Shellfish Safety

Definitions: Shellfish safety includes a wide range of activities from preventing contamination of shellfish harvesting areas, to closing contaminated harvesting areas, to tracking illnesses caused by eating shellfish. Monitoring the percentage of acreage open or closed to shellfish harvest is one method of tracking shellfish safety in Washington. Shellfish areas are assigned classifications related to water quality. Commercial and recreational classification systems are similar but they use different terms. The following definitions list the commercial classification first and the corresponding recreational classification in parentheses. **Approved (Open)** areas are those where pollution source evaluations and water quality data show that fecal contamination and other harmful substances are not present in unsafe amounts. **Conditionally Approved (Conditional)** areas are those that meet the Approved criteria except when known pollution conditions exist, for example, following a heavy rainfall. An area is classified as **Prohibited (Closed)** when contamination is or may be present in dangerous concentrations.

Summary

Washington State is a national leader in the production of commercially harvested oysters, clams and mussels. More than 300,000 people also harvest shellfish recreationally every year from Washington's public beaches. If harmful bacteria, viruses, chemicals or natural toxins are in the growing waters, they can collect in shellfish tissue and cause illness or even death in people.

Washington's commercial growing areas are expanding. From 1991 to 2010, Washington had a net gain of 27,811 acres approved for commercial shellfish production. The number of beaches open for recreational harvesting grew from 78 in 2005 to 201 in 2010. *Vibrio parahaemolyticus (Vp)* is the most common naturally occurring bacterium in Washington waters and causes most shellfish-related illnesses. From 2008 to 2010, Washington averaged about 50 cases of *Vp* each year. *Grimontia hollisae,* formerly known as *Vibrio hollisae*, is a naturally occurring bacterium that is new to Washington and caused six cases of vibriosis in 2010. Paralytic shellfish poison (PSP) and amnesic shellfish poison (ASP) continue to occur in Washington. In 2010, 316 shellfish tissue samples had sufficient concentrations of PSP to require closing commercial areas to harvesting. In 2011, Washington had a confirmed case of diarrhetic shellfish poison (DSP), the first known illness from this biotoxin in the United States. The occurrence of DSP prompted the Washington State Department of Health to establish a new sampling and testing protocol to detect this toxin.

The Department of Health regulates harvesting of shellfish from commercial growing areas and works with other agencies to inform the public about the safety of harvesting shellfish from public beaches. Local agencies and organizations, state agencies and tribes assist the department to sample both water and shellfish and to regulate pollution sources to protect growing areas from contamination.

Introduction

Bivalve shellfish—such as clams (including geoduck), oysters, scallops and mussels—filter seawater to get their food. These shellfish are healthy and safe to eat except when the water is contaminated. Shellfish can concentrate contaminants in their tissues and become unsafe to eat. Shellfish contaminants fall into three categories: bacteria and viruses, marine biotoxins, and chemicals.

Bacteria and viruses. Harmful bacteria and viruses can accumulate in shellfish and cause illness in humans. Thorough cooking of infected shellfish can reduce the number of bacteria or viruses, but many people prefer to eat shellfish raw or lightly cooked. The most common illness-causing virus and bacterium in Washington are norovirus and *Vibrio parahaemolyticus (Vp).*

Norovirus, from water contaminated with human or animal fecal matter, is the most common virus found in shellfish-growing waters. The virus can cause mild to severe gastrointestinal illness in people and typically lasts 24 to 48 hours.

Vp is a naturally occurring marine water bacterium that can cause illness in people. In most years, *Vp* is the leading cause of shellfish illnesses in Washington State. Symptoms are generally moderate, typically lasting 1–7 days and

characterized by watery diarrhea, fever and abdominal cramps.

Vp levels increase in warmer weather. Oysters are more susceptible than clams to accumulating harmful amounts of *Vp.* This is because oysters grow on the beach surface, which is warmer than the sediment where clams grow.

Grimontia hollisae, formerly known as *Vibrio hollisae*, is a naturally occurring bacterium that is new to Washington. It causes vibrio illness with symptoms similar to *Vp* illness but can be more severe. The infection can cause organ damage in some people.

Natural marine biotoxins. All bivalve shellfish, as well as the crabs and snails that eat them, can accumulate biotoxins in their bodies. The shellfish are not harmed by biotoxins and show no outward signs of contamination, but they can cause illness when they are eaten by humans and other mammals.

Three types of biotoxins are found in Washington. All are produced when environmental conditions allow algae to reproduce rapidly or "bloom." The timing for algal blooms is unpredictable. Upwelling currents, warming weather and extensive sunlight seem to be factors that trigger algal blooms, but the exact combination of factors is not yet known. Ongoing research to identify these triggers may help with forecasting blooms and allow development of preventive measures.

The most common biotoxin causes paralytic shellfish poisoning (PSP). PSP is often mistakenly called "red tide" because some associate the toxin with reddish-colored water. This is an incorrect association, as water color is not an indicator of the presence or absence of PSP.

PSP toxin temporarily interferes with the transmission of nerve impulses, resulting in numbness of the lips, tongue and face; lack of coordination; and difficulty talking and breathing. In severe cases, artificial respiration is required.

The second most common biotoxin, domoic acid, causes amnesic shellfish poisoning (ASP). Symptoms include diarrhea and vomiting. More severe cases can result in permanent loss of short-term memory, or coma.

The third most common biotoxin, okadaic acid, causes diarrhetic shellfish poisoning (DSP). Symptoms include nausea, vomiting, abdominal pain and diarrhea. DSP is new in the United States with the first confirmed case occurring in Washington State in 2011.The Department of Health is just beginning to accumulate information on this toxin and its life cycle.

There are no antidotes for biotoxins, and cooking contaminated shellfish does not make them safe to eat. Cooking will destroy the organism, but not the toxin it produces.

Chemicals. Many sources of chemical contaminants can pollute waterways: industrial waste, sewage, airborne contaminants that are deposited into waterways, spills from commercial boats, and storm water runoff, especially in urban or industrial areas. Some chemicals end up in sediment where they can remain for years, and the shellfish that live there are unsafe to eat.

Description of Indicators

Classification of growing areas. Sanitary surveys of growing areas provide information to identify shellfish safety risk. These surveys include analysis of water samples, assessment of potential sources of pollution, and an evaluation of how tides and currents might distribute contaminants. Both commercial shellfish growing areas and recreational public beaches are assigned classifications based on the findings from these surveys and ongoing sampling efforts. (See definition box.) The percent of commercial areas in each classification is a good indicator of the overall levels of contamination in Washington's shellfish growing waters.

Fecal contamination by human and animal wastes. Surveyors look at shorelines and adjacent areas for potential sources of fecal contamination such as septic systems, sewage treatment plants, and storm water and agricultural runoff. They collect marine water samples which are analyzed to determine levels of fecal coliform bacteria. High levels indicate there is fecal matter in the water. Fecal matter may harbor harmful bacteria or viruses that can contaminate shellfish and make them unsafe to eat.

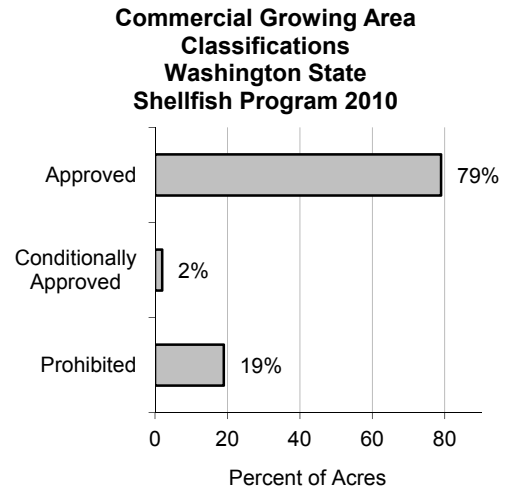
Level of Vp bacteria in shellfish tissue. Because levels of *Vp* are closely related to warmer water and air temperatures, the Department of Health monitors levels of *Vp* between May and October in areas where illnesses have occurred in recent years.

Levels of PSP, ASP and DSP toxins in shellfish tissue. The Department of Health routinely collects samples of various bivalve shellfish for analysis.

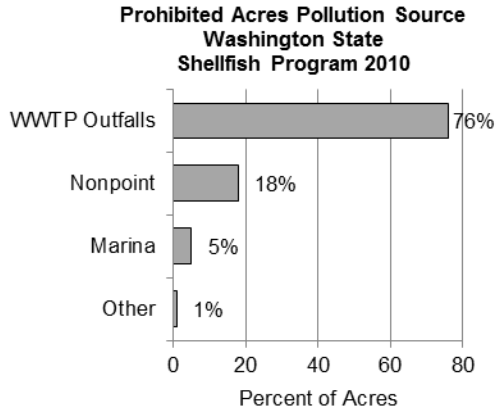
Health outcomes. The Department of Health tracks illnesses associated with eating contaminated shellfish. *Vp* causes most shellfish-related illnesses reported in Washington. Though they rarely occur, illnesses related to PSP, ASP and DSP are also tracked.

Classification of Growing Areas

Commercial areas. In 2010, about 250,000 acres were classified as Approved or Conditionally Approved for commercial shellfish harvesting. More than 60,000 acres were classified as Prohibited. (See definition box.)



Prohibited areas can be attributed to wastewater treatment plant outfalls (where treated wastewater is discharged into Puget Sound), nonpoint pollution sources such as failing septic systems and farm animal waste, marinas and other sources (wildlife waste and unknown sources).

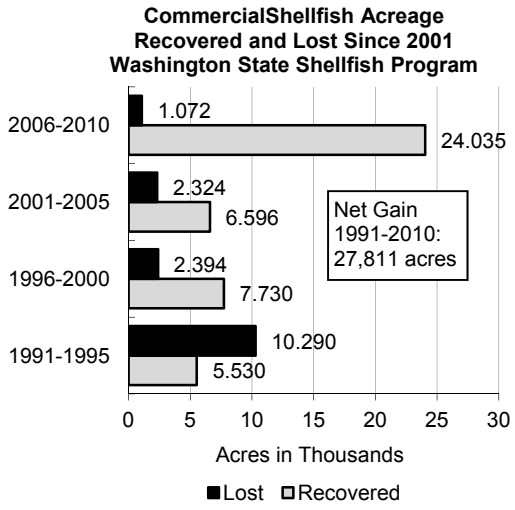


WWTP: Wastewater Treatment Plant

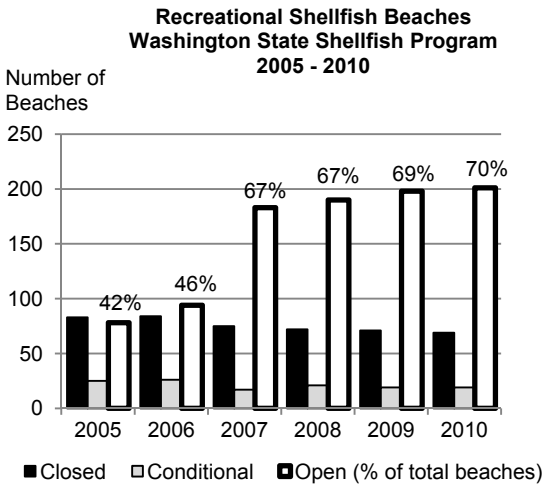
Recreational growing areas. In 2010, Washington listed 1,396 public beaches. About 21% (289) of those beaches had sufficient numbers of shellfish and harvesters to merit conducting a sanitary survey and classifying the beaches. In 2010, 70% of recreational beaches were open, 24% were closed and 7% were conditional. (See definition box.)

Time Trends

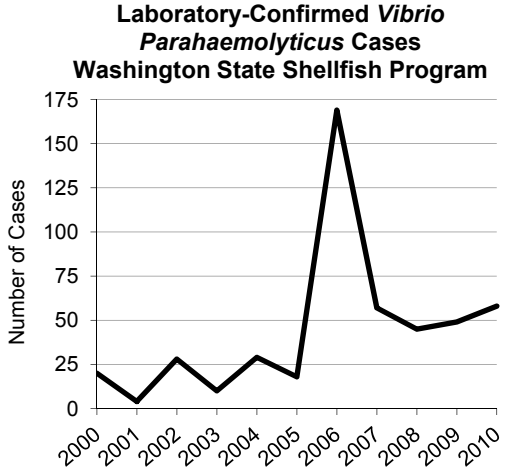
Classification of commercial areas. Since 1991, the Department of Health has used a consistent approach to classify commercial growing areas. From 2001 to 2010, about 16,000 acres of shellfish growing areas were downgraded and subject to harvest restrictions. During the same period, nearly 44,000 acres of commercial shellfish areas classified as prohibited became harvestable again because environmental conditions improved.



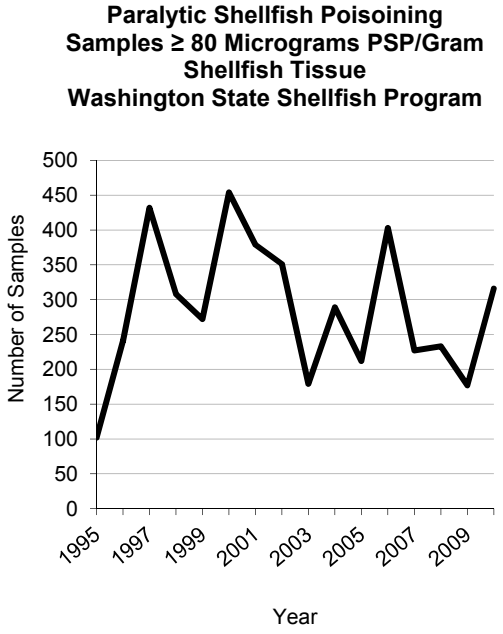
Classification of recreational beaches. The number of classified beaches grew from 186 in 2005 to 289 in 2010. During this time the number and percent of beaches open to recreational harvesting grew from 78 (42%) to 201 (70%).



Vibrio parahaemolyticus. Over the past 10 years, the annual number of laboratory-confirmed cases of *Vp* has varied from a low of four in 2001 to a high of 169 in 2006, when Washington experienced an unusually dry and warm summer. These numbers do not include everyone who might have had *Vp.* Many people who may have *Vp* illness have mild symptoms and do not seek medical attention. Symptoms of *Vp* illness can be similar to symptoms of other gastrointestinal illnesses and so healthcare providers sometimes fail to properly diagnose *Vp*.



Marine biotoxins. Since 1995, an average of 3,000 shellfish samples have been analyzed by the Public Health Laboratories each year for paralytic shellfish poison (PSP) levels. The Department of Health closes shellfish harvest when more than 80 micrograms of PSP are found per 100 grams of tissue. The highest PSP level recorded was 20,751 micrograms, which occurred in 2002.



Geographic Variation

Shellfish harvest area classifications are determined in part by proximity to potential sources of pollution. Urban areas typically have many more sources of pollution, so most approved commercial harvest areas and recreational shellfish beaches are located away from urban areas.

Geographic variation may also account for the relatively large numbers of *Vp* illnesses in Washington. Studies in the late 1990s and early 2000s showed that the strains of *Vp* bacteria found in the Pacific Northwest appeared to cause more severe disease than those found in other parts of the United States.[1, 2] It is not known whether this is still the case.

High-Risk Populations

As with most other foodborne illnesses, young children, the elderly and people with compromised immune systems are at increased risk of shellfish-associated illness. Some American Indian tribal members and some people of Asian descent collect and eat more shellfish than other groups, potentially making them more likely to become ill from contaminated shellfish. People at higher risk for *Vp* illness are those who take antacids for heartburn or medication for acid reflux or ulcers.

Recreational shellfish harvesters who cannot read posted warning signs because of language barriers or inability to read might not be aware of unsafe harvesting areas and conditions.

Intervention Strategies

The prevention of illnesses and the protection of shellfish growing areas are the responsibility of the shellfish industry, multiple regulatory agencies and the general public. Activities include:

- Protecting growing areas from contamination.
- Monitoring and closing harvest areas as needed and issuing warnings to the public when laboratory analysis indicates shellfish are unsafe to eat.
- Annually reviewing regulations that minimize the potential for *Vp* illness and changing those regulations if needed to improve their effectiveness.
- Thoroughly cooking shellfish contaminated with some types of bacteria or viruses, such as *Vp* or norovirus.

Protecting growing areas from contamination. Routine monitoring of water quality, performing surveys to determine the status of a growing area and identifying possible pollution sources can encourage efforts to prevent and control pollution. If water quality declines to the point that the area is threatened, the Washington State Department of Health notifies stakeholders, local governments, tribes, conservation districts and other state agencies so they can plan and implement prevention activities.

Identifying and closing contaminated commercial and recreational growing areas. Sometimes water quality declines to the point where it is no longer safe to harvest shellfish. When this is caused by nonpoint pollution, state law requires local governments to form shellfish protection districts to address the problem.

Temporary closures sometimes occur. These are generally caused by spills, floods or high biotoxin levels, much of which cannot be avoided.

Notifying the public of closed recreational areas. People need to be notified when a recreational area is closed to harvest. The Washington State Department of Health notifies local health jurisdictions, whose staff place signs on beaches indicating the reason for the closure. These signs are sometimes vandalized or stolen and posting on beaches can be somewhat ineffective. The department maintains a toll-free Shellfish Safety Hotline that provides new closure information and a website that shows maps of closed recreational areas. Sometimes the department issues a news release that gets reported by local media.

Educating the public about the hazards of eating raw shellfish. If shellfish are contaminated by bacteria or viruses, cooking can kill the pathogens so that the shellfish are safe to eat. Cooking does not destroy biotoxins. The following table shows when cooking is effective.

Effective	*Not Effective*
Vp	PSP
Norovirus	ASP
Harmful bacteria	DSP

Shellfish must be cooked until it reaches an internal temperature of 145 degrees for at least 15 seconds. Cooking until the shells just open is *not* sufficient to kill bacteria and viruses.

Observing the following practices can also improve safety of eating shellfish potentially contaminated with *Vp.*

- Harvest shellfish shortly after the tide recedes, and avoid shellfish that have been exposed to the sun for any length of time.
- Place harvested shellfish on ice immediately.
- Avoid harvesting on hot days. ("*If the temperature's high, pass them by.*")

In addition to these control measures, the Department of Health has advised people not to eat shellfish from Port Angeles Harbor, the Lower Columbia River and the Lower Duwamish River because of chemical contamination. Local health departments have also issued shellfish consumption advisories based on chemical or biological contamination. To get links to local health departments and updated shellfish consumption advisory information visit www.doh.wa.gov/LHJMap/LHJMap.htm.

See Related Chapter: Foodborne Illnesses

Data Sources

Department of Health 2005 Annual Inventory of Commercial and Recreational Shellfish Areas

Department of Health Biotoxin Database

Department of Health Shellfish *Vibrio* Database

Department of Health Shellfish Water Quality Database

For More Information

PSP toll-free hotline (800) 562-5632

Department of Health Marine Biotoxin Bulletin

Department of Health website for shellfish safety information:
http://www.doh.wa.gov/CommunityandEnvironment/Shellfish.aspx

Puget Sound Partnership, a state agency devoted to protecting and restoring Puget Sound: www.psp.wa.gov

U.S. Centers for Disease Control and Prevention website for shellfish safety information:
www.cdc.gov/nczved/divisions/dfbmd/diseases/marine_toxins/

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Endnotes

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[1] DePaola D, Kaysner C, Bowers J, Cook D. Environmental investigations of *Vibrio parahaemolyticus* in oysters after outbreaks in Washington, Texas, and New York (1997 and 1998). *Appl Environ Microbiol.* 2000;66:4649-4654.

[2] DePaola A, Ulaszek J, Kaysner C, et al. Molecular, serological, and virulence characteristics of *Vibrio parahaemolyticus* isolated from environmental food, and clinical sources in North America and Asia. *Appl Environ Microbiol*. 2003;69:3999-4005.