

GEORGIA BASIN
PUGET SOUND

ECOSYSTEM INDICATORS

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GEORGIA BASIN



GEORGIA BASIN PUGET SOUND

Ecosystem Indicators 2006

The Georgia Basin and Puget Sound includes inland fjords, straits and estuaries stretching from Puget Sound to Johnstone Strait. This great inland waterway was known as the Salish Sea by Tribal and First Nations peoples who inhabited the region for over 10,000 years amidst a bounty of salmon, berries, elk, bear, marine mammals and forest resources. Today, this diverse and productive ecosystem still provides for our basic needs, our quality of life and for the long-term viability of our communities.

While bountiful and beautiful, the Georgia Basin and Puget Sound faces significant threats to its air quality, marine and freshwater resources, species and natural habitats. Contained in this document are summaries on the environmental state of the region. Just as rates of employment and inflation are used to suggest the general health of our economy and body temperature and blood pressure are measured to suggest the general health of the infinitely complex human body, environmental indicators are tracked to reflect the general health of our infinitely complex regional ecosystem.

Findings of the report show that some environmental conditions are improving in the region (solid waste and freshwater quality) but overall conditions have either worsened or there has not been significant change in seven of the nine indicator areas (population health; urbanization and forest change; shellfish; air quality; marine species at risk; toxics in harbour seals and marine water quality).

Individually, these summaries provide glimpses into specific aspects of the ecological and social health of the Georgia Basin Puget Sound. Collectively, they suggest directions for ensuring the ecosystem is vibrant both now and in the future. To view the complete report, please visit: http://www.epa.gov/region10/psgb/ indicators/index.htm.

Acknowledgements

The Georgia Basin Puget Sound Ecosystem Indicators project, which began in 1999, has been made possible through the dedication and generous assistance of many individuals and organizations who have played important roles in monitoring ecosystem indicators in British Columbia and Washington State.

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Photo credit (Killer whale on previous page): Dr. Lance Barrett-Lennard, Department of Fisheries and Oceans

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GEORGIA BASIN PUGET SOUND ECOSYSTEM INDICATORS

Population Health

This indicator describes population growth, life expectancy, infant mortality, average family income and income dependence on traditional resources such as fishing and forestry in the Georgia Basin Puget Sound. The health of our population is inextricably linked to the health of our complex ecosystem. If we are to keep both our population and our ecosystem healthy, we must understand how the activities of 7 million people affect and interact with our environment.

What is happening?

The Georgia Basin Puget Sound was home to 4.1 million people in 1976. The region grew to 7 million people within 25 years and it is projected to grow to 9.4 million people by 2025. Population growth in the region has outpaced the average global growth rate and this pattern is expected to continue over the next several decades. Life expectancy is highest in the Greater Vancouver Regional District (81 years) in BC and San Juan (82 years) in Washington. Infant mortality in Puget Sound has generally decreased from 1999 to 2003; however the data indicate wide variability among social groups and geographic areas.

The average family income in the Georgia Basin Puget Sound is higher than the North American average. Once anchored in resource extraction industries such as forestry and fishing, the region's economy has diversified into more service and value-added manufacturing including aerospace, biotechnology, film, tourism and software development, yet continues to be export oriented, particularly with Pacific Rim nations.

Why is it happening?

Immigration is expected to account for over half of the population growth in the next two decades. People move to this region for lucrative and interesting jobs and the beauty and accessibility of our natural environment.

How does this affect me?

The majority of people in the Georgia Basin Puget Sound lives in coastal areas and watersheds. Environmental impacts associated with increasing population and development pressures affect the very reasons families choose the region for their home. As productive forest lands and other natural habitats are lost to development, traditional resource industries (eg. fishing, forestry and farming) are less sustainable and an economic divide forms between urban and rural areas. Wildlife populations are also less able to survive, which in turn decreases biodiversity of the region. Losing species can mean losing tourism revenues for local communities.

Runoff from urban areas and agricultural lands, sewage discharges and industrial effluents carry pollutants and pathogens into water bodies. The quantity of freshwater available for drinking water, irrigation and wildlife also is at risk where impervious surfaces prevent groundwater aquifers from being recharged.

Air quality is impacted as communities and ports expand, vehicle and marine traffic increase, and roads and other transportation infrastructure grow. Particulate matter and other airborne contaminants are a risk to human health and reduce visibility.

What are we doing about it?

Agency initiatives and public policies aimed toward balancing social, ecological and economic values for managing population growth are found in all orders of government.

The federal government of Canada committed to providing a new source of funding to cities and communities through the transfer of federal gas tax revenues over a five year period. In British Columbia, federal, provincial and the local levels of government (as represented by the Union of British Columbia Municipalities) entered into an agreement in September 2005 that will see $635 million transferred to local governments through to 2009 for infrastructure projects that strive to achieve more sustainable environmental outcomes – reduced greenhouse gas emissions, cleaner water and cleaner air.

Since 1991, the US Transportation Equity Act of the 21st Century, has supported a multimodal approach to meet regional transportation needs. The legislation includes funding for programs such as public transit, bicycle and walking infrastructure and programs, and clean air projects.

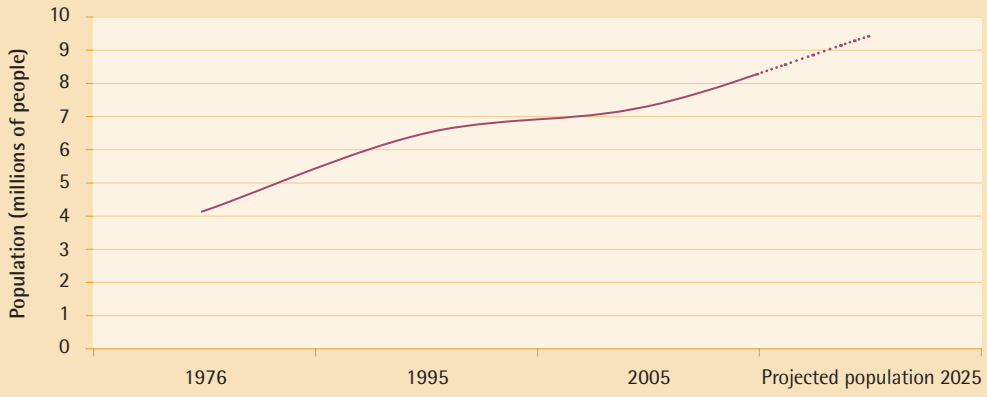
BC and Washington employ "Smart Growth" strategies for growth planning and management. These strategies involve land use planning and urban design, economic incentives, demand management practices to create demand for innovative products and services and watershed level integrated natural resource management principles.

Local governments in BC are engaged in growth management through regional growth strategies and local governments in Washington adhere to the Growth Management Act. Regional growth strategies and the Growth Management Act seek to create a comprehensive approach across local jurisdictions to manage growth, protect environmentally sensitive areas and create consistency between plans, policy and regulation.

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at: http://www.epa.gov/region10/psgb/indicators/

Population Growth from 1976 to 2025



The Georgia Basin Puget Sound population increased from 4.1 million people in 1976 to 7 million people in 2001. The population is expected to grow to 9.4 million people by 2025. (Source: BC Statistics and Washington Department of Ecology)

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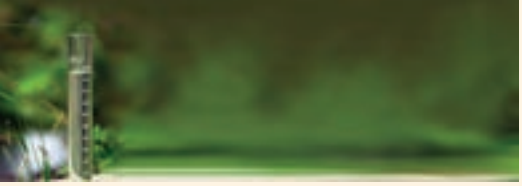


GEORGIA BASIN PUGET SOUND ECOSYSTEM INDICATORS

Marine Water Quality

This indicator measures seawater density stratification, or layering, which reflects the sensitivity of the marine environment to pollution. Seawater density is determined by temperature and salinity. How much seawater mixes is determined by the strength of the density gradient with depth (stratification) and factors such as wind, waves, and tidal action. The stronger the stratification, the more seawater resists mixing. The more persistent the stratification, the longer seawater remains layered. Where seawater stratification is strong and persistent, dissolved oxygen, which is critical for the survival of aquatic life, may become low in the isolated deep waters and pollutants from human activities may be concentrated in the surface waters, reducing the ability of the marine environment to support aquatic life.

What is happening?

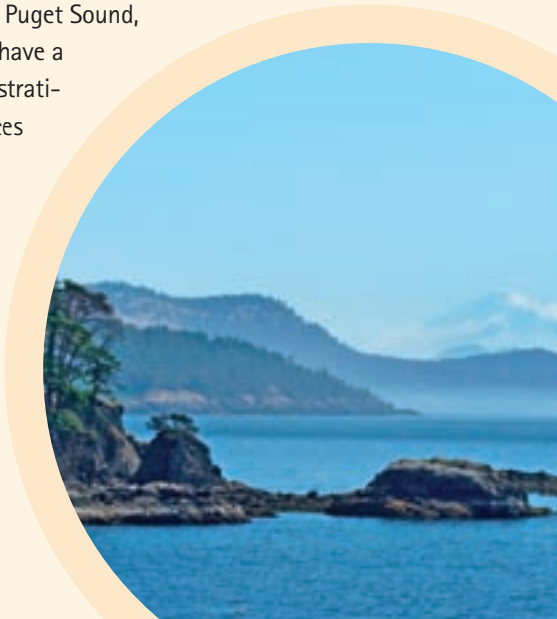
From 1999 to 2004, 13 stations extending from the mouth of Juan de Fuca Strait to the northern end of the Strait of Georgia were surveyed seasonally. Eight stations showed strong-persistent stratification due to freshwater flowing from the Fraser River. The other stations, located in strong tidally-induced mixing areas such as Boundary Pass, Rosario Strait, and the northern end of the Strait of Georgia, showed strong-intermittent or moderate-infrequent stratification.

Between 1998 and 2004, 46 stations throughout Puget Sound were monitored monthly; half of which showed moderate-infrequent stratification, reflecting the strong tidal mixing of the area. Eleven stations showed strong-persistent stratification and 8 stations showed strong-intermittent stratification. These were typically located near river mouths or where mixing processes are weak, such as Hood Canal.

The intensity and duration of stratification can vary greatly over time, due to weather events, seasonality and climatic differences from year to year. Long-term time series data indicate a warming trend in seawater temperatures as well as the occurrence of pronounced variability from year to year. With this in mind, it is important to understand where marine waters are particularly sensitive to effects of pollution, how this sensitivity changes over time and the implications of other factors, such as natural droughts or long-term climate change.

Why is this happening?

Seawater density stratification occurs when high solar radiation and freshwater flows cause a density difference between warmer surface layers and the cold, salty deep waters. In coastal estuaries such as Georgia Basin and the Puget Sound, differences in salinity have a stronger influence on stratification than differences in temperature.



Freshwater input from rivers, such as the Fraser or Skagit, enters the estuary flowing out at the surface onto the ocean shelf, with a return flow of salt water entering the estuary at depth. At any point in time, this circulation is also affected by tides and winds. In addition to changing current direction, these physical forces can decrease stratification.

Much of the volume of the marine waters in the Georgia Basin and Puget Sound is contained in deep areas of these inland fjords. These marine waters are typically well-mixed because of strong tidal currents and varied underwater topography. However, waters in shallow inlets, and in deep areas behind shallow underwater ridges can be less well-mixed and are slower to be exchanged with incoming ocean waters. Pollutants discharged into waters in these areas may be trapped and cycled locally for relatively long periods. In addition, the persistent stratification can keep pollutants concentrated at the surface. Strong and persistent stratification can result in a surface layer that is starved for nutrients and a deep layer that is low in oxygen. If human activity adds nutrients, this produces more organic material and the deep water oxygen debt will increase.

How does this affect me?

Commercial fisheries and wildlife-based tourism both contribute significantly to the region's economic base. The sustainability of these industries is dependent on the health of marine ecosystems, which requires good water quality. Good marine water quality also supports recreation in coastal communities as well as being essential to cultural, aesthetic and spiritual values.

Seawater stratification occurs naturally in the marine environment. When human activities result in pollution being discharged into sensitive stratified waters, the consequences of impaired water quality can be particularly acute.

Areas where density stratification is strong are more likely to retain pollutants in surface waters, where plankton and critical life stages (eg. eggs and larvae) of aquatic life are concentrated. This increases the exposure of sensitive ecosystem components to toxins. In areas where strong and persistent stratification lead to the depletion of dissolved oxygen, the discharge of nutrients into water (e.g., from sewage, agricultural and domestic fertilizers) can increase the chances of widespread fish kills.

What are we doing about it?

Agency initiatives and public policies that are helping to protect marine water quality in the region include:

- Land use planning to protect watersheds and shorelines from development
- Farm planning and nutrient management
- Limiting the division of forested lands through economic and trade strategies
- On-site water infiltration to minimize polluted stormwater flow along impervious surfaces
- Natural landscaping techniques that do not require chemical herbicides and fertilizers
- Treatment technology for septic systems to reduce pathogen and nutrient pollution

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at: http://www.epa.gov/region10/psgb/indicators/

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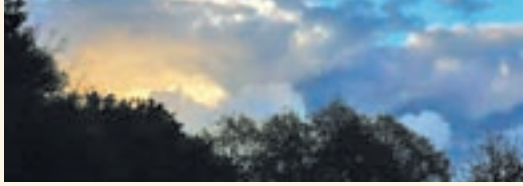

GEORGIA BASIN PUGET SOUND ECOSYSTEM INDICATORS

Air Quality

The Air Quality indicator examines trends related to concentrations of fine particulate matter under 2.5 micrometers in size (less than 1/30 the width of a human hair), also called $PM_{2.5}$. This fine particulate matter comes from combustion processes and atmospheric chemical reactions. Human sources include diesel engines in motor vehicles, marine vessels, wood- and waste-burning equipment and construction equipment. $PM_{2.5}$ was chosen as an indicator of general air quality in the region because it can cause serious human health effects, create haze and reduce visibility.

What is happening?

Clean-air agencies in the Georgia Basin Puget Sound have established standards for $PM_{2.5}$ levels. All measured communities in the region currently meet these standards.

In the Georgia Basin, $PM_{2.5}$ concentrations have remained relatively steady since the mid-1990s, but are projected to increase by 10% by 2020. Despite having a higher population than other areas of BC, Georgia Basin communities have lower concentrations of $PM_{2.5}$. Levels of $PM_{2.5}$ in Puget Sound have gradually decreased since the early 1990s, but are forecast to increase by 19% by 2018. $PM_{2.5}$ concentrations in Puget Sound, where the main particle sources are related to urban and industrial activities, are comparable with other areas of Washington State.

Why is it happening?

The main sources of $PM_{2.5}$ in the region are mobile emissions, industrial emissions, and "area sources". In 2000, vehicles in the Greater Vancouver Regional District (GVRD) and the Fraser Valley Regional District were responsible for 32% of $PM_{2.5}$ and other smog-forming gases. In Puget Sound, 57% of human-generated emissions were from motor vehicles. Vehicle emissions are worse when dirtier fuels (such as diesel) are used when vehicles are poorly maintained and as vehicles age.

Both Georgia Basin and the Puget Sound have considerable marine traffic. There was a fourfold increase in cruise ship traffic between Seattle and Alaska between 1998 and 2004, and increases in all marine traffic are expected to continue. A GVRD study found that within 20 years, marine diesel motors will be the largest source of emissions in the Lower Fraser Valley airshed. There are fewer pollution regulations for marine vessels than for cars and trucks. Many ocean-going ships (such as cargo containers) originate from countries with pollution laws less stringent than Canadian and US laws.

Industrial sources such as refineries and bulk shipping terminals generate significant amounts of $PM_{2.5}$. Area sources such as wood stoves, fireplaces, outdoor burning and construction generate relatively low levels of $PM_{2.5}$ individually, yet collectively are significant as they are numerous and distributed over large areas. As much as 60% of fine particulates in some Seattle residential neighborhoods can come from wood burning.

How does this affect me?

Poor air quality has negative health and economic consequences. Fine airborne particles can be inhaled deeply into the respiratory system where they damage lung tissue, causing or aggravating respiratory and cardiovascular diseases. Particles from diesel exhaust can also increase the risk of lung cancer by carrying carcinogenic agents deep into the lungs. At particular risk are children, the elderly and those with chronic heart and lung diseases.

Asthma and other lung-related conditions continue to increase on both sides of the border, leading to increased suffering and medical costs. The asthma rate for the region is up to 11% of the population. Asthma is estimated to cost Washington State over $400 million each year, while in BC, increased hospital stays from asthma alone cost approximately $15 million.

A recent study estimated that poor air quality costs nearly $233 million a year in the Lower Fraser Valley and that improving air quality by one percent would save the health care system $29 million annually. A 2000 study showed a correlation between haze and loss of tourism revenue in Greater Vancouver and the Lower Fraser Valley.

What are we doing about it?

Agency initiatives and public policies that are helping to reduce $PM_{2.5}$ emissions in the Georgia Basin and Puget Sound include stricter engine and fuel regulations for vehicle emissions, initiatives to get older cars off the road, incentives to encourage the purchase of alternative-fuel and hybrid vehicles, funding innovations in alternative fuels, and equipping school buses and other municipal vehicles with emission reduction and clean-fuel technologies. Collaborative efforts are underway for an international approach to reducing sulphur emissions from ports and marine vessels. Certification programs are in place for cleaner fireplace technologies.

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at:
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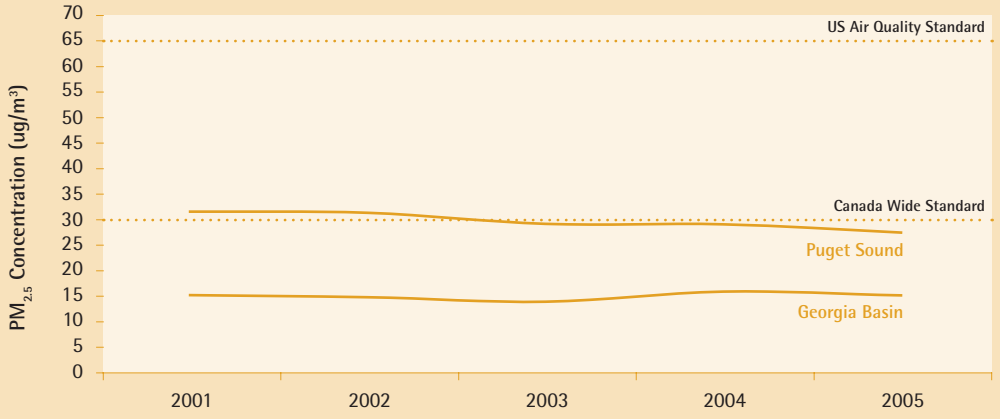
$PM_{2.5}$ Concentrations from 2001 to 2005



All measured communities in the Georgia Basin Puget Sound currently meet established standards for $PM_{2.5}$ levels. Achievement of standards is based on the annual 98th percentile 24-hour ambient measurements averaged over 3 consecutive years. (Source: Environment Canada, National Air Pollution Surveillance Network)

Photo on the first page, far right hand side: Rick Drouillard, Environment Canada

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Shellfish

This indicator describes trends in closures of commercial and recreational shellfish areas. Closures result when monitoring reveals areas contaminated by chemicals or fecal coliform bacteria. Trends in shellfish closures reflect the impact of human activities on water quality, but also on human health, the regional economy and our heritage.

What is it happening?

In 2004, over half of all commercial shellfish area closures in British Columbia were located in the Georgia Basin. Seventy-two thousand hectares of commercial shellfish areas were closed, representing a 14% increase in closure areas from 1989. Urbanized areas including Burrard Inlet, Fraser River estuary and Boundary Bay, as well as Howe Sound were closed to all shellfish harvesting, as were many areas along the southeast coast of Vancouver Island. Expanded monitoring activities, rather than degradation of water quality, prompted many such closures but also led to the opening of many previously untested areas.

Between 1980 and 2004, many commercial shellfish areas were closed to harvest because of water pollution in the Puget Sound. However from 1995 to 2004, there was a net increase in harvest area because of upgrades to these areas. Nevertheless, in 2004, 33 areas, many located in north Puget Sound and Georgia Strait, were listed as threatened by the Washington State Department of Health due to levels of bacteria found in the water.

Why is it happening?

As they feed, shellfish filter large amounts of water through their gills, and pollutants in the water become concentrated in their bodies, posing a threat to the health of people who may eat contaminated shellfish.

Shellfish are exposed to pollutants in the water from urban and agricultural runoff as well as discharge from sewage and septic systems, boats, and marinas. Impervious surfaces associated with populated areas carry surface runoff contaminated with pollutants into waters. In agricultural areas, heavy rain can transport animal manure from pastures and poorly constructed manure storage areas. Malfunctioning and outdated sewage systems and treatment plants, and poorly-maintained septic systems allow bacterial contamination of water. A single weekend boater discharging untreated waste directly into marine waters has the same impact on the marine environment as treated sewage discharge from a city of 10,000 people.

How does this affect me?

Consuming shellfish contaminated with pathogens or biological toxics can lead to fever, vomiting and stomach cramping. Paralytic shellfish poison and other biotoxins can prove fatal if not dealt with immediately. Shellfish closures are necessary when human health is at risk. However, contaminated shellfish and closing shellfish harvesting areas result in economic and cultural losses. The region is one of the largest shellfish-producing areas in North America. Many rural communities depend on revenue from shellfish; when closures interrupt supply, one of our most

sought-after products is not available for consumers either locally or for more distant markets.

Aboriginal communities in the region have used shellfish for subsistence, economic, and ceremonial purposes for over 12,000 years. More than half of coastal First Nations in BC are involved in commercial shellfish production. Shellfishing is also a major recreational draw in coastal communities for residents and visitors alike.

Poor water quality has negative impacts on shellfish, which are crucial to the marine ecosystem. As they feed, shellfish pass digested material to bottom sediments, where it becomes food for other organisms. Their filter feeding improves the clarity of the water, which allows light to penetrate further to the benefit of seagrass and other marine vegetation. Shellfish also remove nutrients in marine water that lead to low oxygen levels, helping to counteract nutrient loading caused by human activities.

What Are We Doing About It?

All active commercial shellfish-growing areas are subject to monitoring which has recently been expanded to cover new contamination threats and more thorough analysis of water quality trends. Federal authorities in both countries work with local stakeholders to create shellfish protection districts and closure response strategies. Funding is provided for restoration work in compromised shellfish-growing areas to identify and fix underlying problems. Restoration activities developed since the late 1990s have improved water quality conditions. Washington Tribes and BC First Nations are leading community partnerships to target underlying pollution sources. In both countries, many shellfish growers belong to trade associations which foster environmental responsibility.

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at:
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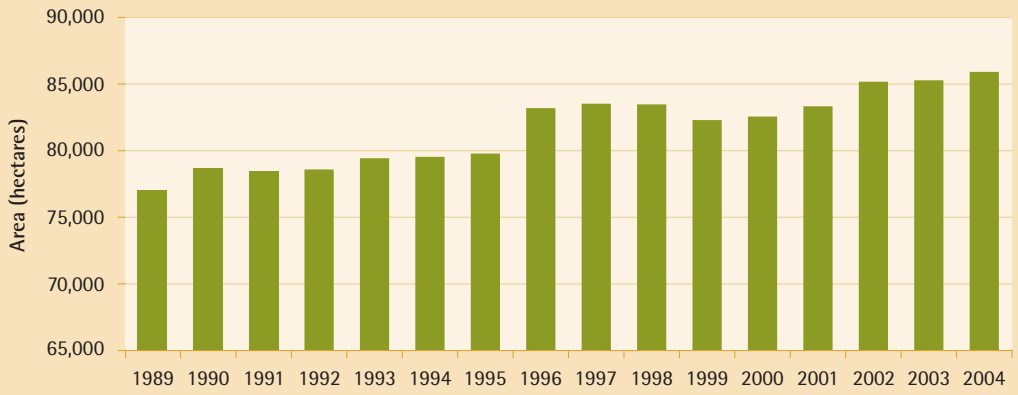
Commercial Shellfish Areas Closed to Harvest from 1989 to 2004



The area closed to commercial shellfish harvesting has increased in the Georgia Basin Puget Sound. The area of monitoring in the Georgia Basin has also increased over time, improving the likelihood of detecting contaminated areas. Despite the closures, there was a net increase in harvest areas within the Puget Sound between 1995 and 2004 because of upgrades to shellfish harvest areas. (Source: Environment Canada's Marine Water Quality Monitoring Program and Puget Sound Action Team)

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Photo on the previous page, far left side: Ginger Mason, Environment Canada

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Toxics in Harbour Seals

This indicator describes the presence of poly-brominated diphenyl ethers (PBDEs) in harbour seals and Pacific herring. PBDEs are persistent chemicals that accumulate in the fat reserves of predators that are higher in the food chain, such as seals. Being long-lived, non-migratory animals, and relatively common throughout the region, harbour seals are vulnerable to accumulating persistent chemicals and are therefore an important indicator species. Pacific herring are studied because they are a key food of harbour seals.

PBDEs are flame-retardant chemicals used in many common household items, such as fabrics and electronics and are chemically similar to polychlorinated biphenyls (PCBs) which are now banned. Some types of PBDEs have been phased out, but one remains on the market (decaBDE), which appears to break down into more toxic and more mobile PBDE forms, raising concerns about possible effects on the health of humans and wildlife.

What is happening?

During 2003, PBDE levels were measured in seals at four locations throughout the Georgia Basin Puget Sound. PBDE levels in seals from Puget Sound were approximately twice the levels found in seals from Georgia Basin, indicating higher levels of PBDEs in the diet of Puget Sound seals. Levels of PBDE in harbour seals sampled from Puget Sound rose exponentially between 1984 and 2003. Based on current production and consumption patterns in North America, research indicates that PBDE levels in harbour seals will soon eclipse PCB levels.

PBDE levels in herring sampled in Puget Sound in 2004 were almost three times higher than herring from Georgia Basin. Seals, diving birds and many marine fish species depend on herring as a food source and studies of many species are also showing that PBDEs are increasing rapidly in the marine food web.

Why is this happening?

High concentrations of PBDEs in harbour seals are due to increased production and consumption of PBDEs, migration of PBDEs from products in which they are used and increasing levels of PBDEs in the environment. As products containing PBDEs are used, thrown out, incinerated or recycled, PBDEs enter ecosystems through the air and many other routes. As they are passed along in food webs, they concentrate in high-level predators such as harbour seals, killer whales and humans. The higher levels of PBDE in Puget Sound may be due to the confined nature of the estuary with limited sedimentation and limited water exchange with the Pacific Ocean.

How does this affect me?

In laboratory animals, PBDEs have been found to have immunological, neurological, developmental and hormonal effects. Rising PBDE levels in harbour seals signal a potential new threat to their health: as highly-exposed animals, seals are likely to show adverse effects. This can provide an early warning about possible health effects for humans.

A recent study of the breast milk of new mothers in the Georgia Basin Puget Sound found PBDE levels 20 to 40 times higher than those found in Sweden and Japan. Another study found PBDEs in the umbilical cord blood of newborns. Although it is unclear whether PBDEs are affecting human health, similar compounds (e.g. PCBs) have been linked to negative health effects. Given these potential risks, there exists reason for concern about PBDE levels increasing in humans and the environment.

What are we doing about it?

PBDE studies are being expanded to better understand the potential risks to humans and the environment. Based on these studies, certain types of PBDEs are being phased out. Legal requirements are also being developed for more stringent regulation and reporting on PBDE use in manufacturing.

In response to environmental concerns, some companies are starting to phase out PBDEs, including Apple, Boeing, Dell, Ikea, Samsung, Sony, Volvo and Xerox. The non-profit community – medical and health organizations in particular – has also been actively supporting the phasing out of PBDEs.

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at:
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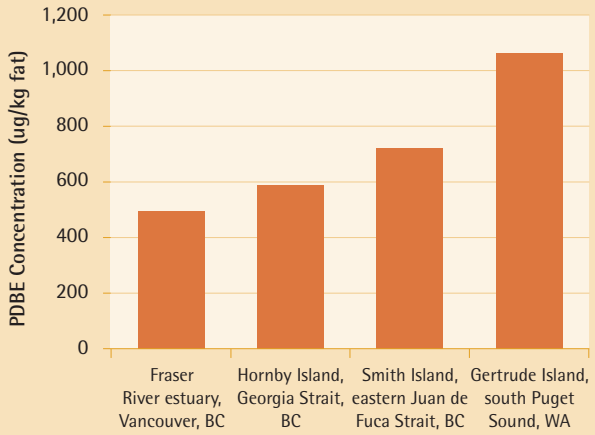
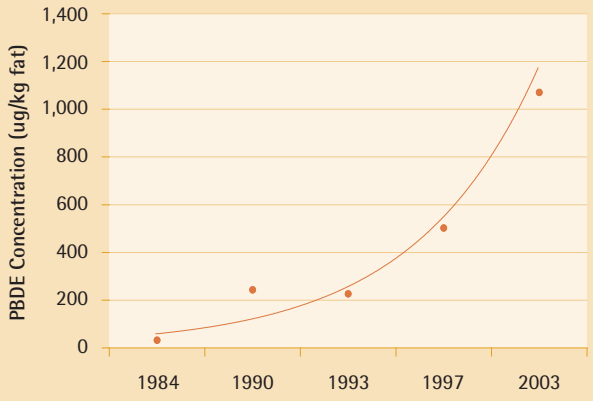
PBDEs in the Georgia Basin Puget Sound Harbour Seals in 2003



PBDE levels in seals from Puget Sound were approximately twice the levels found in seals from Georgia Basin, indicating higher levels of PBDEs in the diet of Puget Sound seals. (Source: Ross et al., 2006)

PBDEs in Puget Sound Harbour Seals from 1984 to 2003



Levels of PBDEs measured in harbour seal samples collected from Gertrude Island in south Puget Sound rose exponentially between 1984 and 2003. Based on current production and consumption patterns in North America, PBDE levels in harbour seals will soon eclipse PCB levels. (Source: Department of Fisheries and Oceans)

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WORKING TOGETHER FOR THE GEORGIA BASIN



GEORGIA BASIN PUGET SOUND ECOSYSTEM INDICATORS

Solid Waste and Recycling

This indicator describes the disposal and diversion of municipal solid waste (also known as trash or garbage) in the region. It is estimated that in North America, only about 6% of materials – such as chemicals, metals, wood products and petroleum – actually end up in a product. The rest is consumed during the manufacturing process or transformed into industrial waste. Solid waste is a measure of material inefficiency in manufacturing and resource use. It also represents wasted resources.

What is happening?

In 2003, more than 5 million tonnes of garbage was sent to landfills or incinerators in the region. This was also a record year for diversion of waste from landfills, with over 5 million tonnes of materials diverted by reusing, recycling, and refining processes, or by being burned for energy recovery. Of an average 4.1kg (9.1lbs) of solid waste generated per person daily, about half was disposed and half was diverted to recycling and other uses.

Between 1999 and 2003, waste generation increased by 34% even though the population increased by 5%. There was a 13% increase in the amount recycled during this period, but despite aggressive waste reduction, pollution prevention and recycling strategies, 15.5% more waste material was sent to landfills.

Why is this happening?

Demographics and income, decreasing household sizes, increasing use of convenience products, and a focus on recycling rather than waste reduction are all factors affecting solid waste generation, disposal and diversion rates. A relatively high per capita income leads to the purchase and use of more products, leading to more waste. For 20 years, average household sizes have steadily decreased and smaller households tend to produce more waste than larger ones. People are working longer hours and at multiple jobs, and having less free time leads to increased use of convenience products which are discarded after a single use. People are also eating out more often, which creates more waste per meal than households typically do. Convenient curbside pickup of recyclables can give consumers the impression that environmental responsibility ends with setting their recyclables on the curb. Reducing the amount of solid waste is also an essential message.

How does this affect me?

Demand for convenient and disposable products leads to increased waste and pollution. Better quality products last longer, therefore can cost less for the consumer in the long run. When goods are made less efficiently, more waste is associated with every phase of production. This leads to smaller margins of profit for the manufacturer and smaller returns on investment. Costs to handle products and waste are passed down to the consumer.

Transportation and handling of solid waste produces greenhouse gases as do combustion and decomposition of materials in landfills. When waste material containing toxic substances is disposed of in landfills or incinerated, pollutants are released into the air and general environment. Waste also means potential jobs are not created. Thousands of new jobs could be created by expanding businesses that add economic value to waste. For every 15,000 tons of waste sent to landfills, it is estimated that seven jobs could be created by composting that amount of waste and nine jobs by recycling it.

What are we doing about it?

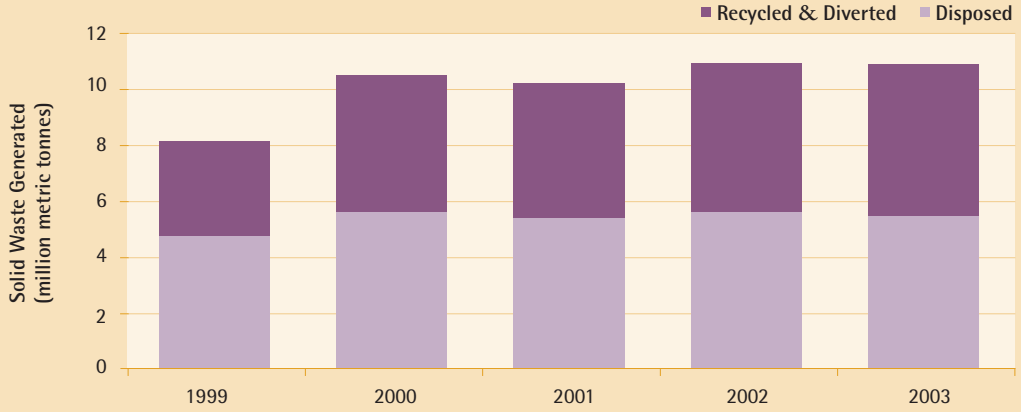
Agency initiatives and public policies that are helping to reduce solid waste in the Georgia Basin and Puget Sound include:

- Solid waste management plans that incorporate an ecological attitude to waste as misplaced resources, and a strategy of continuous improvement in waste reduction, moving toward a zero waste goal
- Strategies to reduce solid waste at its source: reducing packaging and paper use, bulk purchasing, and avoiding disposable products; thereby avoiding costs related to both disposal and diversion
- Purchasing policies that reduce the volume of products purchased and environmental impacts associated with those products
- Making reuse and recycling easy: curbside recycling and the ubiquitous presence of recycling drop boxes
- Programs designed to encourage food donation and composting
- Better community access to commercial composting services and programs for education and development of home composting systems

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at: http://www.epa.gov/region10/psgb/indicators/

Solid Waste Generated from 1999 to 2003



Between 1999 and 2003, the amount of solid waste generated in the Georgia Basin Puget Sound increased by 34% even though the population increased by 5%. Almost half of the waste was send to landfills or incinerators while the other half was reused, recycled, refined or burned for energy recovery. (Source: Washington Department of Ecology)

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River, Stream and Lake Quality

This indicator describes the quality of fresh water found in our rivers, streams and lakes. It employs a water quality index which integrates physical and chemical data on temperature, pH, dissolved oxygen, phosphorous, nitrogen and suspended solids for an overall sense of how well water quality at a particular site supports aquatic life and various water uses such as swimming or drinking water.

The indicator also reports the health of benthic invertebrate communities, which assimilate and demonstrate the impact of physical and chemical changes in water quality on living organisms. The number and types of organisms found at reference sites with unimpaired water are compared to those at test sites, showing the extent of changes in water quality.

What is happening?

In 2003, water quality index data were collected from 16 sites in the Georgia Basin. Ten were rated as good, five fair and one poor. The Fraser River, the largest salmon-producing river in the world, was monitored at five locations: four were rated good and one fair. Between 1998 and 2003, benthic invertebrate communities were collected from 58 locations exposed to human activities: 90% of the sites were different than expected, indicating environmental stress or compromised biological quality. In some cases, the diversity of species was low overall, while in others diversity was high but the community was dominated by pollution-tolerant organisms. The majority of impaired sites were located in urban areas and areas of intense agriculture.

In Puget Sound, 24 sites were monitored regularly for water quality index data, half of which were rated good and half rated fair. Twenty-two additional sites were sampled on a rotating basis; 7 of which were rated good, 14 fair, and one poor. The sites with fair and poor water quality results were typically located near urbanized or agricultural areas. Where benthic invertebrate data were collected, 64% of test sites were considered biologically impaired. Although test sites were located in areas that included forestry, agricultural activity, and urban environments, most of the sites determined to be biologically impaired were found in forested settings.

Why is it happening?

Impaired water quality was measured at sites located in urbanized, agricultural and forested areas developed for other land uses. Population growth, increased land development and intensified agricultural activities have led to increases in point source discharges, such as regulated discharges from manufacturing and sewage treatment facilities, and non-point sources of pollution, such as storm water from urban areas, agricultural runoff and faulty septic systems.

An increase in hard impervious surfaces also reduces the capacity of the land to filter pollutants out of surface runoff and facilitates the flow of polluted water into freshwater environments.

How does this affect me?

When ecosystems are damaged by poor water quality, so too are resource industries that depend on them, such as fishing and wildlife viewing. The salmon industry alone is worth billions of dollars. Approximately half of salmon spawning streams in the Fraser River system are found in urbanized areas, near industrial outfalls, sewage treatment plants and areas of active forestry. Wildlife viewing revenues benefit rural communities through lodging, food, equipment and expanded recreation opportunities. Impaired freshwater quality is extremely expensive to restore and costs are usually borne by taxpayers. For example, it cost $4.5 million to clean up one freshwater river system in Washington. As demand for drinking water increases, poor water quality will also make it increasingly difficult and costly to find watersheds in suitable condition to provide for that demand.

What are we doing about it?

Government agencies, citizens, businesses and community groups are cooperating to coordinate policy development, research and monitoring to better understand and mitigate human activities that impact freshwater quality. Some examples of these efforts are:

- Farm planning and manure/chemical management
- Use of low-impact development and native landscaping
- Community-based watershed planning
- Stormwater planning and the protection of natural floodplains
- Technical assistance, pollution prevention and green purchasing strategies for businesses
- Opportunities for community engagement and learning

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at:
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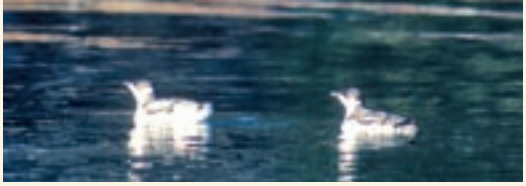


Marine Species at Risk

This indicator describes marine species at risk in the Georgia Basin Puget Sound. It represents the effects of human activities on the regional marine ecosystem. Population growth, land use changes, release of toxic chemicals and many other pressures have the effect of decreased local biodiversity and species viability. Native species whose populations have decreased so dramatically that they are threatened with extinction have been formally listed by Canadian and U.S. agencies. In some cases, a unique local population of a species is listed because it warrants special attention to ensure its conservation.

What is happening?

As of September 1, 2004, 63 species of concern were listed in the Georgia Basin Puget Sound marine ecosystem. In the Georgia Basin, 2 species of fish, 1 reptile, 21 birds and 8 mammals were listed; and in Puget Sound; 3 invertebrates, 22 species of fish, 1 reptile, 11 birds and 9 mammals. Twenty-six of the species listed were designated as threatened or endangered. Species recently added to the list include: bull trout, grey whale (Northeast Pacific population), harbour porpoise (Pacific Ocean population), leatherback turtle, Northern abalone, Olympia oyster, Steller sea lion and two local populations of sockeye salmon in BC.

Even populations of our most iconic animal, the orca or killer whale, are in jeopardy. Between 1995 and 2003, the northern resident killer whale population declined by 7% and the southern resident population by 17%. Both Canada and the US have listed the northern resident population as threatened and the southern resident population as endangered. In 2003, Canada also placed transient killer whales on the threatened list.

Why is this happening?

Past overharvesting drove population numbers down directly; some species continue to be threatened by illegal harvest. Habitat loss and chemical contamination also have a profound effect on species health and survival. The nearshore, where the land meets the sea, is one of the most productive ecosystem types. These environments constantly shift and change, but when they are paved, dredged, and built over with docks and piers, the habitat function they served is lost.

The Georgia Basin Puget Sound has a long legacy of intensive industrial activities including wastewater discharges from pulp and paper mills and oil refineries. Surface runoff from urban development, agriculture, and other sources adds to the contaminant burden. Some of these substances do not break down; others degrade to more toxic compounds. Some pollutants concentrate in the marine food web.

How does this affect me?

Healthy marine ecosystems benefit coastal communities by providing seafood and recreational opportunities, and supporting our cultural, aesthetic and spiritual values. They provide flood and storm protection and maintain biodiversity and biological resilience. When coastal habitats are degraded and fragmented, overall watershed functions are impaired, increasing the vulnerability of coastal environments to erosion and flooding. Restoration and clean-up of environmental damage is costly. Commercial fisheries and wildlife-based tourism - two resource industries that contribute significantly to the regional economy - are dependent on the health of marine ecosystems. Species decline can throw predator-prey populations out of proportion, facilitating the spread of non-native species which can have enormous ecological and economic impacts. An increasing understanding of marine ecology is revealing an array of biochemical compounds, some of which have been identified as having medicinal value.

What are we doing about it?

Agency initiatives and public policies that are helping to protect marine species and habitat at risk in the Georgia Basin and Puget Sound include:

- Scientific surveys and monitoring to better understand marine ecology
- Species recovery and management planning with partners in all levels of government and the private sector
- Land and habitat acquisition by public agencies, private landowners, farmers, community groups and non-profit organizations
- Tax incentives to private landowners to protect their land for conservation and contracts for landowners to rent their streamside land for conservation purposes such as tree and shrub planting

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at: http://www.epa.gov/region10/psgb/indicators/

Marine Ecosystem Species of Concern in the Georgia Basin Puget Sound

	British Columbia	Washington State	Canada	United States	**TOTAL**
Invertebrates	0	3	2	2	**3**
Fish	2	22	5	6	**27**
Reptiles	1	1	1	1	**1**
Birds	21	11	6	7	**23**
Mammals	8	9	9	4	**9**
TOTAL	**32**	**46**	**23**	**20**	**63**

In 2004, 63 species were listed as being of concern by one or more jurisdiction in the Georgia Basin Puget Sound marine ecosystem. Twenty-six of these species are listed as threatened or endangered. Over-harvest, habitat loss and contaminants were causes that were most frequently cited for species declines. (Source: The SeaDoc Society)

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Urbanization and Forest Change

This indicator describes changes in patterns of land use, including forest loss and increases in urbanization. Patterns of land use and land cover, in conjunction with the socioeconomic profile of the seven million people who live in the Georgia Basin Puget Sound, are some of the main driving forces behind overall ecosystem health. Both urban development and loss of forest cover can have a profound influence on the physical, chemical and biological quality of ecosystems.

What is happening?

The area of forest land in the Georgia Basin Puget Sound area continues to decrease as land is used to expand airports, railways, ports, roads and housing to accommodate the region's increasing population.

Between 1992 and 2000, at least 1% of the total area of 452 watersheds was converted from mature forest to other types of land cover, such as bare ground, immature vegetation and/or industrial and urban uses. For 205 watersheds, mostly publicly owned, above 600 meters of elevation, there was a net increase in forest cover as young stands or cleared areas grew into more mature forests.

During the same period, 2 to 19% of the total drainage area of 58 watersheds was covered with impervious surfaces. Research has shown that once 10% of a watershed's drainage area has been converted to an impervious or paved condition, there is a higher risk of erosion, flooding and degradation of natural habitat and water quality. Runoff from hard surfaces carries pollutants and pathogens into water bodies, where they decrease survival of fish eggs and juvenile fish, reduce harvests of coastal shellfish and have many other detrimental effects as they enter the food chain.

Why is it happening?

Population expansion and the migration of people to suburban areas fuel development pressure on forested land. Complex regulations and globalization of markets have negative effects on forest products industries, increasing pressure for lands to produce revenue in other ways. Lack of integrated land use planning has limited control on development.

How does this affect me?

- Impervious surfaces absorb heat and can raise local temperatures, increasing costs associated with cooling
- Increased flooding and stream pollution destroys fish habitat, which reduces fishing revenues and food for killer whales, a major tourism attraction. Flooding also results in damage to homes and property

- Impervious surfaces increase the amount of chemicals, oils and other contaminants that end up in fresh water systems and the human food chain
- The natural cycles that replenish freshwater are interrupted, reducing the water available for human use such as drinking, livestock watering, irrigation, manufacturing and recreation
- Removal or division of wildlife habitat decreases biodiversity, affecting the species essential for pollination and pest management in our agricultural crops
- Loss of forest land means loss of habitat, history, aesthetic beauty and economic opportunities for local food and forest products and for nature-based tourism

What are we doing about it?

Agency initiatives and public policies that help to manage land use changes in the Georgia Basin and Puget Sound include 'Smart Growth', regional growth strategies and community planning initiatives that make density and urban living more attractive, comfortable, and accessible while protecting forests, farms and green spaces. Smart Growth protects forests and natural beauty by encouraging mixed land use, compact designs, various options for housing types, walkable neighborhoods, and alternative transportation options.

Low-impact development and natural landscaping foster the use of low maintenance designs and native plants. Living 'green' roofs and porous surfaces are used instead of hard surfacing material to slow runoff and allow water to be filtered and purified naturally as it seeps slowly into the ground.

Forests are being protected through progressive laws such as the Washington State Forest Practices Act and BC Forest and Range Practices Act to balance forestry production with ecological values using scientifically based adaptive management and monitoring processes to reduce the division of habitat and the impact of forest practices on aquatic resources.

Purchasing land at development value and improved planning and zoning are facilitating ecological conservation, making it easier to establish green corridors to maintain continuous natural areas and connect animal populations. Endangered ecosystems and important ecological areas such as Burns Bog are also being protected from development.

What can I do?

For further information and to learn what you can do to help, please consult the Georgia Basin Puget Sound Ecosystem Indicator website located at:
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