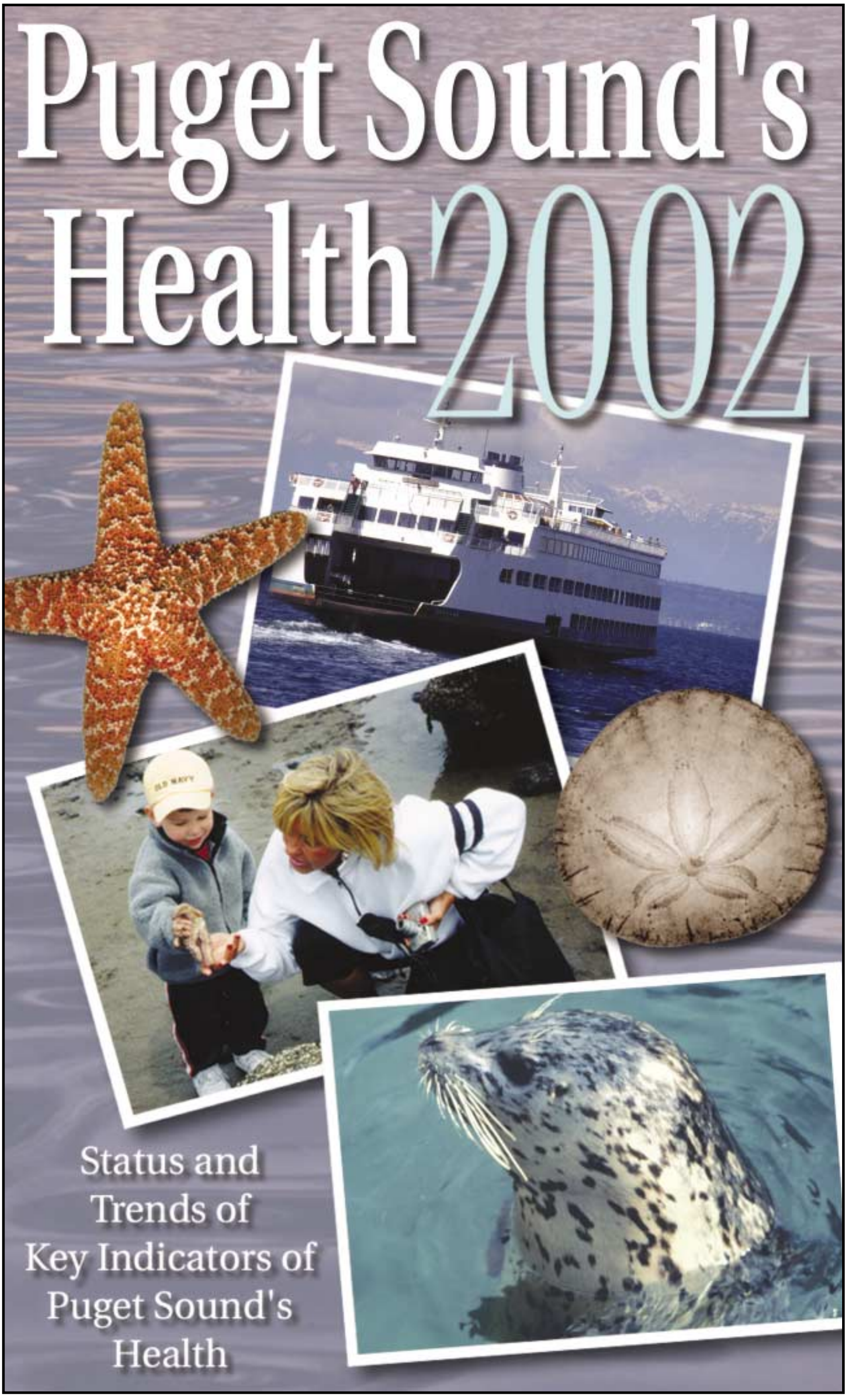
Puget Sound's Health 2002



Status and Trends of Key Indicators of Puget Sound's Health

PUGET SOUND WATER QUALITY ACTION TEAM

Puget Sound's Health 2002

Introduction

This is the Puget Sound Water Quality Action Team's third report on key indicators of Puget Sound's Health. We prepared the report in response to the Washington State Legislature's request to evaluate efforts to protect Puget Sound. The report includes updated information on the 17 indicators presented in 2000 as well as information on two new indicators.

Indicators are measures that can be tracked through time to assess the successes and shortcomings of our efforts to protect and restore Puget Sound. They help us to understand where we are making progress, where we need to redouble our efforts, and where new solutions might be needed.

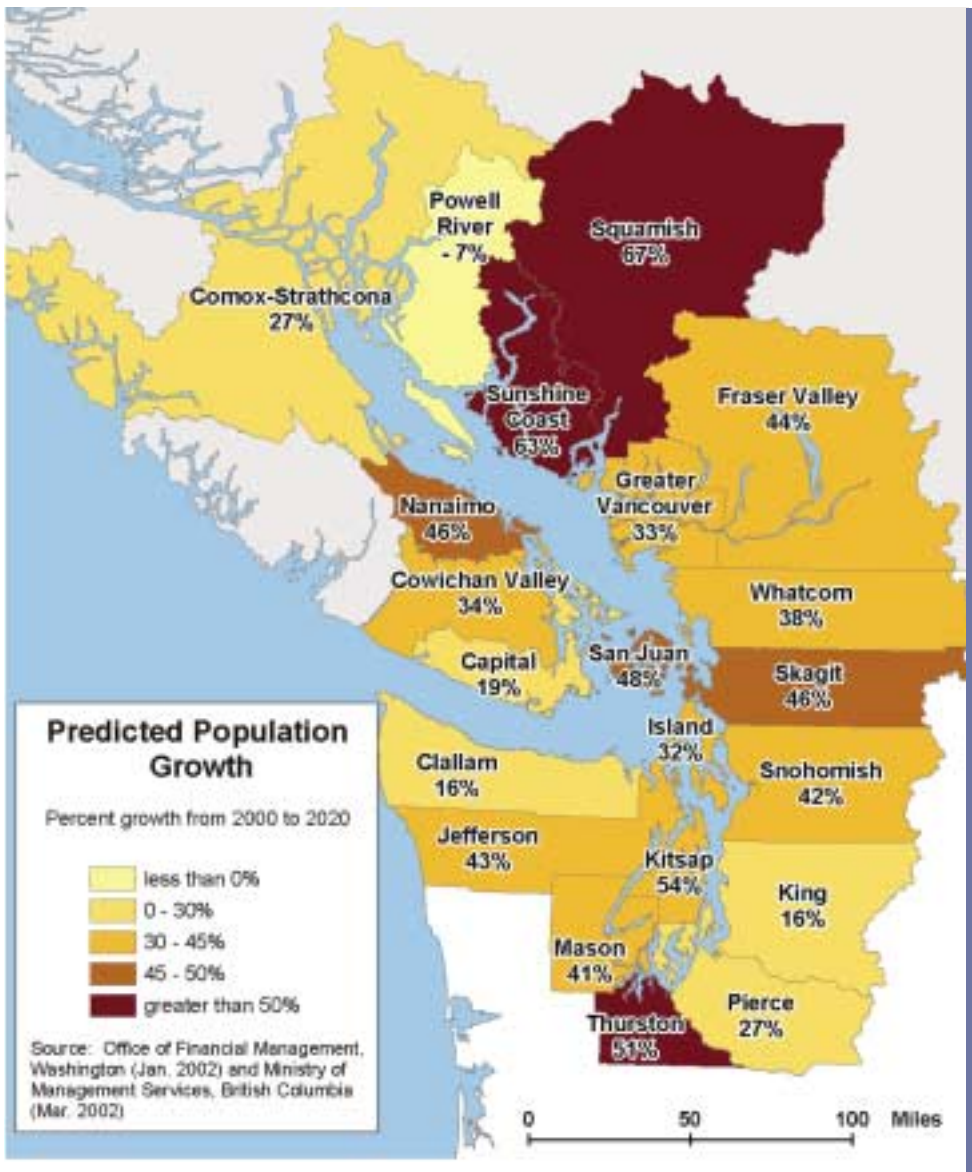
We hope that *Puget Sound's Health* helps you and others who live and work in the Puget Sound region to focus on the Sound as a patient in our care. The environmental indicators presented in this report are the vital signs that we use to measure the health of Puget Sound. Our combined efforts to protect and restore Puget Sound may be seen as treatments designed to fix problems and as advice about the lifestyle choices that will help ensure the continued health of the Puget Sound ecosystem. As you learn about the vital signs we are tracking, we hope you will seek opportunities to contribute to a healthier Puget Sound. (We offer some ideas on page 16.)

We recognize difficulties and risks in presenting a small set of environmental indicators as measures of the performance of Puget Sound protection:

- The environment is continually changing. It is often difficult to determine whether changes observed in environmental indicators reflect natural factors (such as varying ocean conditions) or relate to human actions.
- Our actions and programs to protect and restore Puget Sound do not always have a simple relationship to environmental results. Several programs may act together to bring about the changes we observe in the environment. Actions taken today may not result in an environmental response for a number of years. And, the positive results of our actions and programs might be lost because of the increasing stresses from our region's rapidly growing human population.
- Vital signs, such as the environmental indicators that we track and present in this document, offer a simplified view of a complex system. Selection of a limited number of indicators necessarily limits the breadth and diversity of information that is presented. Turning complex data into simple indicators can sacrifice some of the richness of the underlying information. For more information on conditions in Puget Sound, visit the Puget Sound Water Quality Action Team's website or call us (see back page).

What's Inside:

Puget Sound environmental indicators are designed to answer these questions:



Puget Sound/Georgia Basin

The shoreline of Puget Sound and the Georgia Basin is some of the most rugged and beautiful in the world. The protected marine waters of Puget Sound and the Georgia Basin provide invaluable habitat for fish and wildlife, including the region's renowned Pacific salmon and orca whales. The region supports one of the leading trade centers on the West Coast of North America and is a gateway to some of the continent's busiest ports including Seattle, Tacoma and Vancouver, BC.

Much of the promise and potential of this region is based on natural resources and the industries these resources support, such as tourism, shellfish and recreation. The region's natural resources and high quality of life have led to good economic growth, resulting in ever-increasing numbers of people who live and work here. In 2000, the Puget Sound portion of the basin was home to nearly four million people—double the population of the mid-1960s. Approximately three million people live within the Georgia Basin in Canada. By 2020 the population is expected to be greater than five million people in the Puget Sound basin—29 percent more people than living here today. Also by 2020, four million people are expected to be living in the Georgia Basin (35 percent more people than today). This would bring the total Puget Sound/Georgia Basin population from today's seven million to nine million in 2020.

A growing population means increasing stress on Puget Sound. For instance, the number of miles driven around and through the central Puget Sound region has been growing at about the same pace as the population. The more miles driven on Puget Sound's highways and roads, the greater the possibility of spills of oil and petroleum products and the greater potential for contamination of runoff from highways, roads and parking lots. Stormwater runoff from developed areas is a significant water pollution problem because of the contaminants from those surfaces.

Puget Sound's Health 2002

Written by Pete Dowty and Scott Redman with contributions from Washington State Departments of Agriculture, Ecology, Fish and Wildlife, Health, Natural Resources, the National Oceanic and Atmospheric Administration (NOAA), Fisheries and Oceans Canada, and the Transboundary Georgia Basin/Puget Sound Environmental Indicators Working Group.

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Designed by Jill Williams.

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If you need this report in an alternative format-large print, Braille or cassette tape-please contact the Action Team at (360) 407-7306.

The Puget Sound Water Quality Action Team and the Puget Sound Council

The Puget Sound Water Quality Action Team works with federal, state, tribal and local governments, citizens and businesses to develop and carry out two-year work plans that guide protection of water quality and biological resources. The biennial work plans, based on the *Puget Sound Water Quality Management Plan*, outline the state of Washington's long-term strategy for protecting Puget Sound.

Members of the Action Team include a chair appointed by the governor; representatives of a federally recognized tribe, a city and a county, each appointed by the governor; the heads of ten state agencies; and the regional heads of the U.S. Environmental Protection Agency, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service.

The Puget Sound Council advises the Action Team on work plan projects and activities, and on coordination with other state and local activities. Council members are responsible for tracking the progress of state agencies and local governments in carrying out the biennial work plan. They also recommend changes to the *Puget Sound Water Quality Management Plan* as needed.

The governor appoints eight of the Council's members. They include the chair of the Action Team, who also serves as chair of the Council, and representatives of agriculture, business, cities, counties, the environmental community, the shellfish industry and tribes. The leadership of the state Senate and House of Representatives also selects four legislators to be Council members.

STATE OF WASHINGTON
PUGET SOUND WATER QUALITY ACTION TEAM
OFFICE OF THE GOVERNOR

April 2002

Dear Puget Sound Citizen:

Thank you for your continued interest and involvement in protecting Puget Sound, one of our nation's greatest natural treasures. In these times of economic unrest and heightened concerns for security, we can be thankful for this remarkable place we call home.

As directed by state law, the Puget Sound Water Quality Action Team is proud to report on the health of water and marine life in your Puget Sound. Puget Sound's Health 2002 is our third such report and presents information mostly compiled from 1980 through 2001. We hope the information in this report will increase your understanding about the health of the Sound—the quality of water in shellfish growing areas, harbor seal populations, coho salmon returns to Puget Sound rivers, disease in English sole in urban bays, and other measures.

Much of the news about Puget Sound's health is good, such as an improvement in the marine survival of coho salmon. Unfortunately, we are also faced with evidence of continuing concerns about sediment (the sand and mud bottoms of waterways that provide food for aquatic life), water quality, and declines in a variety of marine organisms in Puget Sound. A primary concern is the pattern of declines observed in recent years in species such as rockfish and herring. This pattern suggests that significant ecosystem changes, which we are only beginning to understand, may be underway.

Puget Sound's Health 2002 reminds us that the number of people living and working in the Puget Sound region continues to grow. As many of us experience every day, that's bad news for people who sit in their cars in traffic. The increased traffic is an obvious result of more of us living in Puget Sound. The growing number of people also causes problems for water quality, Puget Sound's animal and plant life, and tribal, commercial and sport fishermen who catch fewer fish nearly every year.

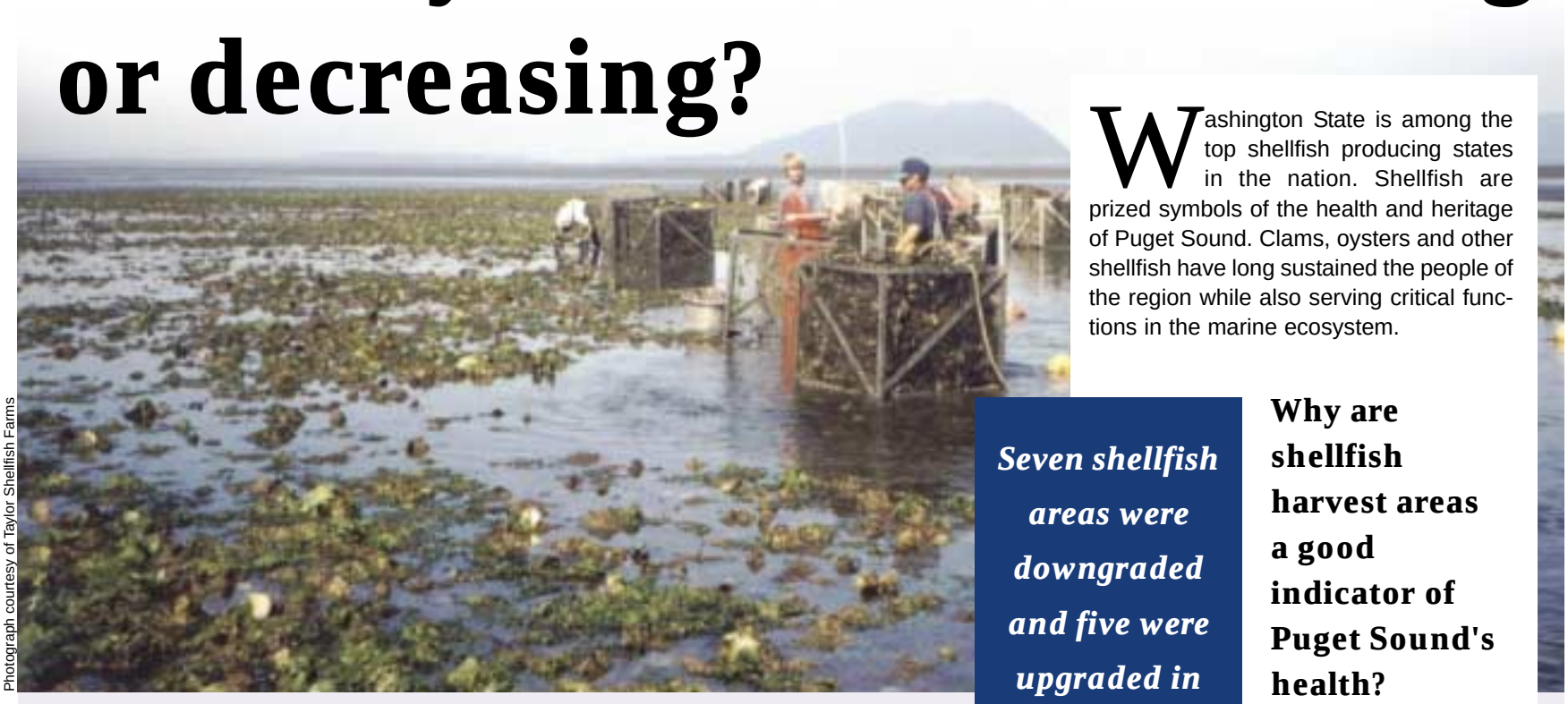
We need to work together to protect the Sound so we may continue to enjoy its beauty and resources. Citizens, service groups, businesses, and state, tribal, and local governments are working together to protect and restore many areas. You can do your part, too. Please look at the final page of *Puget Sound's Health 2002* for some ideas about things you can do to protect our cherished Sound.

Thank you.

Sincerely,

Scott Redman
Acting Chair

Are areas where shellfish can be safely harvested increasing or decreasing?



Photograph courtesy of Taylor Shellfish Farms

Washington State is among the top shellfish producing states in the nation. Shellfish are prized symbols of the health and heritage of Puget Sound. Clams, oysters and other shellfish have long sustained the people of the region while also serving critical functions in the marine ecosystem.

Seven shellfish areas were downgraded and five were upgraded in 2000-2001. There was a net upgrade of 691 acres.

Why are shellfish harvest areas a good indicator of Puget Sound's health?

The health of shellfish beds and suitability of shellfish for consumption closely reflect conditions in the shellfish growing environment. Bivalve shellfish feed by filtering large quantities of water. In this process they can accumulate bacteria, viruses and other contaminants from the water in which they live. The accumulated contaminants can harm animals, including humans, that eat these shellfish.

The state Department of Health classifies shellfish growing areas in an effort to ensure the safety of Puget Sound shellfish that reaches seafood markets, restaurants or our kitchens. The classification of shellfish growing areas provides information about the extent to which contamination restricts our ability to harvest shellfish. Changes in the classification of shellfish growing areas can reflect problems related to how land is used and cared for in the nearby watersheds.

commercial

Area of commercial shellfish beds approved for direct harvest

Status

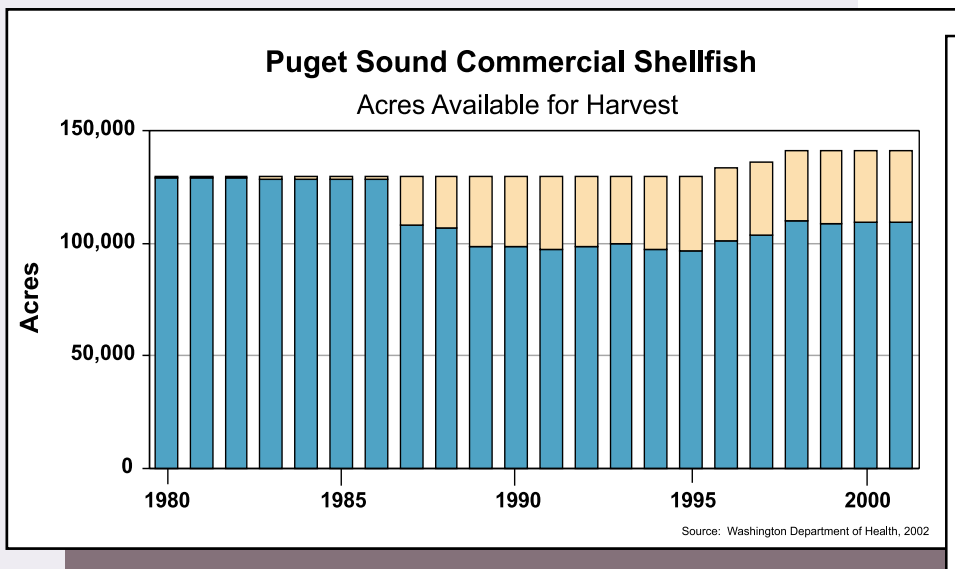
The state Department of Health currently monitors and classifies approximately 140,000 acres of shellfish growing areas for commercial harvesting in Puget Sound. They use the monitoring data to detect conditions that may lead to unsafe shellfish products and classify growing areas accordingly to prevent harvest in these areas. Since 1980, nearly one quarter of the area available for direct commercial shellfish harvesting has been downgraded in classification because of bacterial contamination.

The major threats to safe shellfish harvesting include contaminated stormwater from developed areas (runoff from streets, parking lots, etc.), discharges from sewer and septic systems, and water contaminated by livestock in agricultural areas. As the human population grows in the Puget Sound basin, the threats to shellfish become more pressing as more wastewater is generated and the loss of open land leads to more stormwater runoff. Increasingly, the coordinated efforts of local jurisdictions and the shellfish industry are counteracting threats to water quality and shellfish harvesting areas in Puget Sound.

Trends

During 2000-2001, the state Department of Health reclassified 11 shellfish growing areas based on the monitoring data the agency collects. These reclassifications resulted in the downgrade of 849 acres and the upgrade of 1,540 acres. When combined, these reflect a net upgrade of 691 acres during 2000-2001.

The area involved in these reclassifications was relatively small when compared to the large downgrades that took place in the 1980s that totaled approximately 33,000 acres. However, the net upgrade of 691 acres in the past two years affirms that pollution control efforts appear to be balancing out increasing water quality threats.



Approved or Conditionally Approved

Approved-
Shellfish can be marketed directly with no restrictions placed on harvest due to contamination or sanitary conditions.

Conditionally Approved-
Shellfish can be directly marketed only during prescribed periods. Predictable pollution events, such as storms, close harvest for a specified period based on local conditions.

Restricted or Prohibited

Restricted-
Shellfish cannot be marketed directly due to contamination. Shellfish must be moved to clean waters for a period of time prior to market distribution.

Prohibited-
Shellfish cannot be harvested due to contamination or unsanitary conditions. Relay of shellfish to clean areas for future harvest is not allowed.

Commercial shellfish growing area classifications

The state Department of Health classifies all commercial growing areas using National Shellfish Sanitation Program standards. State law prescribes a similar classification for recreational shellfish areas. 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, which potentially carries disease-causing bacteria and viruses.

What causes the temporary closure of shellfish growing areas?

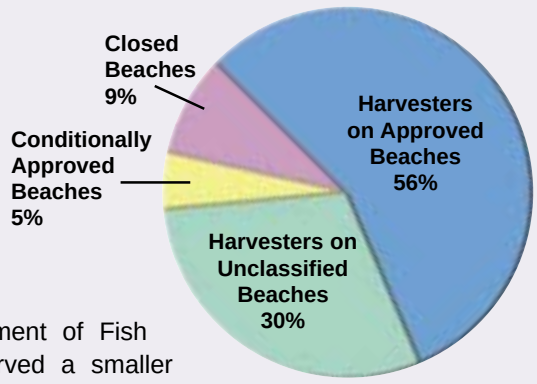
The state Department of Health may temporarily close shellfish growing areas to harvesting for a number of reasons. In some areas, storms that bring high rainfall produce a pulse of contaminated stormwater runoff that enters shellfish growing areas that are otherwise safe for harvesting. Such areas are closed by the Department of Health following high rainfall.

The state Department of Health also restricts shellfish harvesting when levels of naturally occurring toxins, such as the toxin that causes paralytic shellfish poisoning, are high. These toxins are produced by plankton that occur naturally in Puget Sound marine waters, but only reach levels of concern when the plankton reach high concentrations during blooms. These blooms do not appear to be related to contamination. There is another natural biotoxin, produced by a different species of plankton, that causes amnesic shellfish poisoning in humans, but these organisms have not been found in Puget Sound.

Photograph courtesy of Taylor Shellfish Farms

recreational

Areas used by recreational shellfish harvesters



In 2001, the state Department of Fish and Wildlife observed most recreational shellfish harvesters on Approved beaches, but 27 percent were observed on beaches not tested (Unclassified) by the state Department of Health.

Status

The state Department of Health classifies public beaches for recreational shellfish harvesting based primarily on data collected in partnership with local officials. Many public beaches have not yet been evaluated. These beaches are labeled Unclassified for shellfish harvesting.

In 2001, the state Department of Fish and Wildlife observed almost 190,000 recreational shellfish harvesters on public Puget Sound beaches. This is 23 percent fewer harvesters than observed in 2000. Most of these harvesters were observed on Approved beaches (56 percent) but 30 percent of harvesters were observed on Unclassified beaches. The safety of consumption of shellfish from these beaches is unknown. More than 17,000 harvesters (9 percent of the total) were observed on Closed beaches. The state Department of Health has designed an educational program for harvesters in an attempt to reduce this number.

Trends

The state Department of Fish and Wildlife observed a smaller number of recreational shellfish harvesters on Puget Sound beaches in 2001 as compared to the previous four years. A greater percentage of these harvesters were found on Approved beaches in 2001, relative to 1999-2000 and fewer harvesters used Unclassified beaches. The percentage of harvesters observed on Closed beaches remained the same.

Is water quality for recreation improving or declining?

Water Quality Index for fecal coliform bacteria at river and stream monitoring stations

Status

Almost three quarters (73 percent) of the state's long-term river monitoring stations within the Puget Sound basin had good conditions with respect to fecal coliform contamination. The state Department of Ecology monitors these stations monthly for fecal coliform levels and calculates a water quality index for fecal coliform bacteria. This index rates each station's annual performance relative to state water quality standards. The Department of Ecology rated the remaining stations as having fair conditions with respect to fecal coliform contamination. Scientists selected these long-term river monitoring stations to be representative of the larger watershed. They do not reflect many local water quality problems related to fecal coliform contamination. Additional data sources are used in a different ranking system to identify polluted water bodies. In 1998, the Department of Ecology identified 235 bodies of fresh water in the Puget Sound basin as impaired because of fecal contamination.

Trends

At most of the river monitoring stations, no consistent trends in fecal coliform contamination are seen in data from 1991 to 2000. However, eight stations did show a trend and seven of these showed an improvement in fecal coliform contamination between 1991 and 2000. The one exception was a worsening trend at the Cedar River station at Renton.

The rivers and streams flowing into Puget Sound provide recreational opportunities such as paddling, fishing and swimming. River and stream water is considered safe for recreation when levels of fecal coliform bacteria remain below state standards. Extremely dry conditions during November 2000 through March 2001 resulted in record low flows in many rivers reservoirs and this limited many recreational opportunities.

Fortunately, above-average rainfall and snowfall in the remainder of 2001 and early 2002 restored water levels and provided an above average snowpack.

Seven stations out of 20 showed improvement in fecal coliform conditions between 1991 and 2000.

Are the sizes and frequency of oil spills increasing or decreasing?

oil spills

Volume and frequency of "major" and "serious" spills

Trends

Major spills (10,000 gallons and over)

The volume and number of major spills in Puget Sound has remained relatively low since 1992. There were no major spills in 2000-01. Between 1985 and 2001, 16 major spills from facilities (such as refineries, depots), pipelines, vessels and barges released more than 2.2 million gallons of oil. Some of this was contained, but much of this oil reached the waters and land of the Puget Sound basin. Six spills in 1990 and 1991 released more than one half of this volume. In the last five years, only one major spill has occurred—the Olympic Pipeline spill in Bellingham in 1999.

Since 1985, shore-based facilities accounted for 52 percent of the oil spilled in major incidents (10,000 or more gallons). The remaining 48 percent of oil released in major spills was relatively evenly split between spills from pipelines (26 percent) and vessels and barges (23 percent). Heavy fuel oil and crude oil are the materials most commonly spilled in major incidents.

Serious spills (25 to 10,000 gallons)

From 1993 to 2001, the state Department of Ecology recorded 191 spills in the Puget Sound basin, where 25 to 10,000 gallons reached surface waters. Approximately 73,400 gallons of oil entered Puget Sound waters from those 191 serious spills. The annual numbers appear to be rising slightly, although the total volume remains relatively steady. Vessels were by far the greatest source of spills of 25 to 10,000 gallons. A relatively small number of the spills contributed most of the oil released in spills of 25 to 10,000 gallons.

The volume of major spills refers to the total volume spilled; in most cases, not all of the oil spilled reached surface waters.

The use of penalties, where appropriate, is an effective incentive to maintain safe practices.

Puget Sound is one the nation's leading petroleum refining centers. Approximately 15 billion gallons of crude oil and refined petroleum products are transported through the Sound each year. In addition, large quantities of oil travel through the region's pipelines.

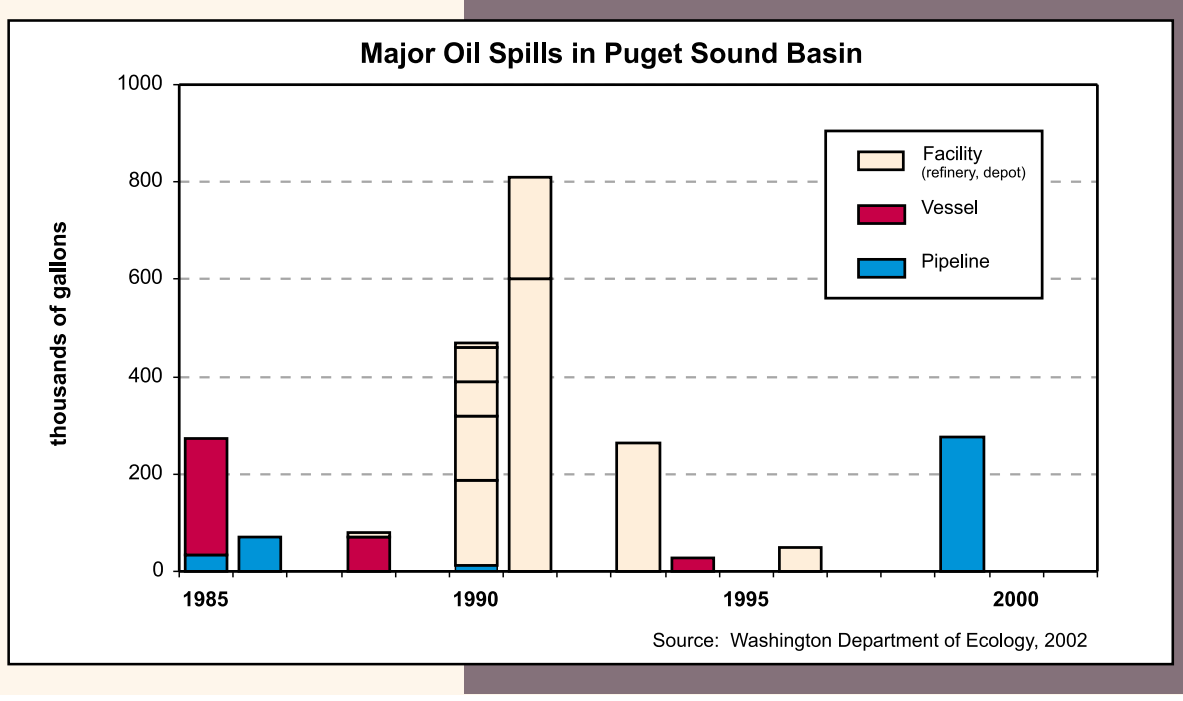
In 2000, about 39 large commercial cargo ships, tankers and oil barges moved through the Sound each day. Marine terminals, where oil is transferred between ships and land, and highway transportation by tanker trucks also contribute to the risk of major spills. Oil spills introduce contaminants into the environment at toxic levels and can immediately harm marine fish larvae, invertebrates, birds and marine mammals.

Spills Prevention

The state Department of Ecology has implemented several procedures to reduce the risk of oil spills. More than 2,600 cargo vessels are screened in a typical year to promote safe operation and maintenance. Refueling inspections help reduce the frequency of spills during fuel transfers. Oil-handling facilities maintain spill prevention plans with Ecology. Investigations of spill incidents are used to improve spill prevention. The use of penalties, where appropriate, is an effective incentive to maintain safe practices. In response to the last major spill in the state, the 1999 Olympic Pipeline spill in Bellingham, the state Department of Ecology intends to issue a penalty of $7.86 million to three companies, upon completion of settlement negotiations that also involve the U.S. Environmental Protection Agency. This would be the largest penalty ever issued by the State of Washington.

The state also maintains a rescue tugboat at Neah Bay for prevention of oil spills from disabled vessels, although the tugboat is currently funded for only 200 days of service per year.

Photograph courtesy of Washington Department of Ecology



Is the area of contaminated sediments increasing or decreasing?

Photograph courtesy of Mohsen Kourehdar, Washington Department of Ecology

Sediments—mud, silt, sand and gravel that have settled to the bottom of water bodies—cover many of the 1.8 million acres of Puget Sound's submerged lands and tidelands. The condition of the sediments in Puget Sound provides a record of historical and ongoing pollution in the region.

Why measure the acreage of contaminated sediments?

Many pollutants have an affinity for sediment particles. Whether they enter Puget Sound through spills, wastewater discharges or stormwater runoff, toxic contaminants tend to bind to sediment particles. Therefore, as sediments settle out on the sea floor they can cause accumulations of contamination. Areas of contaminated sediment can harm marine life that lives or feeds in sediments. Fish and shellfish harvested from contaminated areas can, in turn, threaten human health.

What affects the extent of contaminated sediments in Puget Sound?

Areas of contaminated sediment have developed during the past century as peoples' activities on the water, along the shoreline and in the watersheds of Puget Sound have released toxic contaminants to the environment. Many sediment contaminants do not break down very quickly.

Reduction in the acreage of contaminated sediments will occur only by eliminating sources of pollution and cleaning up contaminated sites. Cleaning up sediments can involve dredging or removing contaminated material and properly disposing of it in designated facilities. Cleanup can also entail capping the contaminated sediments with cleaner material to ensure that the contaminants remain buried so they cannot harm Puget Sound organisms.

Pollutants of Concern

Heavy metals:

- Exposure can cause reproductive failure in people and other animals.
- Sources include discarded batteries, spills of hazardous materials, car emissions, paints, dyes, polluted runoff and industrial and municipal wastewater discharges.

Polycyclic aromatic hydrocarbons (PAHs):

- Exposure can increase risk of cancer and impair immune function, reproduction and development.
- Present in fossil fuels and formed when fossil fuels and other organic materials are burned.
- Sources include stormwater runoff, industrial and municipal discharges, and spills of petroleum and petroleum products.

Chlorinated organic compounds:

- These chemicals do not occur naturally and persist in the environment for long periods before they decompose.
- They are some of the most toxic compounds known and can retard growth, reduce fertility and cause birth defects, liver damage and skin lesions in animals.
- Sources include solvents, electrical coolants and lubricants, pesticides, herbicides and treated wood.
- Examples include:
  - **polychlorinated biphenyls** (PCBs), industrial chemicals that have been banned from many uses.
  - **DDT,** a pesticide whose use was banned in the United States in the 1970s;
  - **dioxins** and **furans** which are formed as by-products of some industrial processes using chlorine.

sediments

Area of contaminated sediments and number of cleanup sites

Status

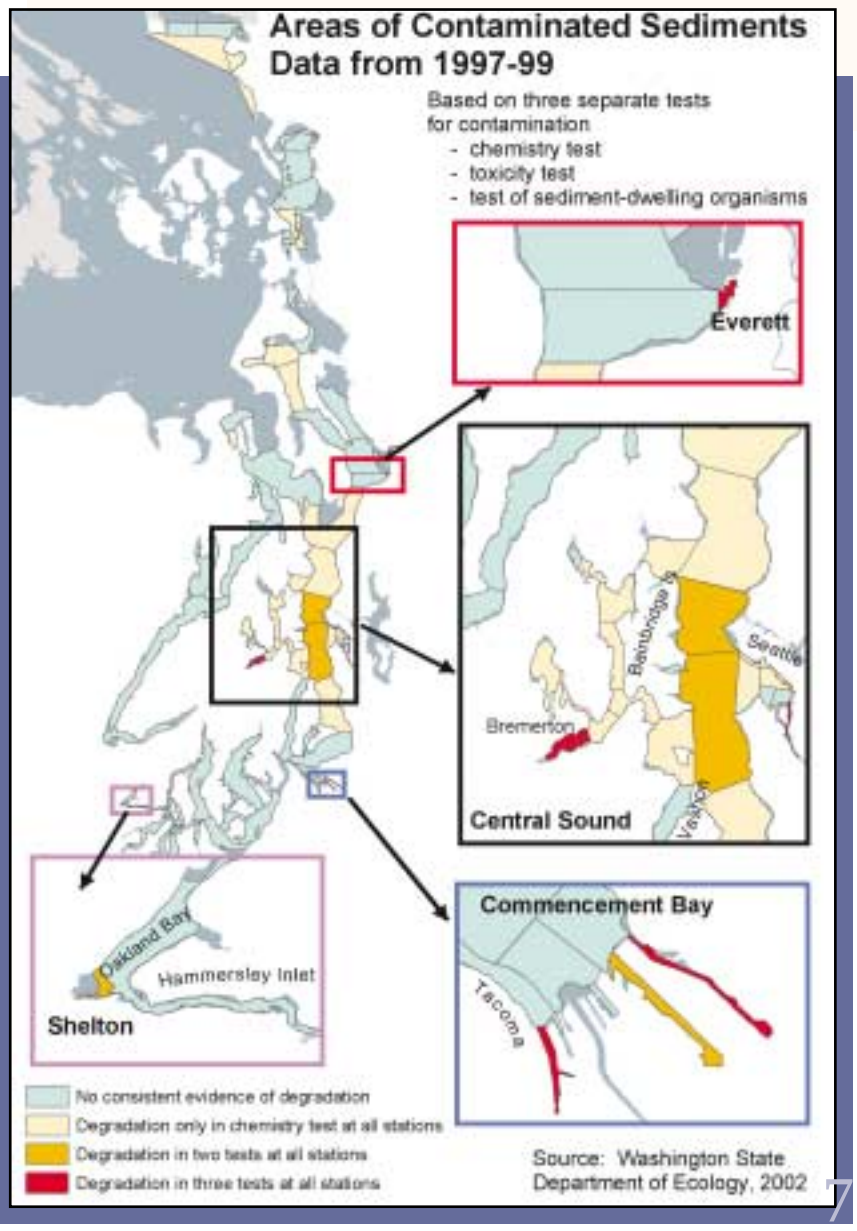
As of 2001, the state Department of Ecology has identified 112 contaminated sediment cleanup sites in Puget Sound. These sites cover an estimated 3,400 acres of marine sediments in the Sound's urban waterways.

A 1997 to 1999 study by state and federal scientists provides additional information about the pattern and extent of sediment contamination in Puget Sound. This study found that 8,700 acres (1.5 percent) of soft sediment in Puget Sound (excluding the San Juan Islands and the Strait of Juan de Fuca) is contaminated. Approximately 10 times that area (another 83,000 acres) is less severely contaminated.

Trends

As of 2001, 22 sites of contaminated marine sediment have been cleaned up or require no cleanup actions. Federal, state, local agencies and private parties are currently cleaning up 11 more sites. An additional 79 sites still need to be cleaned up and 65 of these are in the investigation and design phases leading to cleanup.

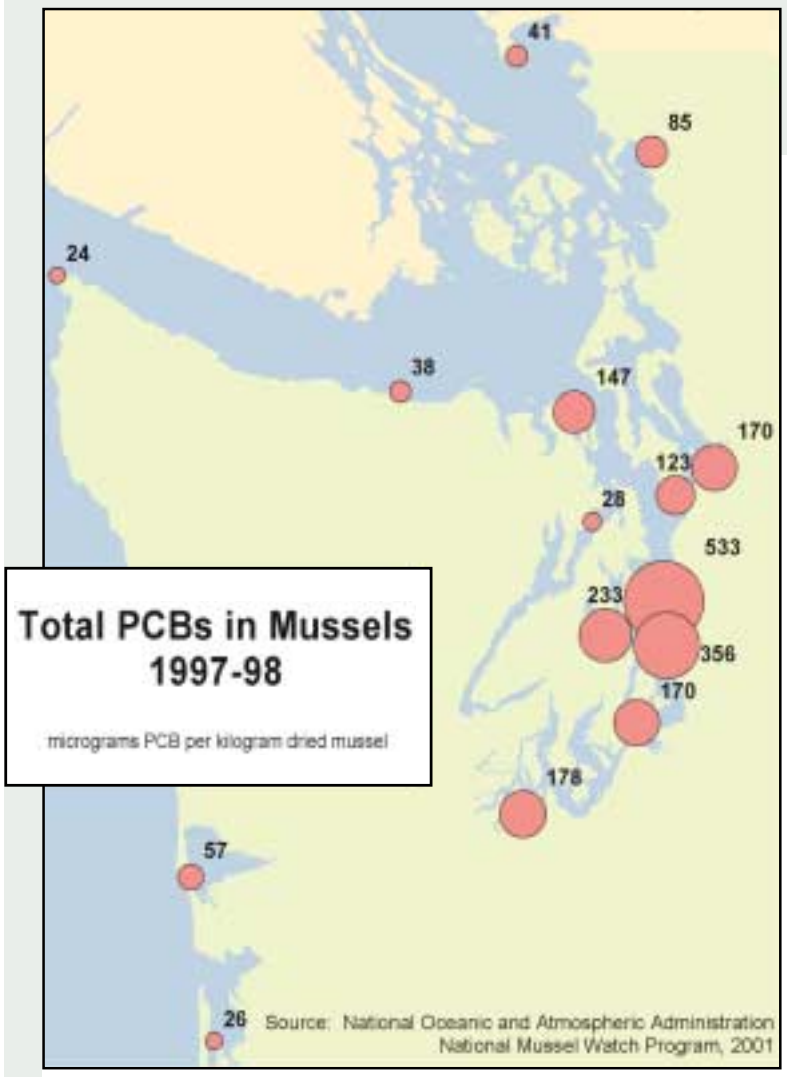
Long-term monitoring by the state Department of Ecology indicates that concentrations of some contaminants (e.g., naphthalene and other smaller PAHs) have increased during the past few years while concentrations of other contaminants (e.g., copper and mercury) have decreased.



Is toxic contamination of marine species increasing or decreasing?

mussels

Contaminants in mussels



Status

Photograph courtesy of Dan Cheney

Mussels filter large quantities of water and can accumulate toxic contaminants that are present in that water. NOAA's National Mussel Watch Program sampled contaminants in mussels in 1997 and 1998 at 13 Puget Sound stations. A few organic contaminants—especially PAHs (see p.7 "Pollutants of Concern")—accumulate to higher concentrations in Puget Sound mussels than in shellfish from elsewhere around the country. Arsenic and many metals, including copper, lead, mercury and silver are present at lower levels in Puget Sound mussels than observed elsewhere in the country.

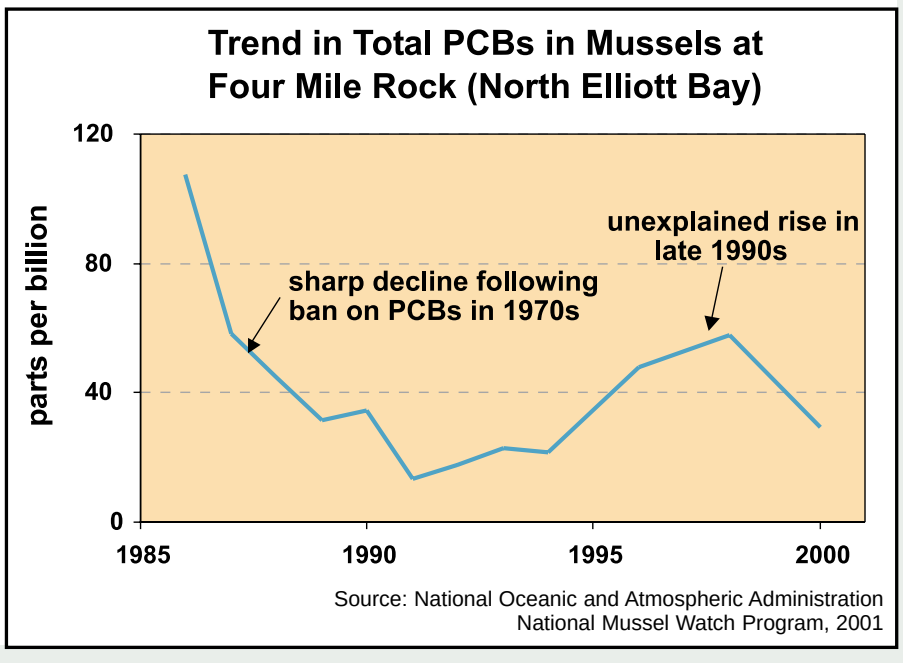
PCBs (see p.7) have been of special concern in Puget Sound. During the 1997-98 Mussel Watch Program, total PCB concentrations in Puget Sound mussels ranged from 24 ppb (parts per billion) at Cape Flattery to 533 ppb at Four Mile Rock beach near Magnolia (north Elliot Bay, Seattle). PCB concentrations in Puget Sound mussels are generally higher than on the outer coast but PCBs are found there also. On average, the PCB concentrations in Puget Sound mussels were neither exceptionally high nor exceptionally low compared to the rest of the US.

Some chemicals that people introduce into Puget Sound are highly toxic to various forms of life.

Trends

The NOAA National Mussel Watch data through 1998 provided evidence for multiple Puget Sound locations of long-term declining concentrations of the long-banned pesticides chlordane and DDT, and several metals such as lead and mercury. However, it also appeared that PCBs were no longer decreasing and possibly increasing during the mid to late 1990s. NOAA scientists have now used newly available data from 1999-2001 to construct a 16-year record of PCBs and have identified three important patterns. First, it is clear that concentrations of PCBs in mussels have generally been declining during the past two decades following the banning of most PCB uses in the 1970s. Second, the highest concentrations were consistently found in mussels from central Puget Sound sites such as Four Mile Rock (north Elliott Bay) and adjacent areas confirming this urban area as a long-term source for PCBs.

Finally, the long-term downward trend was interrupted unexpectedly in the mid-1990s by increases in PCBs at many locations. Fortunately, between 1999 and 2000, PCB concentrations in mussels began to decrease again. These data now indicate that we cannot be certain that PCBs will continue to decline at the dramatic rates seen during the 1970s to early 1990s.

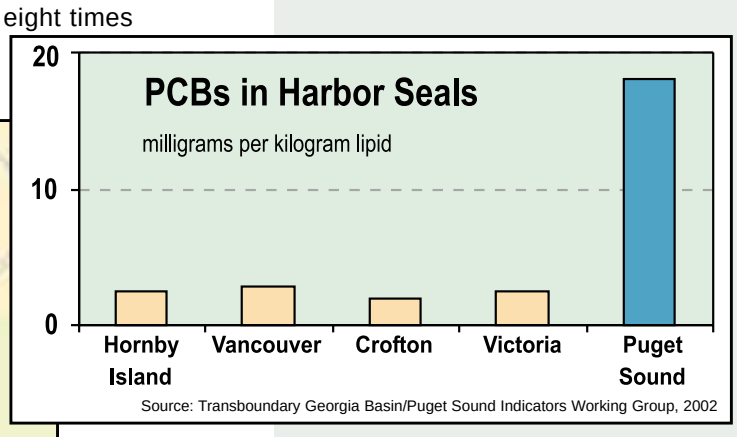


harbor seals

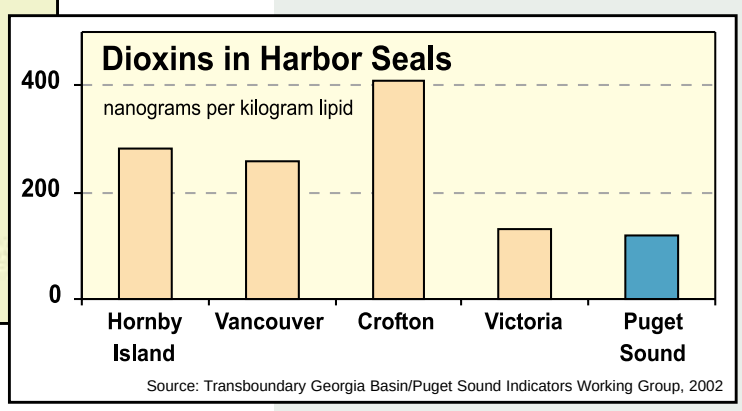
Contaminants in harbor seals

Status

Harbor seals feed relatively high in the food web and accumulate contaminants from their food—primarily fish. These contaminants tend to accumulate in fatty tissue made up of lipid compounds. Results from contaminant analysis are reported per unit of lipid. Harbor seals from Puget Sound have levels of PCBs (see p.7) up to eight times higher than those in the Strait of Georgia. These differences probably reflect higher levels of industrial PCB usage in Puget Sound before the 1970s ban on PCBs.



In contrast to PCBs, the levels of dioxins (see p.7) were higher in Strait of Georgia harbor seals than in Puget Sound seals. These elevated concentrations in the Strait of Georgia are mainly a result of the discharge of these chemicals from the British Columbia pulp and paper mills in the late 1980s and early 1990s.



Trends

There was a sharp decline in measured levels of PCBs and DDT in Puget Sound harbor seals through the 1970s and afterwards. This was a result of the widespread restrictions placed on their use in the early 1970s. These declines have leveled off since the mid-1980s as contaminated land and sediments continue to release PCBs into the marine food web.

english sole

Occurrence of liver lesions in English sole

Photograph courtesy of Randy Shuman ©

Status

Scientists routinely monitor English sole at six Puget Sound locations. They have found that English sole had significantly elevated occurrence of liver lesions at two urban sites (Seattle waterfront in Elliott Bay and Thea Foss Waterway in Commencement Bay) and one near-urban site (Port Gardner near Everett). The risk of developing liver lesions was compared to reference areas in Puget Sound that were used to define baseline risk. PAH concentrations in sediments are also elevated at these three sites. These results indicate that the health of bottom-dwelling fish in Puget Sound is worse off in areas where sediments are contaminated.

Trends

The risk of developing liver disease increased in English sole sampled along the Seattle Waterfront between 1989 and 1998, but decreased in 1999 and was low again in 2000. No increasing or decreasing trends were evident at the other sites.

Numerous sediment capping projects have been completed to the north, south and in the immediate vicinity of the Seattle waterfront site since 1989. Collectively, these projects may have lowered the PAH concentrations in sediments and reduced PAH exposure to English sole feeding in this area. The lower risk of English sole developing liver disease in 1999 and 2000 may be due to an overall reduction in the amount of PAHs present in the surface sediments along the whole of the Seattle waterfront.

Why measure liver lesions?

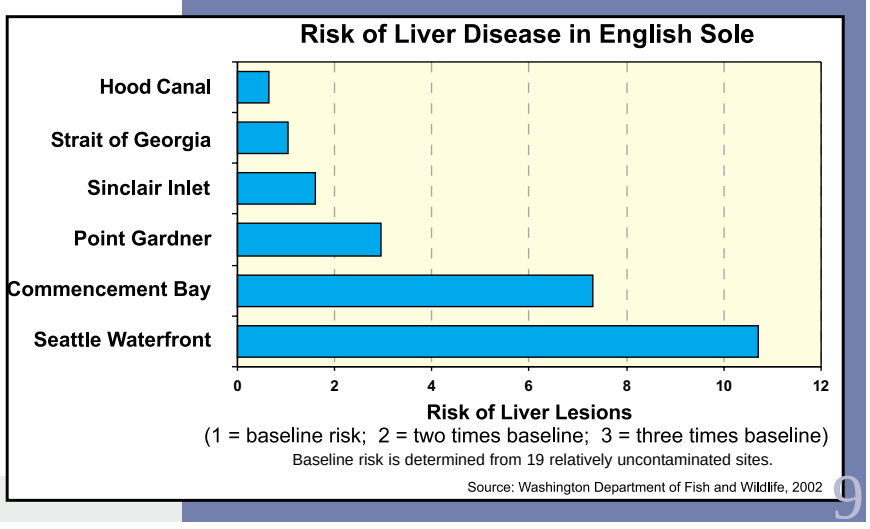
PAHs and other contaminants that English sole encounter in the bottom sediments of Puget Sound can cause a variety of harmful effects. Development of liver lesions, which are growths of abnormal tissue in the liver, may be one of these effects. Other indicators of toxic contaminants reflect the presence of contaminants in the environment or in the tissue of marine organisms. The occurrence of liver disease in English sole provides one measure of the effects of contaminants on fish health in Puget Sound.

What causes liver lesions in English sole?

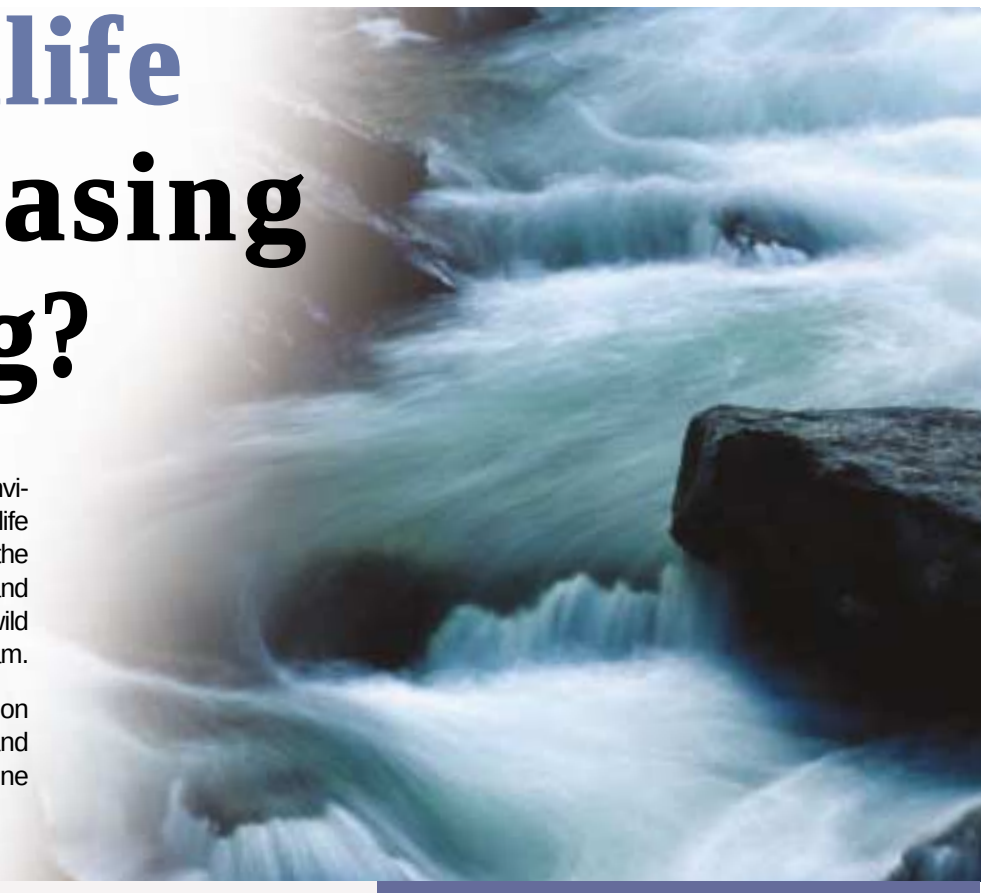
The National Marine Fisheries Service and the state Department of Fish and Wildlife have identified three primary risk factors associated with liver disease in English sole:

- Exposure to PAH contaminated sediments.
- Fish age.
- Exposure to PCB contaminated sediments.

Researchers have linked higher than normal occurrences of liver lesions with lower rates of reproduction in English sole.



Is fish & wildlife habitat increasing or decreasing?



Human development significantly alters the Puget Sound environment, often causing changes that damage fish and wildlife habitats. Habitat loss and degradation are major threats to the health and well-being of Puget Sound's fish and wildlife. Protecting and restoring habitat is a key element of the state's strategy to recover wild salmon and is a priority of the Puget Sound Water Quality Action Team.

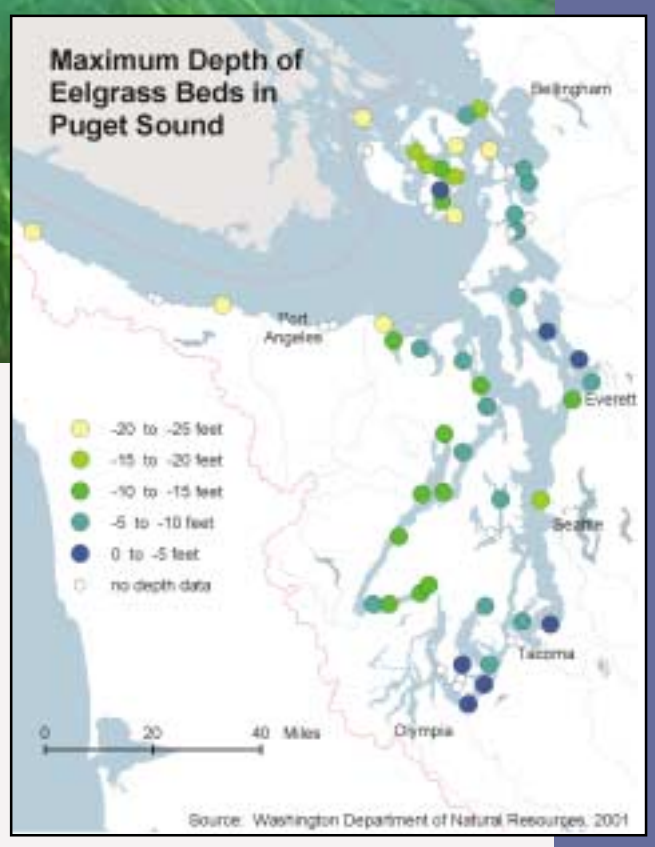
Habitats at risk from direct human development and construction activities include freshwater habitat for salmon and other fish and Puget Sound's fringe of shallow subtidal, intertidal and shoreline habitats known as the marine nearshore.

eelgrass beds

Abundance and distribution of eelgrass beds

Eelgrass beds are important habitats in marine and estuarine waters because they are home to many small organisms that are food for larger species, and they provide protective cover for migrating salmon, other fish, and many other kinds of marine life. Eelgrass also supplies organic material to nearshore areas and its roots stabilize the sediments.

Photograph courtesy of Randy Shuman ©



Status

Based on the first year of a new eelgrass monitoring project, the state Department of Natural Resources estimates that Puget Sound is home to approximately 26,000 acres (or nearly 41 square miles) of eelgrass.

Eelgrass beds are divided into two habitat types. A significant amount of eelgrass occurs in flats, which can be large shallow bays or small pocket beaches. Close to one fifth of all the eelgrass in Puget Sound grows in one large flat, Padilla Bay.

Eelgrass also occurs in narrow fringing beds along steeper shorelines. These fringing beds are used as corridors for migrating salmon and other wildlife. About one-half of all eelgrass in Puget Sound occurs in fringing beds.

In Puget Sound the maximum depth to which eelgrass grows can be as shallow as 2.5 feet below the low tide line to greater than 30 feet deep. Much of the eelgrass in Puget Sound is subtidal; half of the 67 areas sampled for this monitoring program had eelgrass extending to depths greater than 10 feet below the low tide line.

Trends

This first year of data provides a valuable baseline estimate of the eelgrass resource that will be used to estimate trends in the future as the monitoring program continues. At the current level of effort, the monitoring program will be able to detect as little as a 20 percent change in eelgrass abundance during a 10-year monitoring period. Knowing how much of a resource exists and how it is changing is the first step to better protecting it for salmon and other wildlife.

Why Monitor Eelgrass?

Eelgrass and other seagrass species are used as an indicator of estuary health throughout the world because they respond to many natural and human caused environmental variables. Changes in abundance or distribution of this resource are likely to affect other species that depend on eelgrass habitat. Abundance describes the total amount of the resource and is measured by calculating the percent coverage within an eelgrass bed, or basal area coverage (area of plant at base). Vertical distribution is characterized by measuring the maximum water depth of eelgrass beds, which affects the amount of light available to the plants. Tracking changes in both these measurements over time will help us learn how this resource is changing.

What affects eelgrass beds?

Eelgrass, like other plants, needs light, nutrients, and the appropriate substrate, or bottom sediments, to grow and thrive. Light availability and quality are the most important factors controlling growth and distribution of eelgrass beds. Light in the water column (the vertical depth of water from the surface to the bottom) depends on the amount of sunlight available and the water clarity and quality. People's actions, climate changes, and extreme weather events can harm water quality.

Two main factors that control light in the water column are nutrients and suspended sediments. Both have marine as well as land based sources. The relationship between nutrients in marine waters and eelgrass is complicated. Eelgrass primarily uses nutrients in the substrate for growth. However, excess nutrients in the water, often due to the runoff of excess fertilizer, can spur algae to grow on eelgrass leaves and in the water column. Algae can limit eelgrass growth by reducing the amount of light that reaches eelgrass leaves. In Puget Sound, suspended solids such as silt and other particles in the water column also reduce light availability. Suspended solids come from erosion runoff, dredging activities, rivers and storms.

Substrate type, wave energy, and other environmental conditions also determine the amount and distribution of eelgrass in Puget Sound. One recent concern is physical alteration of the shoreline to protect or support shoreline property development (see related indicator; p.11). The resulting structures can increase wave energy and alter substrate type creating nearshore areas less able to support eelgrass beds.

marine shorelines

Modifications to marine shorelines

People have modified Washington State's shorelines extensively. Shoreline modification, such as bulkheads or seawalls, tends to harm habitat through conversion of tidelands to uplands. Modification also indirectly affects habitat by altering nearshore processes. The amount of modified shoreline in an area can be a useful indicator of the effect people have on the nearshore environment.

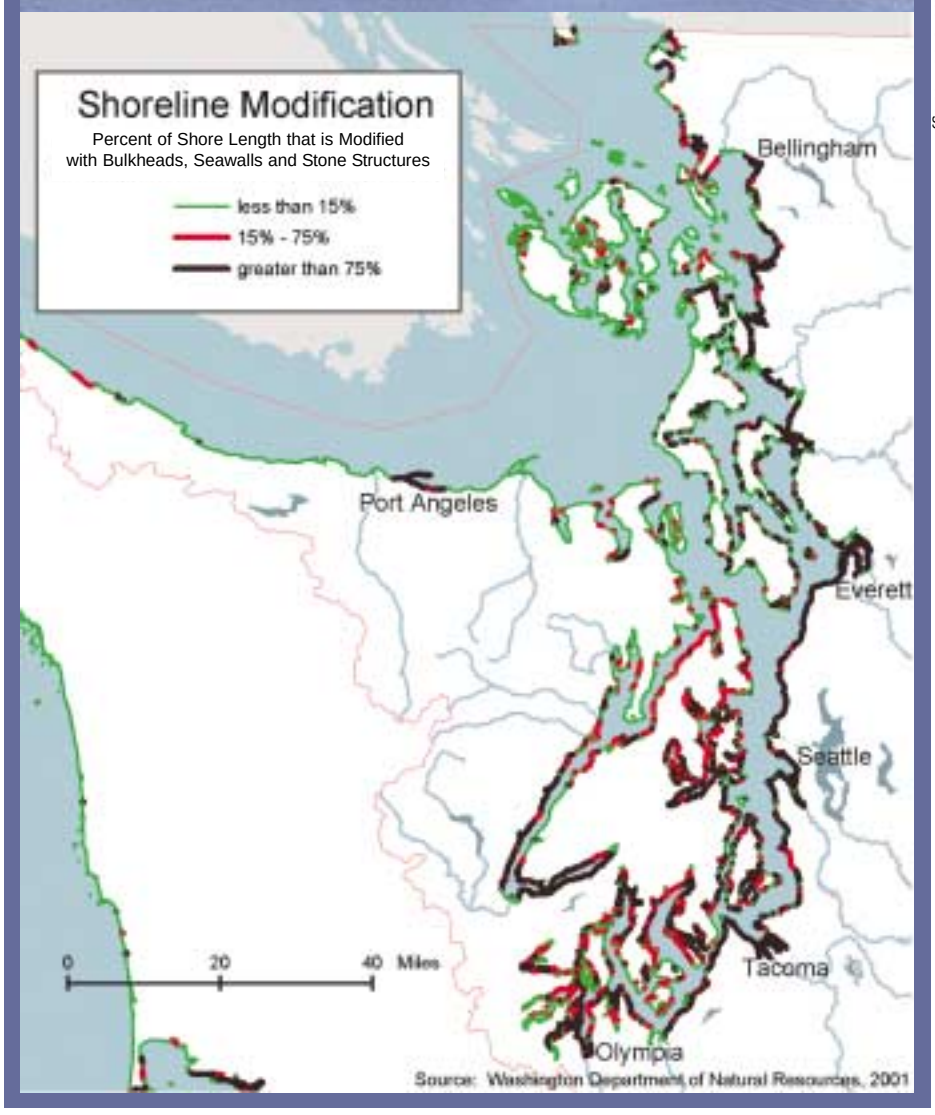
Scientists with the Nearshore Habitat Program at the Department of Natural Resources inventoried the extent of shoreline modification as part of a statewide inventory of saltwater shorelines (the ShoreZone Inventory) that was completed in 2000.

Status

Approximately one-third of all saltwater shorelines in Washington State have some of kind of shoreline modification structure, such as a bulkhead. Given that shoreline modification is known to degrade nearshore habitat, this finding suggests that one in every three feet of saltwater shoreline in the state may be impaired.

Few changes have been made to the outer coast, however, people have made extensive changes to Puget Sound. The large river deltas in Puget Sound are some of the most extensively modified areas, including the Commencement Bay / Puyallup River areas, and the Elliott Bay / Duwamish River areas. These urban bays were once highly productive estuarine deltas. Snohomish and King Counties have the most highly modified shorelines. San Juan County has the lowest modification overall because the county is less heavily developed, and many of the shorelines are rocky and do not tend to erode. The ShoreZone Inventory also indicates that the state has approximately 1,200 boat ramps, 3,600 piers and docks, and 30,000 recreational boat slips.

Photograph courtesy of Hugh Shipman, Washington Department of Ecology



freshwater habitat

Freshwater habitat available to salmon

Rivers, streams, lakes and wetlands are all critical to the survival of salmon and steelhead species. They provide food, shelter and spawning and rearing habitat. When fish-bearing streams cross roadways, migrating fish must use culverts designed to carry water. Many existing culverts are barriers to fish passage because of improper design, changes in watershed hydrology or because of deterioration and the need for maintenance. These culverts take away habitat as upstream aquatic areas are made unavailable for spawning and rearing. Fortunately this habitat loss is reversible when barrier culverts are maintained or replaced, but this is a slow and costly process.

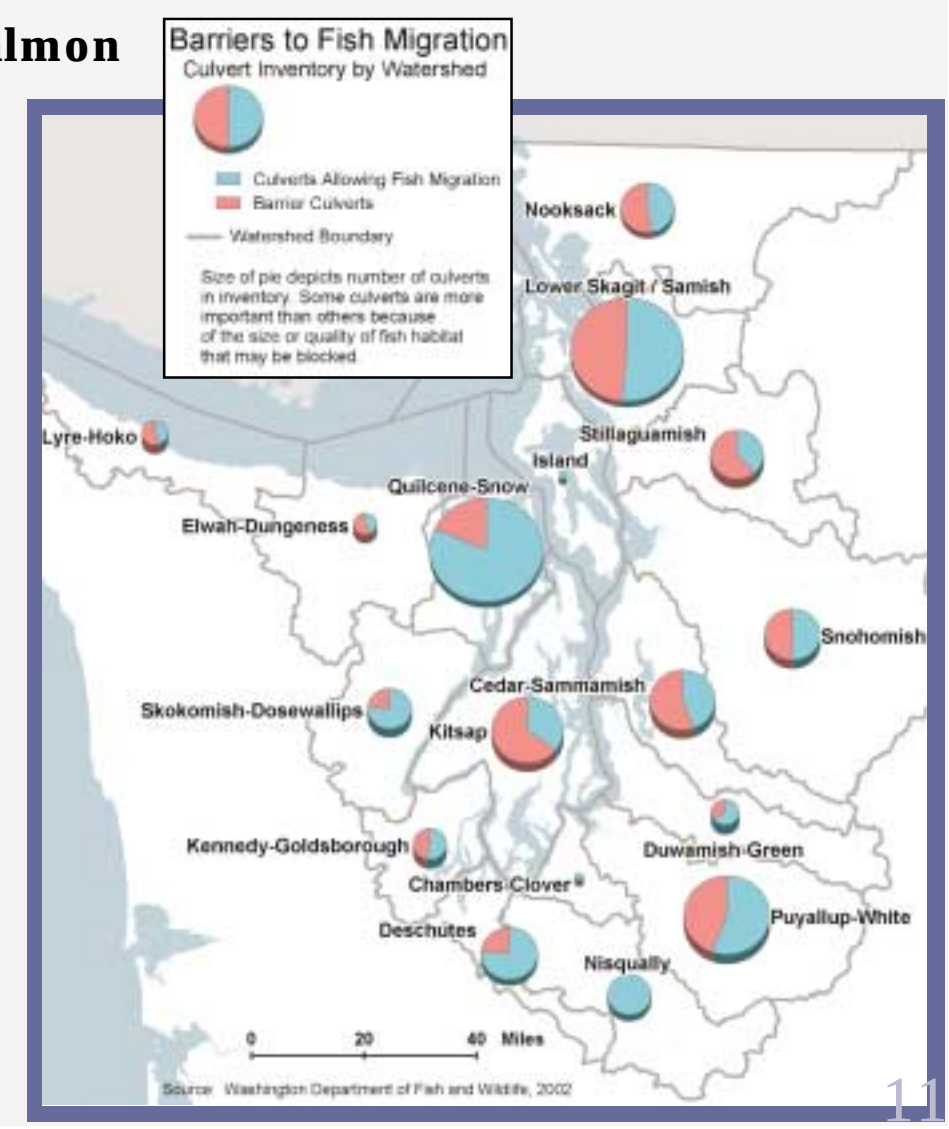
Status

There is no comprehensive inventory of culverts along the 170,000 miles of public and private roads in Washington State. The state Department of Fish and Wildlife and state Department of Transportation jointly maintain the most complete inventory of culverts, known as the Salmonid Screening, Habitat Enhancement and Restoration (SSHEAR) Fish Passage database.

As of early 2002, the SSHEAR inventory identified 3,526 culverts on fish-bearing (or potentially fish-bearing) streams in the Puget Sound basin. Fifty-two percent of these culverts, or 1,828 culverts, act as either partial or total fish passage barriers.

Trends

New culvert assessments during 2000-01 increased the inventory in the SSHEAR database by 37 percent. This reflects a substantial effort to inventory and assess Washington culverts, yet the state Department of Fish and Wildlife estimates that the SSHEAR database represents only 10 to 15 percent of the culverts in Washington State.



water temperatures

Water temperatures at river and stream monitoring stations

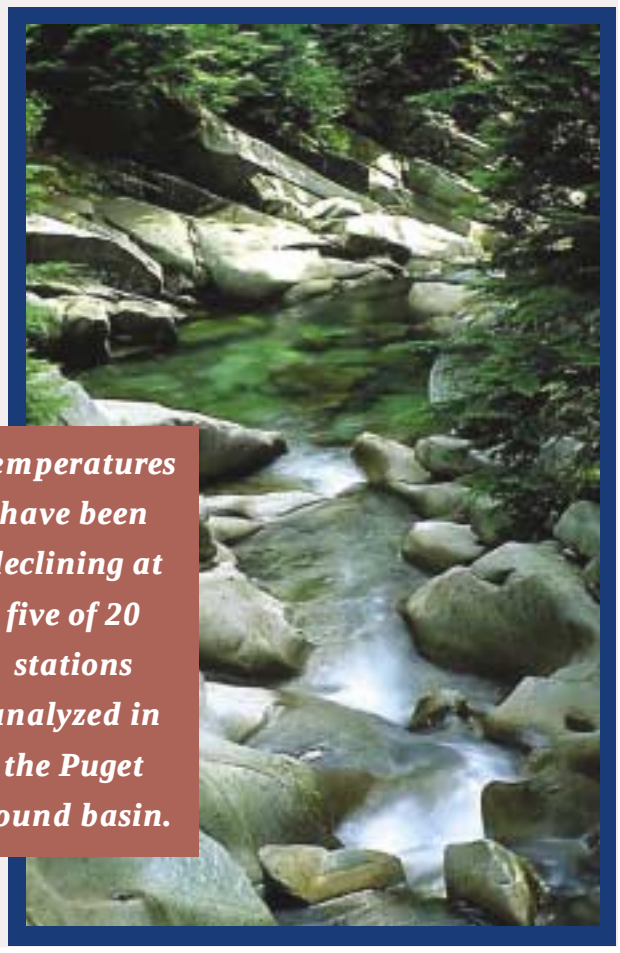
Water temperatures in Puget Sound's rivers can rise high enough to harm salmon and other cold-water fish. Stream temperature varies naturally from year to year depending on weather conditions, the amount of snow pack and the seasonal pattern of snowmelt. Clearing trees and other cover along stream banks can cause stream temperature problems. Also, dams and the extraction of water for drinking, industrial and other uses can affect stream temperature.

Status

The state Department of Ecology reported that each of the long-term monitoring stations in rivers and streams had good conditions for water temperature in 2000. The agency measured water temperature every month at 33 stations and calculated a water quality index for temperature. This index rates each station's annual performance relative to state water quality standards. Scientists selected these long-term river monitoring stations to be representative of the larger watershed. They do not reflect many local stream temperature problems. Additional data sources are used in a different ranking system to identify local temperature problems in compliance with the federal Clean Water Act. In 1998, the Department of Ecology identified 105 waterbodies in the Puget Sound basin as impaired because of high temperatures.

Trends

At most of the river monitoring stations, no consistent trends in water temperature are seen in data from 1991 to 2000. However, the state Department of Ecology's water quality index for temperature indicates that during this nine-year period, temperatures have been declining at five of 20 stations analyzed in the Puget Sound basin.



Temperatures have been declining at five of 20 stations analyzed in the Puget Sound basin.

marine water quality

Puget Sound's marine waters provide essential habitat for organisms ranging from plankton to marine fish and salmon to marine mammals. The state Department of Ecology summarizes overall water quality based on the strength and persistence of layers, or stratification, in the water column; lack of nitrogen-containing nutrients for several months; low amounts of dissolved oxygen in the water; high ammonium concentrations; and high fecal coliform bacteria counts. The results are presented in terms of levels of overall water quality concern.

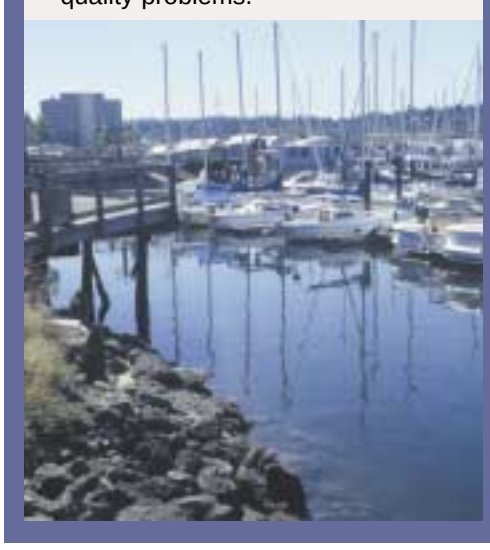
Status

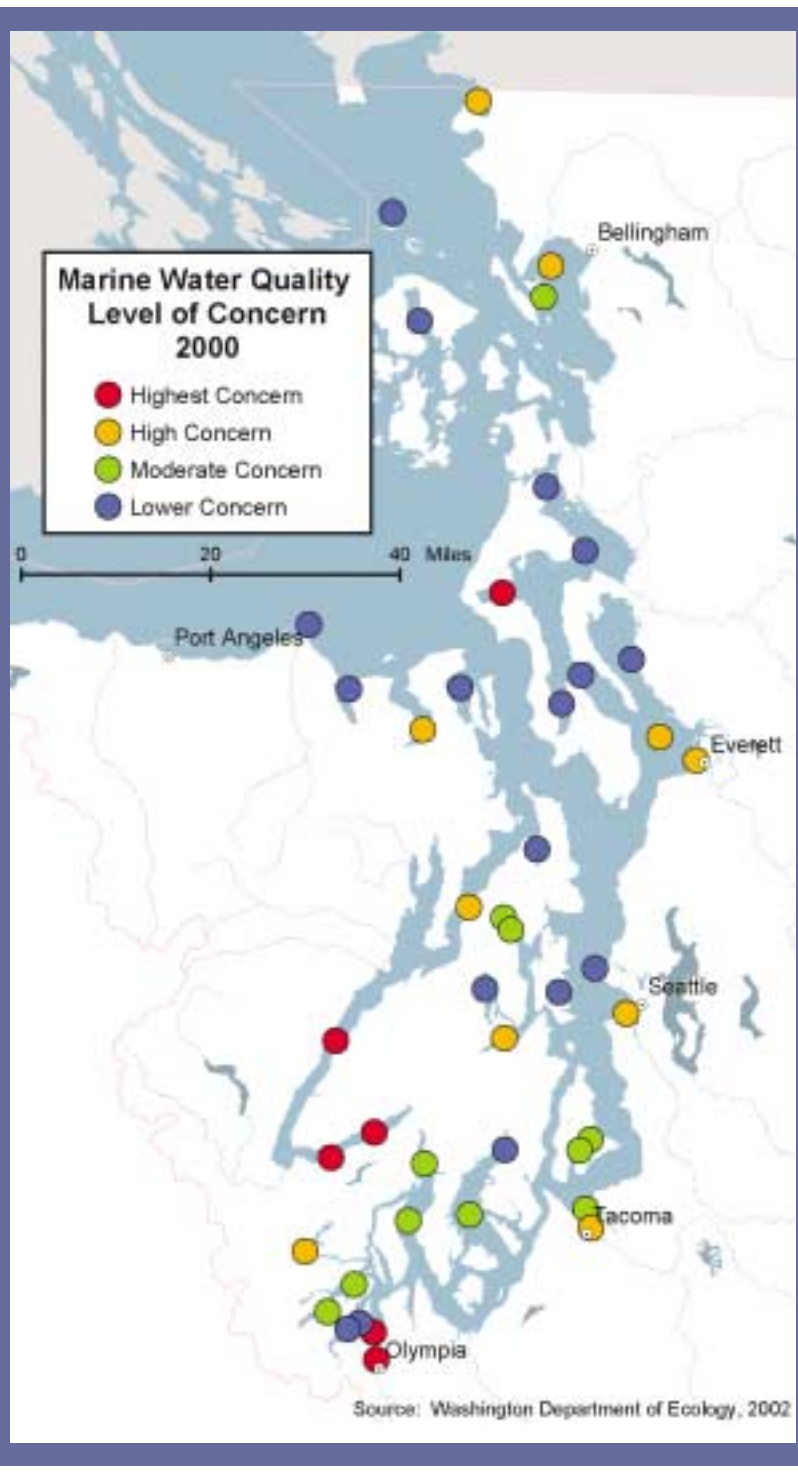
Based on data from 1994 to 2000, the areas of greatest marine water quality concern are Budd Inlet, southern Hood Canal and Penn Cove on Whidbey Island. Concern at Budd Inlet is based on high fecal coliform and ammonium concentrations, strong and persistent stratification, depleted oxygen levels and low nutrients. Nutrient input to Budd Inlet decreased in the late 1990s as the regional wastewater treatment plant incorporated nitrogen removal. Southern Hood Canal and Penn Cove concerns include very low oxygen concentrations and sensitivity to additional nutrient loadings.

The Department of Ecology generally classified sampling stations near urban areas or in areas with reduced levels of tidal flushing as areas of high concern.

Components of Marine Water Quality

- **Fecal coliform bacteria**—not agents of disease themselves, these bacteria indicate the presence of other disease-causing organisms from sewage or agricultural contamination.
- **Dissolved oxygen**—low amounts of oxygen can be harmful to some marine life, such as fish.
- **Dissolved inorganic nitrogen**—low levels of nitrogen-containing nutrients can leave marine waters susceptible to water quality problems when nutrients are added from wastewater or agricultural sources.
- **Ammonium**—high concentrations of ammonium can indicate sewage or agricultural contamination.
- **Stratification**—when marine waters develop stable layers (become stratified) then pollutants as well as nutrients cannot be mixed around and some layers may develop water quality problems.





Are aquatic nuisance species increasing or decreasing in Puget Sound?

Photograph courtesy of Washington Department of Agriculture

spartina

Acreage of spartina infestation

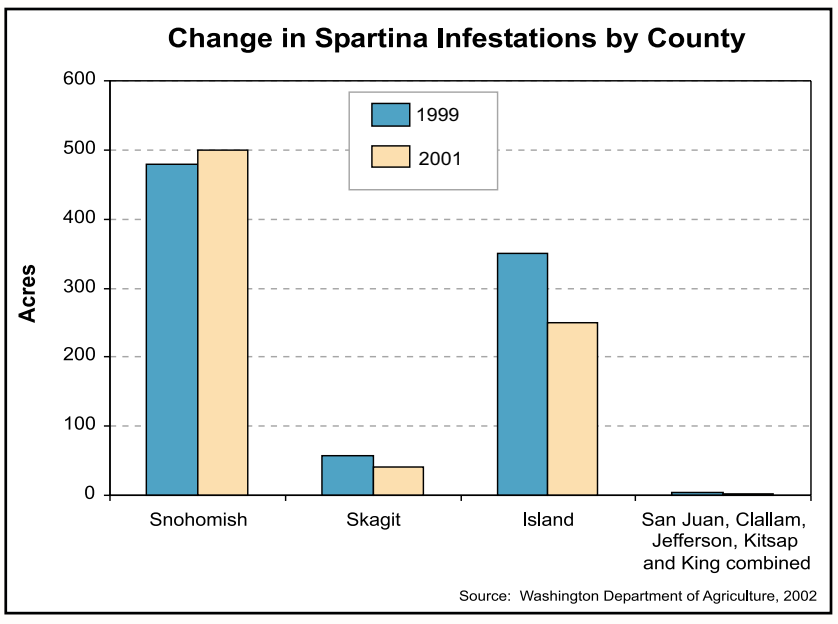
Status

Spartina (commonly known as cordgrass) infestations are concentrated in the northern and central areas of Puget Sound. None have been found south of the Tacoma Narrows or in southern Hood Canal. State and local agencies, volunteer groups and private landowners are actively working to eradicate spartina.

Trends

As of the beginning of the 2001 control season, the control efforts of the state Department of Agriculture and its partners have reduced the size of the Puget Sound spartina infestation. In a few cases they have eradicated the nuisance plant from specific sites. As the state Department of Agriculture and its partners succeed at reducing or eliminating smaller, outlying populations of spartina that have the potential to greatly increase in area, larger areas of infestations, such as south Skagit Bay, will become a bigger priority and the focus of additional funding. Between 1999 and 2001, the area of spartina infestations was reduced in each county where it occurs except Snohomish County. The south Skagit Bay site in Snohomish County has proven extremely challenging to control and many areas within this site have never been controlled. Because of this, there was a small increase in the Snohomish infestation between 1999 and 2001.

With the current level of funding, the state Department of Agriculture and its partners anticipate eradicating all known spartina infestations in Puget Sound in four years.

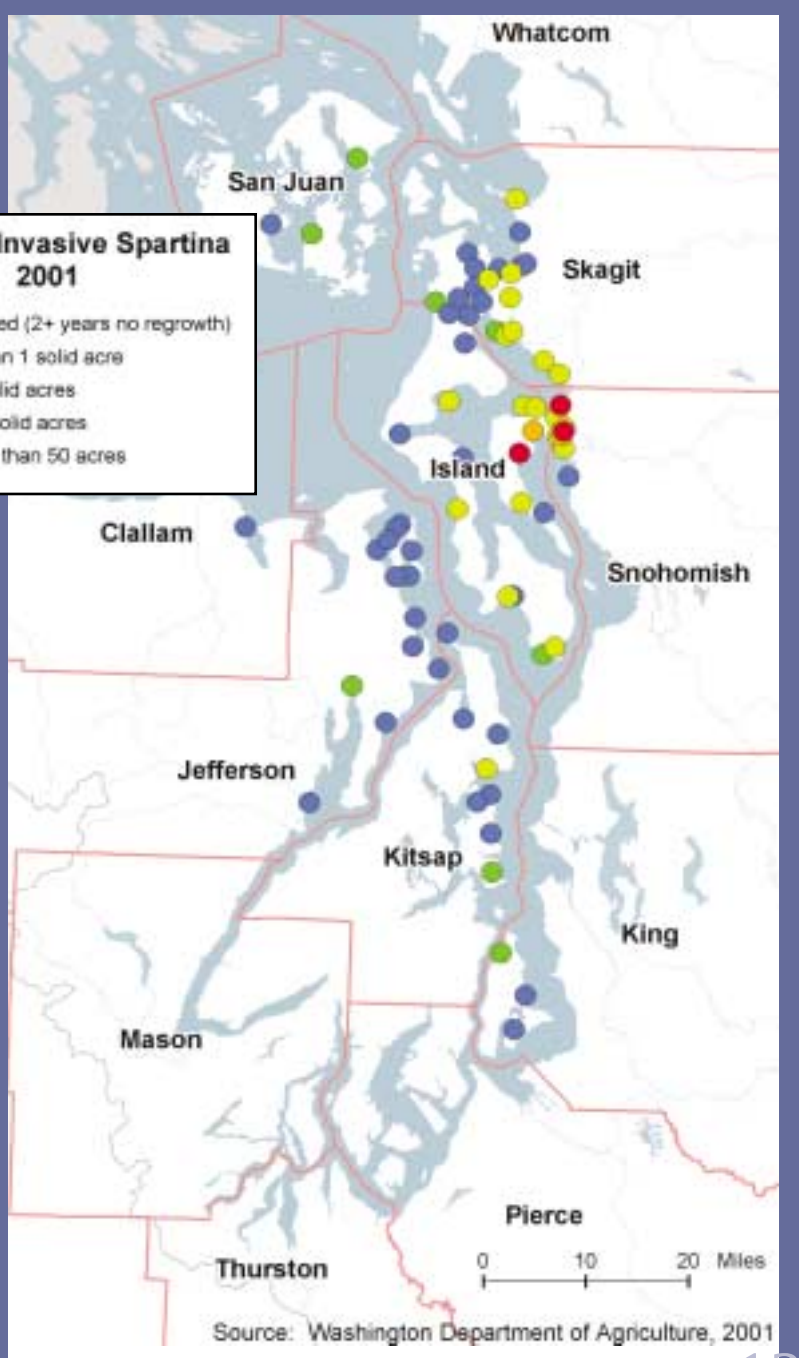


A variety of human activities have resulted in the movement and introduction of species into new areas. Such activities include the discharge of ballast water from ships, imports of species for agriculture and aquaculture, trade in live seafood, and improper disposal of unwanted exotic organisms. Many introduced species, known as exotic species, die in their new environment or become inconspicuous members of new communities. Some species can be invasive, which means they become very prolific and alter the basic nature of ecosystems. Invasive species that threaten native species and habitats are considered nuisances.

Photograph courtesy of Brett Dumbauld, Washington Department of Fish and Wildlife

Spartina is an invasive aquatic salt marsh grass that has entered Puget Sound and can alter nearshore habitat to the detriment of fish, shellfish and birds that use this habitat. Spartina is not as extensive in Puget Sound as in other coastal areas of our state. While eradication from the Puget Sound basin is a difficult challenge, it is possible to achieve. The Washington Department of Agriculture leads the state's efforts to control spartina.

Other species of concern include the green crab (pictured above) and mitten crab, which have not yet been observed in Puget Sound but have damaged other West Coast areas, including San Francisco Bay.



Are fish & wildlife populations increasing or decreasing?

Photograph courtesy of Jeff Skriletz, Washington Department of Fish and Wildlife

Puget Sound is home to more than 220 species of fish, 26 different kinds of marine mammals, 100 species of sea birds and thousands of species of marine invertebrates. Some species are migratory, while others remain in the Sound year-round. Species selected as indicators of Puget Sound's health include fish and wildlife that represent some of this diversity:

- Harbor seals
- Scoters (ducks)
- Pacific herring
- Rockfish
- Coho salmon

Pacific salmon and a number of marine fish species in Puget Sound are in peril. Chinook salmon in Puget Sound and summer chum salmon in Hood Canal have been listed since 1999 as "threatened" species under the federal Endangered Species Act (ESA). That means there is a threat that without protection the species may become extinct.

In 2001 the National Marine Fisheries Service (NMFS) completed a review of seven Puget Sound marine fish species for listing as "threatened" or "endangered" under the ESA. They concluded that listing was not warranted for six of these species because the Puget Sound populations are not distinct from healthy populations that live outside of the Sound. One species, Pacific whiting, is still under review. The scientists involved in the review expressed concern about the widespread, nearly synchronous decline of multiple fish species within Puget Sound regardless of their status with respect to the ESA. They suggested that this might indicate ecosystem-level changes that would be of deeper concern than the decline of any single species.

In 2002, NMFS will complete a review of the southern resident orca whale population for potential listing under the ESA. This population, whose range includes Puget Sound, has declined from a high of 97 whales in 1996 to 78 in 2001.

scoters

Status

Scoters are the most abundant diving duck in Puget Sound during the winter. Winter densities of scoters in north Puget Sound are about ten birds per square kilometer and about four times that number in south Puget Sound.

Trends

Densities of scoters in Puget Sound have declined by 57 percent during the past 20 years. During the same period, 13 out of 18 other marine diving bird species in Puget Sound declined as well. These include a 72 percent decline in scaup, a 91 percent decline in long-tailed duck, a 95 percent decline in western grebes, and a 96 percent decline in marbled murrelets. In contrast, some species showed significant increases, such as harlequin ducks that were up 189 percent.

Bird species that either eat fish or depend upon specific spawning events of Puget Sound forage fish appear to have declined more than species such as harlequins that don't have such specific requirements and tend to feed on other parts of the food chain such as crustaceans and invertebrates. Researchers have observed declines in scoters and scaup in other marine areas throughout the Pacific Flyway. This suggests that the birds have not moved from Washington to some other part of their wintering range.

It is not yet clear whether these changes relate to global or regional cycles such as the Pacific Decadal Oscillation, which affects a large portion of the Pacific Ocean, or to local changes such as the decline of forage fish or changes in habitat.

Photograph courtesy of U.S. Fish and Wildlife

coho salmon

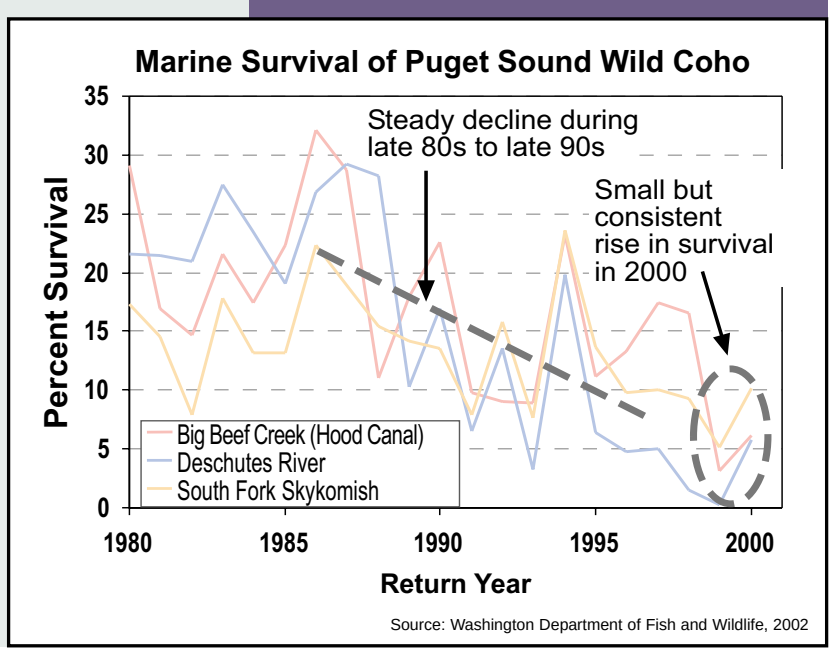
Status

Production and survival of coho salmon can vary widely from year to year due to a number of factors. Recent marine survival of Puget Sound wild coho salmon has been much lower than historical levels. The Deschutes River coho population in south Puget Sound has experienced particularly low marine survival. South Puget Sound coho populations in general are performing more poorly than other populations in Puget Sound. In contrast, south Puget Sound populations had higher survival rates than other populations in the early 1980s. The cause for this reversal is unknown.

Coho salmon survival remains far below historical levels.

Trends

Throughout Puget Sound marine survival of wild coho steadily declined during the late 1980s to late 1990s. In contrast, marine survival for the coho brood that returned in 2000 increased slightly in populations throughout Puget Sound. Scientists speculate that this recent increase could signal the start of a new climate pattern that results in marine conditions more favorable to coho survival. Continued monitoring will determine if this recent small, though pervasive, increase represents a turning point to higher marine survival and increases in Puget Sound coho stocks.



harbor seals

What affects harbor seals?

Increasing harbor seal populations may be the result of:

- Protection from bounties or harvest by the Marine Mammal Protection Act of 1972.
- Variable abundance of food resources such as hake and herring.
- Availability of secure pupping sites.
- Decreased levels of contamination in the environment.

Harbor seals may be able to tolerate disturbances from people better than other marine mammals in Puget Sound such as the harbor porpoise, which has disappeared from central and south Puget Sound in recent decades.

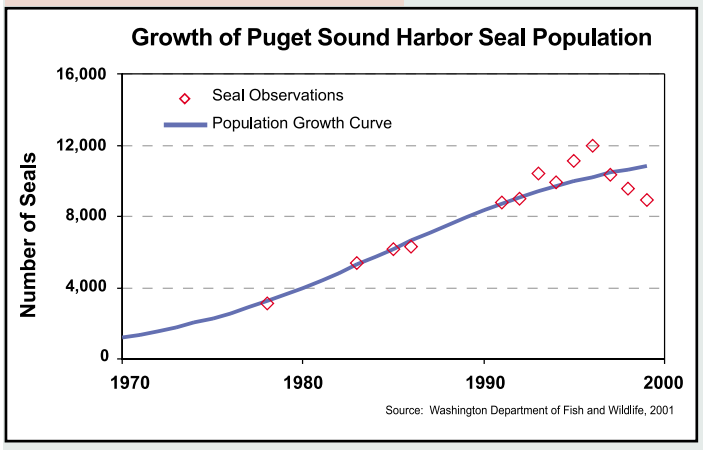
Status

Since harbor seals received protection under the federal Marine Mammal Protection Act (MMPA) in 1972, Washington harbor seals have been recovering from a period of prolonged hunting pressure. The region's population of harbor seals has grown steadily and most of this growth has been in the San Juan Islands and the Strait of Juan de Fuca. The least growth has been in Hood Canal.

State and federal researchers estimated that 14,600 harbor seals lived in Puget Sound and the Strait of Juan de Fuca in 1999.

Trends

Between 1978 and 1999, the population of harbor seals in Puget Sound, grew faster than in the rest of the state and rose from 42 percent of the total state population to 46 percent. Harbor seal abundance in these waters has increased three-fold since 1978.



Analysis of the harbor seal population growth rate suggests that Washington's inland harbor seal population is near the current carrying capacity of the environment, or the number that can be sustained in the long-term. This does not mean that the seal population has reached its historical size; the region's capacity for supporting harbor seals may be lower than it was historically.

Photograph courtesy of Randy Shuman ©

herring

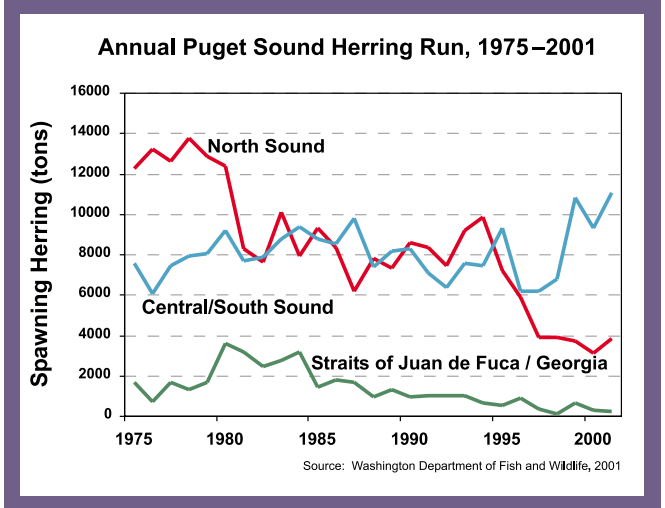
Status

In 2000 and 2001, the amount of Pacific herring spawning in Puget Sound was between 13,000 and 15,000 tons. In recent years, the greatest quantity of herring in Puget Sound was from stocks spawning south of Port Townsend. Stocks that spawn at Cherry Point, north of Bellingham, and Discovery Bay, on the Strait of Juan de Fuca, are at historically low levels.

Pacific herring in Puget Sound come together to spawn in the winter or spring. For management purposes, the state Department of Fish and Wildlife has identified 19 distinct spawning groups in Puget Sound.

Trends

The spawning biomass of Pacific herring in Puget Sound has increased in recent years from the low levels—10,000 to 11,000 tons—observed in 1997 and 1998 to about 15,000 tons in 2001. Herring stocks from north Puget Sound and the Strait of Juan de Fuca have declined during the past 25 years. In particular, stocks in north Puget Sound declined sharply in the late 1990s. At the same time there was a large increase in central and south Puget Sound stocks between 1998 and 1999. In two of the past three years, the biomass of herring in central and south Puget Sound exceeded 10,000 tons. The biomass observed in these years is the highest on record for the central and south Sound stocks.



What affects herring?

Herring stocks may be affected by a number of factors. Low numbers of spawning herring may be related to:

- More are being eaten by greater numbers of predator species such as harbor seals, salmon, and Pacific hake.
- Changes in water conditions, such as temperature, salinity and dissolved oxygen.
- Reduced food supplies.
- Alteration of critical nearshore habitat, especially eelgrass beds on which eggs are deposited.
- Harvest levels.

Forage Fish

Pacific herring are an important prey item eaten by a number of fish, birds and mammals in Puget Sound. Herring, and other small marine fish such as sand lance and surf smelt, are called forage fish because they are the food of many other organisms. Pacific herring are among the more common Puget Sound prey items eaten by spiny dogfish, coho and chinook salmon, Western and red-necked grebes, red-breasted mergansers, rhinoceros auklets, Dall's porpoises, and harbor seals.

Photograph courtesy of Wayne A. Palsson

rockfish

Status

Rockfish stocks throughout Puget Sound are considered depressed because either their abundance or size has drastically declined during the past 25 years.

NMFS completed a status review of several Puget Sound marine fish, including copper, quillback and brown rockfishes, in 2001. While NMFS decided that listing these fish as "threatened" or "endangered" of becoming extinct under the ESA was not warranted, the review teams acknowledged declines in a number of species and suggested further study to determine the overall significance of the apparent ecosystem-wide changes.

Trends

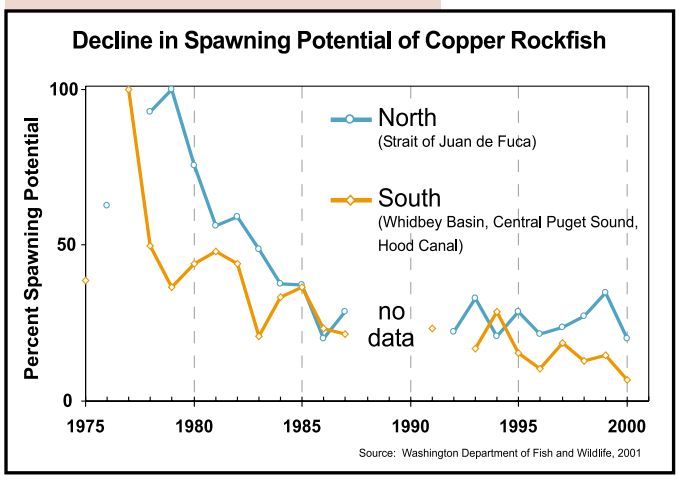
Rockfish abundance has declined markedly from levels seen in the 1970s. One indication of this decline is in the experiences of recreational fishers. In the 1970s, the average fisherman was catching one or more rockfish per trip. More recently, it may take two or three fishing trips to catch a rockfish. Although this trend of fishing success can be affected by changes in fishing regulations, the change can be used as a relative indicator of the number of rockfish that are in Puget Sound. This decline in the numbers of rockfish and the loss of larger fish from the population means that the spawning potential of rockfish has declined by about 75 percent from the levels observed in the 1970s.

What affects rockfish spawning potential?

The condition of a stock can be measured by its potential to produce offspring, or its **spawning potential**.

Spawning potential declines when there are fewer fish of spawning age or when individual fish produce fewer eggs. Older rockfish produce many more offspring than younger fish.

Scientists have suggested that overharvesting by commercial and recreational fishing is the most likely cause of the loss of older rockfish. Other factors that may harm older fish include contamination of the food chain and their habitats being disturbed by trawling, diving or other activities.



What can you do?

Ten simple things *you* can do to help protect and improve the quality of water in *your* Puget Sound. Choose at least one and start making a difference today!

1. Make smart growth, not sprawl choices

Choose to live in a neighborhood that provides you with all conveniences—low maintenance homes and lawns, nearby shopping, walking paths, easy-access to buses and trains, and green, open spaces to enjoy.

2. Keep *your* boat and *our* water clean

Rinse and scrub your boat hull and decks with a brush instead of using soap. If your boat is stained, use phosphate-free soap or laundry detergent to clean it. Take your boat out of the water when scrubbing off barnacles and doing other thorough cleaning, scraping and painting jobs. Always use pump-outs to empty your holding tank. Take precautions to avoid spills when filling boat tanks with gas and oil. And don't throw cans, bottles, and other disposable items overboard.

3. Watch for and keep nuisance plants and animals out of Puget Sound

When fishing, put unwanted live bait and organic packing materials into the trash—not the water. When boating, remove plants and animals from your boat, trailer and other equipment after taking your boat or watercraft out of the water. When house cleaning, trade unwanted aquarium fish or plants with friends, return them to the store where you bought them or freeze them and then dispose of them in the trash. Don't dump them into waterways.

4. Follow fishing and hunting regulations

Fish and hunt what, where and when regulations guide you. Also, release fish when it makes sense.

5. Use your car less and never pour anything down a storm drain

Vehicles are the biggest cause of air pollution in the Puget Sound, and oil, grease and metals from cars and trucks also pollute the Sound. When possible, walk, bike or at least share a ride with others. Fix oil leaks in your car. Also, recycle used motor oil. And never pour anything down a storm drain. Wash your car on grass or gravel—not your driveway. Use non-toxic, low-phosphate soap sparingly. Best of all, take your car to a commercial car wash that recycles water.

6. Keep vegetation and shorelines natural

Preserve the established trees around your home, in your neighborhood and nearby shoreline. Plant new trees and shrubs to encourage excess rainwater to filter slowly into the soil. Add native plants to your landscape. Build homes and other structures away from shorelines. And in locations where homes and businesses are already in place, instead of adding cement, wood or metal bulkheads, use drift logs, gravel, or native vegetation to prevent erosion and protect the environment.

7. Use less water

At home and at work, help cut down on the millions of gallons of water that is treated at a wastewater treatment plant or runs through smaller, home and neighborhood septic systems every day. Run full loads of clothes and dishes. Install faucet aerators and showerheads. In your garden and on your lawn, apply no more than one inch of water per week, and water in the morning or evening. Sweep your driveway and sidewalks, don't hose or spray them with water.

8. Cut down on fertilizers, pesticides and herbicides

If you use fertilizers, pesticides or herbicides, follow directions and use them sparingly. Don't fertilize before a rainstorm. Consider using organic fertilizers. Compost grass clippings, weeds and other yard waste.

9. Pick up after your pets and keep animals out of streams

Scoop your dog's poop and properly dispose of it, preferably in the toilet. You can also seal the waste in a plastic bag and throw it in the garbage. This is legal in most areas, but check your local laws. Also, make sure fences and other structures are keeping cows, horses and other animals out of streams.

10. Keep your septic system in top working order

Have your system inspected regularly and get your tank pumped when needed.

For more information, visit the
Puget Sound Water Quality Action Team's
website: www.wa.gov/puget_sound

Water Quality Consortium/Washington Department of Ecology

OYSTER PAN FRY (serves 4)

- 2 pints fresh small or extra small Pacific oysters
- 1 tbsp. olive oil
- 1 tbsp. butter
- Freshly ground pepper
- Mrs. Dash seasoning

1. Rinse and pat oysters dry on paper towel
2. Liberally sprinkle Mrs. Dash on both sides of the oysters
3. Warm a good, non-stick pan on medium high heat. Add olive oil and then the butter.
4. Add oysters to the hot oil and butter, season with fresh pepper
5. Cook oysters about 5 minutes on each side. Continue flipping oysters until all their own liquor has cooked away.
6. Serve hot with Italian farm bread, a tossed salad and dry white wine.

STUFFED BAKED SALMON (serves 6)

- 1 five pound salmon, head removed
- 1 yellow onion, sliced
- 1 large lemon, sliced
- 1 orange, sliced
- 1/2 lb. butter, cut into 6 pieces

Preheat oven to 400° F

1. Place salmon on a cookie sheet covered with foil. Salmon should be in the center of the foil.
2. Fill salmon with onion, orange and lemon.
3. Put butter pieces inside fish and stuffing, evenly spaced.
4. Fold foil over fish, but don't seal along belly of fish. Twist off ends of foil.
5. After 15 minutes, decrease oven to 350° and continue cooking for 45 minutes.

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