive problems. For example, a variety of organic compounds, including dioxins, PCBs and phthalates, have been shown to have estrogen-like effects (Johnson, 1988). In addition, scientists have begun to show that environmental contamination by PCBs and other toxic chemicals can cause immune system dysfunction and increased susceptibility to disease.

Sediments are widely considered to be the major repository for toxic contaminants in the marine environment. Industrial activities, combined sewer overflows, old shoreline landfills, storm water discharges, and military operations have all contributed substantial amounts of toxic chemicals to our waterways. Most of the chemicals that enter the Sound attach to fine particles and eventually settle to the bottom. The species that live in or upon marine sediments, such as bottomfish, are at most risk of experiencing the effects of these contaminants.

There is one major contaminated sediment site in the waters of the North Sound and Straits: Bellingham Bay. The sediments of this urban embayment contain a host of chemicals, most notably 10 to 13 tons of mercury, deposited by the now-closed Georgia Pacific chlorine plant. In addition to mercury, the sediments of the bay also contain copper, lead, arsenic, zinc, tributyl tin, anthracene, dioxins and furans, pentachlorophenol, PAHs, and a host of other organic compounds (Washington Department of Ecology). While most of these chemicals found their way into the bay via historical processes, some, such as PAHs continue to be a major problem for water and sediment quality throughout the bay and the Sound.

The Puget Sound Action Team recently included Bellingham Bay on its list of contaminated sediment sites that have impaired benthic communities as a result of the contamination (PSQWAT, 2002). A cleanup planning process for the Bay has been underway for more than 5 years, but as yet, there has been no final decision made as to the extent of possible dredging or the ultimate fate of dredge spoils.

There is also some sediment contamination in the Strait of Georgia. This contamination is associated with the industrial effluents in the area and appears to be relatively limited in its extent. Chemicals found in these sediment hotspots include cadmium, PCBs, furans, PAHs and other organic compounds.

In Skagit County, Padilla and Fidalgo Bays, along with Guemes Channel also have some sediments contaminated with PCBs, although contaminant levels are not high or widespread enough to warrant cleanup action.

Add It Up: A Review of Pollutant Loading in the North Sound and Straits

At RE Sources, we are often asked questions about particular industrial facilities that discharge pollutants into area waters. A common question runs something like this: "so, how much (insert your favorite pollutant) do they release, anyway?" Usually, we cannot answer that question, even if we have the discharge permit at hand. This is because the permits do not give absolute totals. Rather, they limit pollutant concentrations – usually expressed in milligrams per liter (mg/L) or micrograms per liter (ug/L), and/or mass amounts – usually expressed in pounds per day, week or month. Sounds simple enough, one might say.

Thinking this would be a relatively simple endeavor, the Baykeeper and a volunteer set out to determine how much of a set of key pollutants is discharged into area waters each year. To keep this exercise simple, we opted to search only for toxic compounds such as heavy metals, persistent bioaccumulative chemicals, some organic compounds, and oil & grease.

It is impossible to know what individuals may be dumping into storm sewers and ditches, and how much pollution enters area waterways in stormwater runoff from parking lots, roads, and landscapes. While non-point pollution such as this is deemed by the Environmental Protection Agency to be the majority of pollution entering our water, it is very difficult to ascertain just how much non-point pollution there really is.

We opted to focus only on permitted dischargers in Whatcom and Skagit Counties. We found 223 NPDES or state waste discharge permits in the two counties. Of these, 84 are for sand and gravel mining operations, many of which no longer operate. Sand and gravel permits only regulate suspended solids leaving the area, so they were not included in our search for toxic compounds. There are also 17 dairies on the list. While dairies are of concern for their potential to release high amounts of fecal coliform, they do not have permit limits for toxicants. Again, we discounted them from our search.

We had reduced the list of facilities that could potentially discharge toxicants to 122. This list represents a wide variety of facilities, such as four oil refineries, an aluminum smelter, a tissue mill, wood treatment facilities, fiberglass fabricators, boatyards, food processors, and sewage treatment plants.

The first step in our process was to request the discharge permits for each of these facilities. This is done by filing a public disclosure request to the Department of Ecology. The agency usually responds within a few weeks. Sometimes, though, Ecology staff would call to say that the permit had been misplaced. Generally, the permits were found and sent along, accompanied by a hefty bill for photocopying (the state dings citizens a whopping 15 cents per page when they ask for public documents).

Then the fun began. Our dedicated volunteer Eileen began to review the permits. She quickly found that many facilities discharge a host of pollutants for which they have no limit. This is because the Department of Ecology has determined that, under normal conditions, the facility effluent will not exceed the state standard for that particular pollutant. For example, say facility X discharges 6 mg/L of lead into a marine waterbody. The Department of Ecology may determine that this facility needs no limit for lead because they do not believe that the facility shows a "*reasonable potential to exceed*" the state water quality criteria for lead. This facility could discharge a small amount of a bioaccumulative neurotoxin every day for years without ever receiving a limit for this pollutant. So, pollution permits are not representative of all pollutants discharged by a facility.

As well, permit limits are often expressed in terms of *maximum daily and average monthly limits*. Refinery Y may be given a limit for phenolic compounds expressed as 4.94 pounds maximum per day (a mass limit), with a monthly average not to exceed 2.2 pounds per day. So, how much do they discharge?

Another challenge was uncovering how much wastewater is discharged by a given facility. This is necessary information when permit limits are expressed as concentrations, as total flow is needed to translate concentrations to mass amounts. But facilities are not given limits for flow. Some facilities are required to report their average flows, others are not, so it is difficult to obtain consistent information. As well, when facilities are experiencing extremely high flows, during a storm event for example, their treatment capacity may be diminished. Yet, the facilities have differing monitoring frequencies required for different pollutants. So, if a high flow event does not occur on a regularly scheduled monitoring day, the pollutant loading for that high flow day is not recorded.

Assessing the impacts of stormwater flowing from facilities is another problem. Only the very largest facilities, such as refineries, are required to measure the volume of stormwater that flows from their parking lots and process areas. Oil and grease is generally the pollutant found in the highest quantities in industrial stormwater. Facilities tend to be limited to 10 or 15 milligrams per liter, with the facility required to test a sample monthly. But because no one knows how much storm runoff issues from most facilities, it is impossible to figure the total amount of oil and grease leaving these facilities and entering our waters. We might know the concentration of oil and grease in a particular sample, but that's all we know.

One might easily suppose that these amounts would be small and thereby insignificant. But 10 milligrams per liter (mg/L) in a runoff volume of 500,000 gallons per day, which could be expected for a medium-sized facility, yields nearly 42 pounds per day, or 15,330 pounds per year, of oil and grease discharged into your local waterway. Say there are 5 facilities each discharging a similar volume to that waterway. That's over 76,000 pounds of oil and grease a year! Clearly, even a relatively small concentration can add up quickly.

An additional obstacle was that some facilities do not treat their waste but send it to a local sewage treatment plant for treatment and discharge as part of the larger municipal flow. For example, there are several facilities in Skagit County that discharge mercury as part of their wastewater. This wastewater is sent to a municipal treatment plant where it receives treatment as municipal sewage and is then discharged. Neither the treatment plant operators nor the industry that discharged it can say how effective the treatment plant is in removing this pollutant. Its anyone's guess how much of the permitted amount of a given pollutant from a given facility ends up in the Sound.

To be accurate, it must be noted that in most cases actual discharges are far below permitted levels, as reported by the facilities, and most facilities are very conscientious about their testing and reporting. As well, while we might like to assume that everyone is conscientious, we know that some facilities aren't. There are bad actors that often seem to go out of their way not to comply. And, perhaps most important of all, we just don't know what volumes of what materials are actually discharged into area waters, because no one has ever added it up. We tried, and here present limited results with lots of caveats. The sad truth is that the State Department of Ecology, whose job it is to monitor pollution and implement the Clean Water Act in our state, has never done this either. When writing discharge permits, agency staff do not consider the impacts of other similar discharges in the area, nor do they even total up the amount discharged by a given facility. ***Our regulators have no idea how much of these pollutants are discharged into our waterways each year.***

The chart below contains our best guess for the amounts of pollutants listed, by receiving water. Note that there are many question marks. These indicate that we were unable to obtain flow data to allow for conversion from concentration to mass data. Without flow data, we simply cannot say how much of that pollutant is discharged (neither can the Department of Ecology). As well, the chart indicates discharges that occur via a municipal treatment works.

Pollutant Discharges to the North Sound and Straits

	Lummi Bay/ Nooksack River/ Bellingham Bay	Birch Bay/ Semiahmoo Bay/ Drayton Harbor	Fidalgo Bay/ Guemes Channel/ Samish Bay	Skagit River	Strait of Georgia	Total Pollutant Discharges to the North Sound and Straits
Aluminum	42.2 lbs/yr				25,079.8 lbs/yr	**25,122 lbs/yr**
Arsenic		**?**		**?**		**?**
Benzene*	.55 lbs/yr					**>.55 lbs/yr**
Benzo(a)pyrene (BAP)					191.9 lbs/ yr	**191.9 lbs/yr**
BTEX*[1]					11 lbs/yr	**>11 lbs/yr**
Chlorine	>12,485.6 lbs/yr	724.9 lbs/yr	6,824.5 lbs/yr	1,919.9 lbs/yr	>2,218.8 lbs/yr	**>24,173.7 lbs/yr**
Cyanide		.48 lbs/yr		237.5 lbs/yr	204.7 lbs/yr	**442.68 lbs/yr**
Hexavalent Chromium			496.4 lbs/yr		463.5 lbs/yr	**959.9 lbs/yr**
Chromium			6,716 lbs/yr	>438.6 lbs/yr	>6,716 lbs/yr	**>13,870.6 lbs/yr**
Lead*	755.2 lbs/yr	>1.37 lbs/yr	224.2 lbs/yr	>54.8 lbs/yr	**?**	**1,035.57 lbs/yr**
Mercury*	40.2 lbs/yr		4.9 lbs/yr	3.65 lbs/yr		**>48.75 lbs/yr**
Oil & Grease*	>15,015.8 lbs/yr	>9,628 lbs/yr	>277,929 lbs/yr	>91.4 lbs/yr	>286,129 lbs/yr	**>558,793.2 lbs/yr**
Pentachlorophenal (PCP)					**?**	**?**
Phenolic Compounds			6,140.7 lbs/yr		4,007.6 lbs/yr	**10,148.3 lbs/yr**
Styrene*				45.7 lbs/yr		**>45.7 lbs/yr**
TPH-g*[2]	124.9 lbs/yr					**>124.9 lbs/yr**
TPH-d	76.1 lbs/yr					**76.1 lbs/yr**
Total Toxic Organics (TTO)*	32.4 lbs/yr			780.4 lbs/yr		**812.8 lbs/yr**
					Grand Total	**>665,857.65**

Information used is from the most current NPDES permit unless otherwise noted.

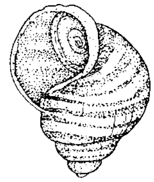
? = unable to obtain flow data from the Department of Ecology

* = these pollutants are sent to municipal sewage treatment plant where the effectiveness of treatment is unknown

[1] BTEX: Benzene, Toluene, Ethyl Benzene, and total Xylenes.

[2] Total Petroleum Hydrocarbons

The Policy Piece: Who Regulates What and How it Works



Many laws regulate some aspect of the marine environment. From fishing to dredging to tanker traffic, laws abound. Because of space limitations, we will not attempt to present a comprehensive list of all laws affecting the marine ecosystem, but will name a few of the most influential:

Clean Water Act/Federal Water Pollution Control Act: regulates the discharge of pollutants into the nation's navigable waters. This law will be discussed in detail below. The CWA is administered by the Environmental Protection Agency. In 38 states, the EPA has delegated this authority to the state. Here in Washington, the state Department of Ecology (DOE) is responsible for CWA implementation.

Coastal Zone Management Act and the state Shoreline Management Act: These laws regulate development in coastal areas. The CZMA is administered by the National Oceanic and Atmospheric Administration, with the states reviewing various actions for consistency with CZMA. The SMA is administered by the state DOE.

Comprehensive Environmental Response, Compensation, and Liability Act (commonly known as Superfund) and the state Model Toxics Control Act (MTCA): Superfund and MTCA regulate the cleanup of contaminated sites and detail the process through which the government may seek redress from liable parties. Superfund is administered by the Environmental Protection Agency and MTCA is administered by the state DOE.

Endangered Species Act (ESA): The ESA provides a framework for assessing the status of a particular species and listing it as threatened or endangered. Once a listing has occurred, management is prescribed by the responsible agency. For marine organisms, the National Marine Fisheries Service is responsible for ESA implementation.

Marine Mammal Protection Act: This act was passed in 1978 to address the serious decline in marine mammal populations. All marine mammals enjoy protected status that makes harassing, injuring or killing them a crime. This law is administered by the National Marine Fisheries Service.

Ocean Dumping Act: The Ocean Dumping Act regulates the intentional ocean disposal of materials. It also authorizes research, the establishment of marine sanctuaries, and coastal water quality monitoring. Four federal agencies have authority under the ODA: the EPA, the U.S. Army Corps of Engineers, the National Oceanic and Atmospheric Administration (NOAA), and the Coast Guard.

Oil Pollution Prevention Act of 1990: This act makes parties responsible for the discharge of oil into the water liable for the costs of cleanup. The Coast Guard has primary responsibility under the OPPA.

A Primer on the Clean Water Act

2002 marks the 30th anniversary of the Clean Water Act (CWA), making this year the "Year of Clean Water." This is a landmark law for several reasons: It acknowledged, for the first time, that we all have a right to clean water, and it gave citizens the power to enforce the law if the government agencies entrusted with this responsibility don't.

When Congress passed the Clean Water Act in October of 1972, our nation's waterways were in crisis. Many rivers, bays, and sounds were so polluted that fish kills and beach closures were an ordinary occurrence. Lake Erie was declared dead, the Cuyahoga River was on fire, and our own Bellingham Bay made National Geographic magazine because of mercury-laden sediments (October 1972). The Clean Water Act was viewed as an important way to rein in unlimited discharges of pollution to our nation's waterways and to give citizens power to steward the waters of our homes.

The goals of the Clean Water Act were clearly stated:

- "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" – that is, to make all wa ters "fishable, drinkable, swimable"
- "To eliminate the discharge of pollutants into navigable waters by 1985"

A lot has changed in the last 30 years. We now have an Environmental Protection Agency and an institutionalized environmental regulatory regime. The Cuyahoga River is no longer in flames, and people are fishing in Lake Erie again. But, mercury discharges to Bellingham Bay ceased only two and a half years ago – leaving a legacy of contamination still to be dealt with. All of the commercial shellfish beds in Whatcom County are closed to harvest due to fecal contamination, and <u>76 rivers, lakes and bays in Whatcom and Skagit Counties alone fail to meet water quality standards</u>.

Clearly, we have not restored the integrity of our waters, nor have we eliminated the discharge of pollutants. Part of the reason for this is that the regulatory agencies have been captured by the very interests that they are supposed to regulate. It has been relatively easy for this to happen, because the citizen pressure just isn't there to encourage regulators to rigorously enforce the law. The Clean Water Act was designed to give citizens tools to work for their local waterways, but few people understand the act or how to effectively engage in advocacy using this powerful tool.

In honor of the anniversary of this landmark law, we offer a primer on the Clean Water Act. There are several key elements to the Act about which citizens hoping to engage in water quality advocacy should know.

<u>National Pollutant Discharge Elimination System (NPDES)</u>: The Act established the National Pollutant Discharge Elimination System. The key word here is *elimination*. The NPDES was created as a means to ratchet down on pollutants, eventually getting facilities to zero discharge. The Act requires that all "point sources" of pollution have an NPDES permit. Point sources are those that issue from a single point, such as an industrial discharge or that of a sewage treatment plant. Do not assume that because a facility has an NPDES permit, it is not polluting or that its pollution discharges are not harmful. It simply means that the facility has a permit to pollute.

NPDES permits can provide a powerful avenue for citizen involvement, because there is a public comment provision that allows for input on the permits as they are drafted. These permits are generally renewed every five years. Often, citizen comments can result in significant changes to facility NPDES permits, resulting in real change at the end of the pipe.

NPDES permits generally contain numerical effluent limits for some, but not all, of the pollutants in the wastewater. Generally, a facility applying for an NPDES permit must characterize its effluent, testing it for a wide variety of pollutants. Then, the state Department of Ecology sets limits for those pollutants that the state determines have a "reasonable potential to exceed" state water quality standards, discussed below. Most facilities discharge a host of pollutants in quantities low enough as to not trigger an effluent limit. Pollutants may be discharged in small amounts, but nonetheless, they are discharged. In areas where several similar facilities discharge to one waterbody, the overall effect may be that there are more of some pollutants in the water than may be desirable.

Herein lies a flaw of the NPDES system: The system was envisioned as a way to move polluters to zero discharge, but the permit only limit some pollutants, and those limits are determined by the state's Water Quality Standards, which tend to remain unchanged for many years. If the standards don't move toward zero, then the permits get stuck with the same effluent limits year after year, and pollution is not eliminated.

In addition to effluent limits, NPDES permits can require facilities to institute better housekeeping practices to contain pollutants, require technology changes to create less pollution or better treat the effluent, require toxicity testing on organisms likely to be affected by the discharge, and a variety of other things. These other requirements are often where much of the action is in NPDES permits. While it is nearly impossible for citizens to get effluent limits that are below those set forth in the Water Quality Standards, citizen comments can result in more rigorous monitoring, toxicity testing for sensitive species likely to be found in the vicinity of the discharge, studies of sediment contamination, etc. The results of such monitoring and studies can then be used to make the next permit more stringent.

It should also be noted that NPDES permits are appealable. This means that if you feel a permit does not meet the requirements of the Clean Water Act or the state Water Quality Standards, you can appeal the permit to the state Pollution Control Hearings Board. Unfortunately, appeals are expensive, and there is no provision for the recovery of legal expenses, so appeals are often not practical for individual citizens to undertake.

Currently, 117 facilities have discharge permits in Whatcom and Skagit Counties. These include four oil refineries, an aluminum smelter, a tissue mill, several wood treaters, boatyards and ship yards, hatcheries, gravel pits, auto wreckers, fiberglass fabricators, dairies, and a host of other facilities. To review a

NPDES permit for a particular facility in Whatcom or Skagit Counties, or to receive notification of permit activity in your area, contact the Northwest Regional Office of the Department of Ecology at (425) 649-7000.

State Water Quality Standards: Established by the state through the legislative process (WAC 173-201A), these standards have three important components:

- **Designated uses:** Waterbodies are classified according to the uses they traditionally supported. For example, waters that have been used for domestic drinking water, shellfish harvest, salmon migration, etc. are classified as "Class AA Extraordinary." Even if the waterbody is currently degraded, if it can be shown that these uses historically existed, then dischargers in the area will be held to a higher standard.

- **Water Quality Criteria:** These criteria establish standards for each designated use and consist of both numeric and narrative descriptions of chemical, physical and biological conditions necessary to support each of the designated uses. Facilities discharging to Class AA waters have lower allowable limits than those that that discharge to Class A or B waters, for example.

- **Anti-degradation requirements:** This provision prohibits any activity that would remove an existing use, requires states hold to a minimum lowering the quality of waters that currently meet or exceed standards, and prohibits any activity that would degrade waters of exceptional ecological significance or with high recreational or social value. While the anti-degradation concept is potentially a powerful aspect of the Act, it is difficult to quantify, and this component of the Act is not used to its potential.

Technology Based Standards: Established by the EPA, these standards set minimum pollution control requirements for various categories of dischargers, such as municipal sewage treatment plants, and some industry groups, such as the pulp and paper industry and aluminum smelters. For example, the EPA promulgated new technology standards for pulp mills in the late 1990s. The new rules required many mills to transition away from the use of elemental chlorine in their bleaching processes, while other types of mills were required to abandon chlorinated compounds entirely. This was expressed in pulp mill permits as permit limits for dioxins that would not be achievable with any chlorine use. Essentially, the technology based limits forced the industry to move beyond old technologies to which it had been wedded.

It should noted here that when there are both technology based standards and water quality based standards for the same pollutant, the Department of Ecology is mandated to choose the most stringent. Citizens who comment on NPDES permits should check to see that Ecology is using the toughest of these two types of limits for each pollutant.

Mixing Zones: Also known as Dilution Zones, these are areas where some or all water quality standards are waived to allow for dilution of pollution. This is a challenging aspect of the

Act for many who are concerned about water quality, because it relies on that old saw, "dilution is the solution to pollution." In most cases, this just is not true. Mixing zones are especially problematic when discharges contain persistent, bioaccumulative pollutants (PBTs). PBTs do not go away: They stay in the environment and make their way up the food chain. Allowing greater amounts of PBTs to be discharged with the thought that they will become diluted is misguided, at best.

"Clean water is not an expenditure of Federal funds; clean water is an investment in the future of our country."

- Bud Stusten, U.S. Representative

Impaired Waters: These are waters that fail to meet state or federal water quality standards for one or more parameters. Section 303 (d) of the Clean Water Act requires states to submit a list of its impaired waterways to the EPA every four years. This list is often referred to as the "303(d) list." It does not take massive degradation for a water body to be listed as impaired. Reaches of a stream can be listed, for example, due to high temperature. As well, a waterway can be listed because of sediment contamination. While it is unfortunate to have impaired waterbodies, it is important that communities get their impaired waterbodies on this list as it opens up opportunities for restoration funding and ensures that dischargers will be held to a higher standard.

In Whatcom and Skagit Counties, there are over 70 waterbodies listed as impaired. Most rivers and creeks are listed for parameters such as high temperature, fecal coliform, or depressed dissolved oxygen. Several marine waterbodies are listed for toxic contaminants, many of which result from sediment contamination.

In Washington, there are Sediment Quality Standards incorporated by reference into our Water Quality Standards. That means that waterways with sediment contamination are placed on the 303 (d) list.

If you are concerned about the health of your local waterbody, you may want to start by checking to see if it is listed as impaired on the 303(d) list. If it is not on the list, it does not necessarily mean that the waterbody is healthy. There are many reasons that degraded waterbodies are not listed, including lack of political will and lack of reliable water quality data. Find out whether the water has been monitored. If so, data should be available that you can submit to the Department of Ecology. If not, perhaps you can convince Ecology, the local conservation district, or a local school to begin a monitoring program. If data do exist that shows a problem and the state still refuses to list your waterbody, you can then ask the EPA to disapprove the list.

Total Daily Maximum Loads (TMDLs): If a waterbody is listed on the 303(d) list, the Act requires that the state prepare a TMDL study for the waterbody. These studies are important, because in a TMDL the state assesses how much of a given pollutant can be discharged into the water without violating water quality standards. Then, a pollution budget is assigned to that waterbody, and that budget is divided amongst the facilities that discharge to that area. So, while no individual facility may be violating water quality standards, together several facilities might contribute to the impairment of the waterbody. The TMDL gives the state the power to require more stringent effluent limits of all facilities discharging to that waterbody for the pollutant of concern.

Citizen Enforcement: While we hope that the government agencies charged with enforcing environmental laws will vigorously do so, this is often not the case. Recognizing this, the Clean Water Act grants citizens the right to undertake enforcement actions in the form of Citizen Suits. Under the Act, any individual or organization that is adversely impacted or has the potential to be adversely impacted by a documented discharge violation may bring suit against the discharger. Citizens may only bring this type of suit if an enforcement action has not been taken by state or federal enforcement agencies. If the suit is successful, the court can order relief similar to that required in a governmental enforcement action, such as issuing an injunction requiring compliance and levying fines of up to $25,000 per day of violation. As well, successful litigants may recover their legal expenses for bringing suit.

The above information is a very brief primer on some of the most important aspects of the Clean Water Act. Certainly, the Act contains many more provisions, and the specifics of implementation vary from state to state. Here in Washington, the state Department of Ecology has authority to implement and enforce the Act. If you are interested in learning more about the NPDES permitting program in Washington or the status of your local waterway, you can log onto the Ecology website at www.ecy.wa.gov. You can also contact RE Sources for information on Citizen Action Trainings on the Clean Water Act, for help with a specific permit or facility, or to volunteer with the North Sound Baykeeper reviewing discharge permits and monitoring facilities.

Has the Clean Water Act Worked?

In 1972, before the Clean Water Act:

- only 1/3 nations waters safe for swimming and fishing
- wetland losses estimated at 460,000 acres per year
- sewage treatment plants served only 85 million people
- agricultural runoff resulted in erosion of 2.25 billion tons of soil into our waters

Today, thirty years after the Act was passed:

- 2/3 nations waters safe for swimming and fishing
- rate of annual wetland losses estimated at 70,000 to 90,000 acres per year
- modern wastewater treatment facilities serve 173 million people;
  soil loss due to agricultural runoff has been cut by one billion tons per year

Conclusion

The waters of northern Puget Sound and the Strait of Georgia are a precious natural asset. Sadly, this rich ecosystem has been degraded, sometimes badly, by the human activities of the past 100 years. To a great extent, many of these negative impacts occurred before our society understood the ways that our behavior impacts the world around us. Now, we live with a legacy of degraded shorelines, contaminated sediments, depleted fish populations, shellfish closures, and the most contaminated marine mammals on earth.

But we live in an opportune time and place. The waters of the northern Sound and Straits are not as degraded as those of the central and south Sound. The Straits of Georgia and Juan de Fuca keep local waters flushed with cleaner flow from the north. Many historic practices that degraded water quality, such as the discharge of mercury into Bellingham Bay, have been curtailed or ended completely. Even folks who live well away from the marine shore, such as dairy farmers, are becoming aware of their impact on the marine environment and changing their practices to lessen their impacts. As well, we have a population that cares about the natural world and feels lucky to live here.

We can turn around the downward trend of ecosystem health, but it will take the involvement of each resident, doing their part. We need to cultivate a sense of belonging to the natural world and then live responsibly within it. This means thinking about ways that our individual behaviors affect the ecosystem of which we are a part. We must examine our driving habits and our gardening methods, the way we build and the way we clean, how we dispose of our waste and what we do when we walk the dog. And we can each take a close look at our buying habits; it is the sheer enormity of stuff that we Americans have that places the great strain on the natural world.

In addition to making lifestyle choices that lighten our step on the earth, we must also become engaged and informed citizens. We must communicate regularly with elected officials and hold regulatory agencies, such as the Department of Ecology, to the highest of standards. We must encourage them to stand up to business interests that would have them sell away long-term environmental integrity in favor of short-term economic gain.

We can return the marine ecosystem of the northern Sound and Straits to its status as a coastal jewel. And as we do so, we will find great rewards in the beauty of a thriving marine ecosystem, with all the gifts it has to offer.

"The human race is challenged more than ever before to demonstrate our mastery, not over nature, but of ourselves."

– Rachel Carson

For Further Involvement

North Sound Baykeeper
RE Sources for Sustainable Communities
1155 N. State Street, Suite 623
Bellingham, WA 98225
(360) 733-8307
www.re-sources.org

The following organizations are actively working for the health of the marine ecosystem of the north Sound and Straits:

Bellingham Bay Pilot
Jessica Paige, Dept. of Ecology, 360-738-6250
www.ecy.wa.gov/programs/tcp/sites/blhm_bay/blhm_bay.htm Whatcom County

Drayton Harbor Shellfish Protection District
Contact: Amy Stillings, 360-676-6876
www.whatcomshellfish.wsu.edu

Evergreen Islands
Info@evergreenislands.org
www.evergreenislands.org

Marine Resources Committee
360-676-6876
www.whatcom-mrc.wsu.edu

North Cascases Audubon
360-671-8427
www.northcascadesaudubon.org/php/index.php

Padilla Bay National Estuarine Reserve
360-424-1558
www.padillabay.gov

People for Puget Sound
360-336-1931
www.pugetsound.org

Portage Island Shellfish Protection District
Contact: Amy Stillings, 360-676-6876
www.whatcomshellfish.wsu.edu

Puget Soundkeeper Alliance
206-297-7002
www.pugetsoundkeeper.org

Skagit Audubon
360-293-5951
www.fidalgo.net/~audubon

Skagit County Marine Resources Committee
360-336-9400
www.nwstraits.org/skagit.html

Washington Department of Agriculture
360-902-1800
www.wa.gov/agr

Washington Department of Ecology
360-738-6250
www.ecy.wa.gov

Washington Department of Fish and Wildlife
360-902-2200
www.wa.gov/wdfw

Washington Department of Health
1-800-525-0127
www.doh.wa.gov

Washington Department of Natural Resources
360-902-1000
www.wa.gov/dnr

Whatcom County Marine Resources Committee
360-676-6876
www.whatcom-mrc.wsu.edu

Glossary

Anadromous: fish, such as salmon and sea-run trout, that hatch in fresh water, live part or the majority of their lives in salt water but return to fresh water to spawn

Bioaccumulation: an increase in the concentration of a chemical in a biological organism over time

Brackish: containing some salt

Dredge: to remove mud and sediment from the bottom of water bodies. This can disturb the ecosystem and cause silting that can kill or harm aquatic life. Dredging of contaminated muds can expose biota to heavy metals and other toxics.

Endangered: any species which is in danger of extinction throughout all or a significant portion of its range

Estuary: where fresh water meets the sea

Fecal Coliform Bacteria: bacteria common to the intestinal tract of mammals; Indicates waste from livestock or humans and may be a sign of disease-causing pathogens from a variety of sources, such as agriculture or leaking septic tanks

Habitat: the specific environment in which an organism lives and on which it depends for food and shelter

Hardpan: a layer of hard subsoil or clay; a foundation such as bedrock; hard, unbroken ground

Herbicide: a chemical that kills plants

Impervious Surfaces: surfaces, such as streets, parking lots and rooftops that can block rain from soaking into the ground and increase the volume of water running, often polluted, into streams and lakes

Intertidal Zone: the area between the extremes of high and low tide

Nearshore: the area from 65 feet below mean low water to 200 feet upland of the ordinary high water mark. Includes habitat types such as eelgrass and kelp beds.

Niche: the set of functional relationships of an organism or population to the environment it occupies; the area within a habitat occupied by an organism

Non-Point Source Pollution: pollution which does not originate from a single source or point but from runoff, leaking septic systems, landfills, etc.

Pesticide: man-made chemicals used for control of target organisms; includes insecticides, herbicides, fungicides, and other biocides

PCBs (polychlorinated biphenols): strong, stable, non-burning chemicals used in electrical equipment such as capacitors and transformers, and by-products of a variety of industrial products

PAHs (polycyclic aromatic hydrocarbons): a specific type of aromatic hydrocarbon released naturally from volcanoes and forest fires; a pollutant from automobile exhaust, oil spills, and burning of coal, oil, gas, and garbage

Point Source Pollution: a discharge from a specific polluter, such as a factory, or sewage treatment plant

Riparian Zone: the border of a stream or river above its banks

Salmonid: members of the family Salmonidae; includes salmon, trout, chars, and whitefish

Sediment: fine soil or mineral particles

Spawn: to deposit and fertilize fish eggs

Stock: a race or run of a fish species that spawns at a specific time or in a specific stream from others of its species

Stormwater Runoff: rainwater that washes contaminants over the land and into our waterways

Subtidal Zone: the region below low tide

Threatened: a species likely to become endangered in the foreseeable future

Watershed: all of the land that carries rainfall to a given river, creek, lake or bay

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