

# Executive Summary

The *Puget Sound Update* is a technical report that summarizes the condition of Puget Sound as measured by ongoing monitoring and research activities of the Puget Sound Assessment and Monitoring Program (PSAMP). This report also includes research findings from a variety of additional monitoring and research efforts conducted by local governments, research institutions, Tribes, state and federal agencies, and citizen monitoring groups. The scope of the report is the marine and freshwater ecosystems of the Puget Sound Region focusing on water quality, toxic contamination, nearshore habitat and marine species.

The purpose of the *Puget Sound Update* is to:

- Share information among scientists engaged in Puget Sound.
- Provide a concise summary of scientific information that policy-makers can draw upon for actions to protect, conserve and restore Puget Sound's natural resources.
- Provide recommendations for action based on the science, and to serve as the basis of scientific information for the *State of the Sound* report (see box below).

The key audiences for the *Update* are resource managers, planners, scientists, educators, staff to elected officials and the interested public.

## Puget Sound reports

Every two years, the Puget Sound Action Team produces a *State of the Sound* report highlighting indicators that reflect the condition of Puget Sound's water and submerged lands, habitats, and species, and threats to those resources. The document also reports the progress of the Puget Sound Action Team partner agencies to improve Puget Sound's health through management activities focused on improving water quality, habitat and species. The *State of the Sound*, published in January 2007, includes status and trend information drawn directly from the *Puget Sound Update* and other technical reports. The key audiences are state legislators and other elected officials, resource managers at all levels of government, the business and non-profit communities and the interested public.

The *Sound Science* document is a one-time, state-of-the-science document produced in 2007 by a broad group of scientists from Federal, state, local, and tribal governments and academia. The report summarizes what is known about the greater Puget Sound ecosystem including the terrestrial, freshwater and marine environments (e.g. species, food web structure, ecosystem processes, habitats, ecosystem services), explores the biological, chemical, and physical linkages between those elements, and provides analysis of how future changes in climate and human population growth might impact the functions provided by the Puget Sound ecosystem. The key audiences are scientists, resource managers at all levels of government, the business and non-profit communities, and the interested public.

The following are highlights from the *2007 Puget Sound Update*. They are grouped by topic. The information summarized represents key findings of PSAMP and other monitoring and research programs since the previous edition of the *Puget Sound Update* (2002).

### Biological Resources

- Nearly 60 percent of groundfish stocks in Puget Sound are in good condition. Those in decline include middle-trophic-level predators such as **rockfishes**, **spiny dogfish**, **Pacific cod**, and **Pacific hake**.
- Spawning potential for **copper and quillback rockfish** dropped by nearly 75 percent between 1970 and 1999, and more recent information confirms a continued decline.
- Across Puget Sound, estimates of **herring** spawning biomass have varied from year to year but most stocks have declined in the last five years. In 2002, the combined biomass of Puget Sound herring stocks was estimated at 17,700 tons. In 2004, that figure dropped to about 11,000 tons—a decrease of about 40 percent. In 2006, biomass estimates are 12,000 tons.
- Southern resident **orcas** were listed on the federal endangered species list in 2005. The population currently consists of 86 whales, down from a peak of 98 in 1975.
- **Surf scoters**, **white-winged scoters**, and **black scoters** have collectively declined by approximately 57 percent between 1978 and 1999. This decline has continued from 1999 through 2005 in nearly all of the subregions of Puget Sound. The decrease in scoters represents the largest decline in biomass of marine birds over the last 25 years in Puget Sound.
- **Loons** and **grebes** that over-winter in Puget Sound have declined from 64 to 95 percent over the past 25 years. It is unknown whether this reflects declines in the overall populations or whether birds are over-wintering outside of Puget Sound.
- Native **eelgrass** has declined in Hood Canal for four consecutive years since 2001. The San Juan Archipelago has experienced declines in small embayments; in 11 embayments approximately 83 acres of eelgrass were lost between 1995 and 2004.
- **Sea lions** have become more abundant in Washington waters. The California sea lion populations have increased by about 5 percent annually, with a current population of 4,000 - 5,000 animals. Steller sea lions are also increasing in population by about 10 percent annually. Surveys conducted in 2005 of steller sea lions during peak abundances in fall and winter recorded 1,000 - 1,500 sea lions along Washington's outer coast. This species also regularly inhabits North Puget Sound.
- **Harbor seals** have been steadily increasing in population since the early 1970s, with current populations consisting of 16,000 seals along the outer Washington Coast and 14,000 in the inland waters of Puget Sound.
- The **pinto abalone**, a once fairly abundant native species in Hood Canal, north Puget Sound and the San Juan Islands, appears to be critically depressed and in such low abundance that

this species may be unable to naturally reproduce. In the San Juan Archipelago, between 1992 and 2005, abalone have declined from 351 animals to 103 animals at 10 long-term monitoring stations.

## Physical Environment and Habitat

- The Pacific Ocean off the west coast of the U.S. experienced two unusual conditions in 2005 — a winter-like colder state that persisted through mid-July, followed by ocean warming that resembled a large El Niño event. The biological impacts of these alternating atypical ocean conditions in 2005 were significant. Zooplankton stocks were reduced by one half, salmon returns weakened, and sea bird deaths were extraordinarily high among common murre, cormorant, and Cassins' auklet populations. Several subtropical species, such as albacore tuna and Humboldt squid, became common in the offshore shelf waters.
- During the 20<sup>th</sup> century, the global average **air temperature** rose by approximately 1.1 degrees F (0.6 degrees C). In Puget Sound, the average temperature doubled the global average, increasing by 2.3 degrees F (1.3 degrees C) during the same period.
- Average global **sea surface temperature** has increased by 1.7 degrees F (0.9 degrees C) since 1921.
- Hood Canal, Budd Inlet, Penn Cove, Saratoga Passage, and Possession Sound are locations of highest concern, based on Ecology's **index of water quality** for Puget Sound. Eleven other areas are of high concern.
- Overall **dissolved oxygen** (DO) concentrations in Puget Sound appear to be continuing a downward trend. Very low DO was observed at 14 stations, seven of which had higher DO concentrations in the period from 1998 to 2000. Another seven stations with previously high DO concentrations experienced low DO during 2001-2005.
- **Hood Canal DO** levels measured during 2004 were at the historical low point for any recorded observations. Comparing oxygen data from 1930 through the 1960s with data from 1990 to 2006 shows that, in recent years, the area of low dissolved oxygen is getting larger and spreading northwards. Periods of hypoxia are persisting longer through the year.
- **Tidal wetland** losses were documented throughout Puget Sound and at present, approximately 82 percent of the historic extent of tidal wetlands in the region have been lost to development and other land uses.

## Toxic Contamination

- Analysis of samples collected 1997-2003 indicate that approximately 1 percent of Puget Sound **sediments** are highly degraded, 31 percent are of intermediate quality, and 68 percent are of high quality. The 1 percent of highly degraded sediments are located primarily in urban bays.

- Chinook salmon sampled from Puget Sound in 2005 have three to five times the **PCB** levels of chinook from Alaska, British Columbia, and Oregon.
- Flame retardants, or **polybrominated diphenyl ethers** (PBDEs) occurred in 17 percent of sediment sites sampled in Hood Canal in 2004 and were detected in 16 percent of samples from 10 Puget Soundwide sediment sampling sites in 2005.
- **PBDEs** are now second to PCBs in order of importance in the Puget Sound food web. PBDEs in English sole from urban areas are almost 10 times higher than those levels measured in sole from the Georgia Basin. Herring from Puget Sound have nearly three times the levels of PBDEs in Georgia Basin herring. Harbor seals from Puget Sound have over twice the PBDEs found in seals near Vancouver, BC. Scientists estimate that PBDE levels are doubling every four years in marine mammals, including harbor seals and orcas, and will surpass PCB levels in these species by 2020.
- In Puget Sound sediments, **polycyclic aromatic hydrocarbons** (PAHs) have not changed significantly over the past decade, except in Bellingham Bay, Port Gardner, and Anderson Island, where levels have increased. Point Pully (in central Puget Sound) had a significant decrease in PAHs during this same period.
- In Dungeness crab sampled between 1998-2005, **PAH** exposure was six times higher in urban areas than in non-urban areas. English sole had three to four times the PAH exposure in urban areas, compared to non-urban areas.
- English sole from Elliott Bay and the Thea Foss Waterway currently have four to six times the risk of developing liver lesions, (typically associated with **PAH** exposure), compared to sole from Hood Canal or the Strait of Georgia.
- Six **endocrine-disrupting compounds** (bisphenol A, estradiol, ethynylestradiol, and three phthalates) were detected in 20 percent of samples from surface water locations in King County's lakes, rivers, streams, and stormwater discharges collected in a pilot study in 2003.
- Male English sole from several Puget Sound locations (including 30 percent of males sampled in Elliott Bay) are producing an egg-protein (vitellogenin) normally found only in female fish. This finding suggests that these fish have been exposed to **endocrine-disrupting compounds**.
- **Pre-spawn mortality** occurred in 25 to 90 percent of female coho salmon returning to urban streams in the Puget Sound region between 2002 and 2005, suggesting that contaminants from stormwater are posing a threat to the spawning success of salmon in urban streams.

## Pathogens and Nutrients

### *Fresh Water*

- In Ecology's 2004 Water Quality Assessment, 58 freshwater sites were identified with **DO** problems in Puget Sound because of excessive nutrients (phosphorus and nitrogen) in the streams. Nutrients sources include drainage from agricultural, forestry, and residential activities and other sources.
- Twenty-five of 38 freshwater stations were scored "Good" according to the **total nitrogen** Water Quality Index. Ten stations scored "Fair." Three stations (in Hood Canal and on the Deschutes River near Olympia) scored "Poor."
- In 2005, freshwater stations were nearly equally divided between "**Good**" and "**Fair**" for **phosphorus** and were stable in water years 2000 through 2005.
- The WQI for **fecal coliform** rated "Good" at 28 of 38 freshwater streams for fecal pollution. The remainders were "Fair." Fecal conditions appear to be stable since 2000.

### *Marine Water*

- Hood Canal, Budd Inlet, Penn Cove, Saratoga Passage, and Possession Sound are locations of highest concern, based on Ecology's **index of water quality** for Puget Sound.
- Stations in Hood Canal, Penn Cove, Possession Sound, and Saratoga Passage had very high sensitivity to **eutrophication**, suggesting that these locations are at greatest risk for further declines in water quality, due to human additions of nutrients.
- The most recent Water Quality Assessment lists 76 water bodies in Puget Sound with **fecal coliform** problems. However, fecal coliform data collected at marine ambient stations suggest a general decline in fecal coliform contamination from 2001 through 2005. The highest levels of fecal contamination occurred in Budd Inlet, Commencement Bay, Elliott Bay, and near West Point (north of Elliott Bay), Possession Sound, and Port Angeles harbor.
- DOH determined that 31 of 98 shellfish growing areas in Puget Sound experienced significant **fecal pollution** in 2005. Those with the greatest impact were Drayton Harbor, Dungeness Bay, and Henderson Inlet. Samish Bay and Burley Lagoon show no evidence of change in fecal pollution since 2002.
- Between 1995 and 2005, over 12,500 acres of **shellfish growing areas** were upgraded and 5,000 acres were downgraded, for a net increase of 8,500 acres. As a result of Kitsap County's Pollution Identification and Correction Program, parts of four shellfish harvest areas have been cleaned up and reopened for harvest; Burley Lagoon, Cedar Cove (part of Port Gamble), Illahee State Park, and Dyes Inlet.
- Twenty percent of 428 recreational beaches in 12 Puget Sound counties are threatened by **fecal pollution**. Five percent of these beaches are closed because of **biotoxins**. Within King County, trends at 21 recreational beaches indicate that **fecal pollution** has declined since 1997. Ecology's Beach Environmental

Assessment, Communication and Health (BEACH) Program indicates that central Sound beaches typically have the highest measured bacterial pollution, most notably in Dyes and Sinclair Inlets.

- Eighteen of 29 **paralytic shellfish poisoning** (PSP) sampling sites (62 percent) had at least some PSP impact in 2005. Burley Lagoon ranked highest in PSP impact in 2005. The year 2003 appeared to be lowest in PSP activity throughout Puget Sound.
- In 2003, a short-lived *Pseudo-nitzschia* bloom occurred at Fort Flagler near Port Townsend. Mussels from the sentinel monitoring cage contained domoic acid slightly above the U.S. Food and Drug Administration's (FDA's) action level, and DOH closed the area to shellfish harvest. In October 2005, *Pseudo-nitzschia* blooms occurred at four places in north Puget Sound (Sequim Bay, Port Townsend, Holmes Harbor, and Penn Cove). Several shellfish species were affected. All four areas were closed to shellfish harvest.