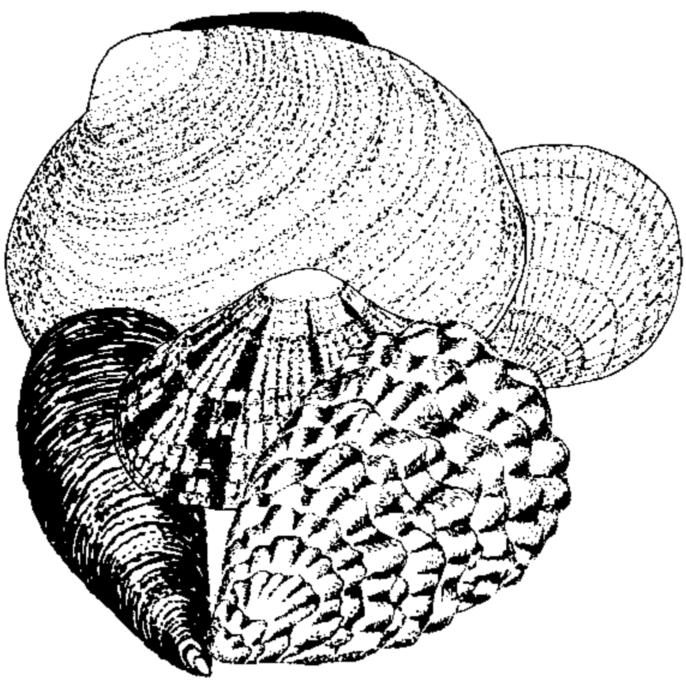
# Gathering Safe Shellfish in Washington

## Avoiding Paralytic Shellfish Poisoning





*Louisa Nishitani and Kenneth K. Chew*

Fond of shellfish? Washington waters offer a delectable variety of clams, oysters, mussels, and scallops readily available to be gathered and enjoyed. At certain times, however, some shellfish become unsafe to eat because they contain a poison harmful to human beings. Paralytic shellfish poisoning, commonly known as PSP, is a danger that you as a shellfish consumer can avoid by being well informed and observing certain basic precautions. This bulletin provides information about PSP, its symptoms and treatment, and its relationship to "red tides." It also explains what Washington State is doing to protect you from this hazard so that you can safely enjoy the bounty of Washington seashores.

## PSP

Paralytic shellfish poisoning (PSP) is a serious illness caused by eating shellfish that have consumed large amounts of a poison-producing microscopic organism called *Gonyaulax catenella.* (This scientific name is pronounced gone-ee-all'-ax cat-a-nell'a, and the organism has no common name.) The *Gonyaulax* toxins are extremely potent nerve poisons; in fact, as little as one milligram (0.000035 ounce) can be enough to kill an adult. The poisons themselves, as well as the illness they cause, are referred to as PSP. The poison acts very rapidly, and no antidote has as yet been discovered.

## Symptoms

Early symptoms of PSP are a tingling of the lips and tongue, which may begin within minutes of eating poisonous shellfish or may take an hour or

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two to develop. Depending on the amount of toxin a person has taken in, symptoms may progress to tingling of fingers and toes and then loss of control of arms and legs, followed by difficulty in breathing. Some individuals have a sense of floating, while others are nauseated. If a person consumes enough poison, death can result from paralysis of the breathing mechanism, in as little as two hours. Approximately 15 percent of the reported cases of PSP have resulted in death.

You should be careful to distinguish these symptoms of PSP from two other types of illness sometimes caused by eating shellfish—allergic reactions and gastrointestinal problems or hepatitis resulting from sewage pollution.

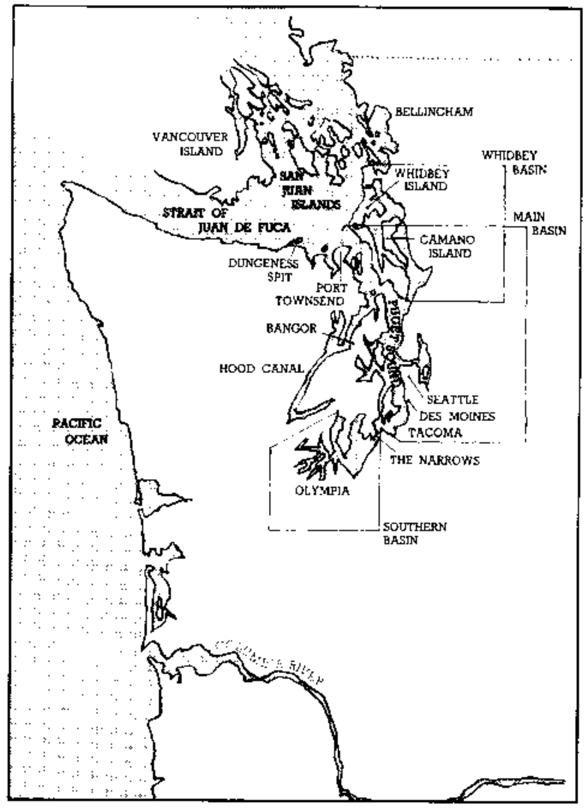
## Treatment

It is essential to begin treating PSP immediately—as soon as the lips or tongue begin to tingle, because the poisons can take effect rapidly and, as indicated, there is no known antidote for them. Induce vomiting and give a brisk laxative to remove the toxic shellfish from the digestive tract. *Get the patient to a doctor at once.* If this is not possible, prepare to administer artificial respiration, which may be required for many hours.

## PSP Occurrences

The accumulation of PSP toxins in shellfish is not a new phenomenon, nor is it one confined to Washington alone. It has been occurring, in fact, for hundreds of years in many parts of the world, primarily in temperate waters. Along the Pacific Coast, poisonous shellfish have been found all the way from Alaska to California. The first recorded death in this region occurred in 1793 when one of Captain Vancouver's men died after eating toxic shellfish in British Columbia. Indian tribes were undoubtedly aware of the problem long before that, however.

Since laboratory testing for PSP began in the 1940s, toxic shellfish have been found along both the Strait of Juan de Fuca and the ocean shores, regularly in some areas but only intermittently in others. In the early 1970s, poisonous shellfish were found in the San Juan Islands and in the Bellingham area. Before 1978, no cases of shellfish poisoning from shellfish harvested in Puget Sound east and south of Port Townsend had been reported, even though




sparse populations of *G. catenella* were known to occur there. However in the fall of 1978, extraordinarily high levels of PSP occurred in shellfish throughout the area between Whidbey and Camano islands. It is believed that as water from that area flowed southward around Whidbey Island, it carried enormous numbers of *Gonyaulax* into the Main Basin of Puget Sound. As a result, shellfish became poisonous that year as far south as Des Moines. In 1979, toxic shellfish were found in The Narrows.

Toxin at levels not requiring the closure of beaches to shellfish harvesting was found in shellfish just south of The Narrows in 1980. In 1981, similar low levels were found throughout most of the Southern Basin, south of The Narrows. In 1988, high levels of PSP toxins necessitated closure of shellfish harvesting sites in the Southern Basin for the first time. Low levels, not necessitating closures, have also been found in Hood Canal as far south as Bangor.

As of summer 1989, the only Washington waters that have never been closed to shellfish harvesting because of PSP are those of Hood Canal. This situation represents a dramatic increase in areas affected by closures in the last few years and has greatly altered the shellfish-collecting habits of Northwesterners.

As already mentioned, PSP problems are also widespread in British Columbia and Alaska.

## PSP Seasons

In general, shellfish are more likely to become poisonous in late spring, summer, and fall than in winter. However, you should be aware that some species—particularly butter clams and scallops—tend to be toxic for longer periods extending into winter or even throughout the year in some areas. In spring, longer days and warmer waters encourage faster growth of the swimming stage of *G. catenella*. Furthermore, the longer periods of calm weather and relatively calm seas from spring through fall allow the cells, which swim upward during the daytime, to accumulate near the surface. When enough of these cells collect in the upper water layer, the shellfish filtering them out for food become poisonous.

Shellfish filter water at remarkable rates; for example, a large oyster can filter as much as 30 liters (about 8 gallons) per hour. The more abundant the *G. catenella* cells, the faster the toxin content of the shellfish increases. The warming of the water also permits the shellfish to feed faster. All of these factors combined may lead to PSP levels that require closures—just when the first good clamming tides of spring occur, causing disappointment and frustration for eager diggers.

At times, for reasons not yet understood, some of the swimming cells of *G. catenella* form nonswimming resting cells or cysts, which settle to the bottom. Scientists believe that these cysts are at least as poisonous as the swimming cells and perhaps even more so. If large numbers of the cysts are present in the sediment, clams and other shellfish may consume them at any time of the year and become poisonous.

## Shellfish Subject to PSP

Unfortunately, all species of bivalve shellfish (clams, oysters, mussels, and scallops) commonly eaten in Washington have been found to contain poisons at some time. Different species vary considerably, however, in the rates at which they become toxic, in the total amounts of toxin they take up, and in the speed with which they get rid of it.

Some kinds of shellfish with a high tolerance to PSP can feed normally when *G. catenella* is abundant and rapidly become very poisonous. Other kinds of shellfish with a low tolerance to PSP tend to reduce their feeding rates when *G. catenella* is abundant and are less likely to become highly toxic. It is very rare that shellfish themselves are killed by the poison they consume.

Shellfish also vary in what they do with the toxin they take in. Butter clams tend to move some of the toxin to the black part of the neck and keep it there for varying lengths of time. This retention and also the consumption of cysts are probably what cause butter clams to be poisonous throughout the year in certain areas. (For descriptions and illustrations of the shellfish most popular with Washington diggers, see Figures 1–9.)

Mussels, on the other hand, tend both to take up and to lose the poison rapidly. Since mussels normally locate on rocks and pilings, they are up out of the sediments where cysts accumulate. As a result, PSP in mussels is generally related to an abundance of swimming *G. catenella* and thus more likely to occur during the warmer months. Nevertheless, you should be forewarned that it is possible for mussels to become poisonous at other times if storms stir up the bottom-dwelling cysts.

Paralytic shellfish poisons also have been found at low concentrations in several other kinds of marine life that some people like to eat, such as limpets, shore snails, and hairy tritons. Several species of crabs have been found to contain small amounts, but not enough to cause concern. In Dungeness crabs, for example, the toxin has been found in the digestive tract, which is normally not eaten, but it has not been found in the muscles, which are eaten.

## PSP and Red Tides

No doubt you have heard a great deal about red tides over the years. Unfortunately, there is much misunderstanding about the relationship between red tides and poisonous shellfish—including a widespread tendency to equate the two. This misconception has led to the dangerous false assumption that shellfish are safe to eat if no red tide is visible. On the other hand, some people in Puget Sound believe that because they have eaten clams safely for years

# Common Washington Shellfish

In Washington State, a number of different kinds of shellfish make good eating. Here are descriptions of those most commonly sought by recreational diggers.

1 **Native littleneck clam** *(Protothaca staminea)*
*Size:* Medium, to 2½ inches
*Shape:* Oval to round
*Other characteristics:* External surface sculptured with radiating and concentric ridges. May have angular brown and white pattern or be white only. Inner surface white, sometimes with small bumps along margin.

2 **Manila or Japanese littleneck clam** *(Tapes philippinarum—Venerupis japonica)*
*Size:* Medium, to 2½ inches
*Shape:* Oblong
*Other characteristics:* External surface with radiating and concentric ridges. May have angular color pattern or be dull gray-brown. Inner surface often yellowish with purple streaks or patches, without small bumps along margin.

3 **Butter clam** *(Saxidomus giganteus)*
*Size:* Large, to 5 inches
*Shape:* Square to oval
*Other characteristics:* Heavy, solid shells. Slight gape at one end in adults. External surface with prominent concentric ridges. Yellow when young, gray-white when adult. Internal surface white.

4 **Horse clam** *(Schizotherus nuttalli)*
*Size:* Large, to 8 inches long and 6 inches high
*Shape:* Elliptical, blunt on one end
*Other characteristics:* Shells gape widely at one end. Exterior shell white or yellow, with smooth concentric sculpture and varying amounts of black or brown covering that peels off. Interior chalky or pearly.

5 **Softshell clam** *(Myra arenaria)*
*Size:* Large, to 6 inches
*Shape:* Elliptical, pointed on siphon end, rounded on other end
*Other characteristics:* Shell soft, easily broken. External surface with uneven concentric sculpture, white or gray, sometimes with yellow to brown covering at shell edges. Internal surface white, with large spoon-shaped projection on hinge side.

6 **Geoduck** *(Panope generosa)*
*Size:* Large, to 9 inches
*Shape:* Oblong, rounded at one end, appearing cut off at other, gaping, except at hinge area
*Other characteristics:* Shells heavy, external surface with rough concentric sculpture, gray-white with yellow covering. Internal surface dull white with deeply impressed muscle scars.

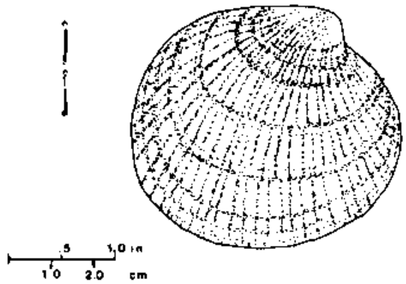
7 **Cockle** *(Clinocardium nuttalli)*
*Size:* Large, to 4½ inches
*Shape:* Triangular, heart-shaped in cross section
*Other characteristics:* Shell heavy. External surface with prominent radiating ribs with thin covering. Light brown when young, darker and mottled when adult. Interior surface chalky with pearly edges.

8 **Pacific oyster** *(Crassostrea gigas)*
*Size:* Large, to 12 inches in length
*Shape:* Very irregular, depending on environment and degree of crowding
*Other characteristics:* Gray or white; edges may be dark. External surface smooth or fluted. Internal surface white with a polished surface. Lower valve cupped, upper valve usually flat. End, hinged.

9 **Bay or Blue mussel** *(Mytilus edulis)*
*Size:* Small, to 2 inches
*Shape:* Elongate; hinge end pointed
*Other characteristics:* External surface smooth with fine concentric sculpture. Shell covering blue, brown, or black. Internal surface dull blue.

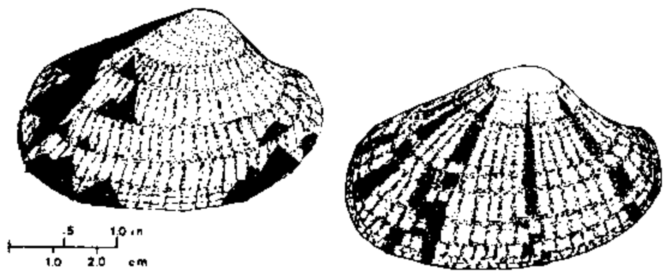
*Drawings: Nancy Musgrove*

Figure 1



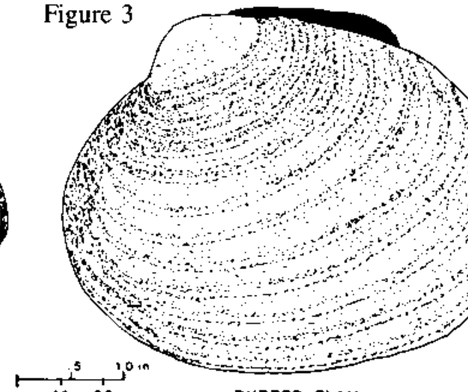
NATIVE LITTLENECK CLAM

Figure 2



JAPANESE LITTLENECK OR MANILA CLAMS

Figure 3



BUTTER CLAM

Figure 4

HORSE CLAM

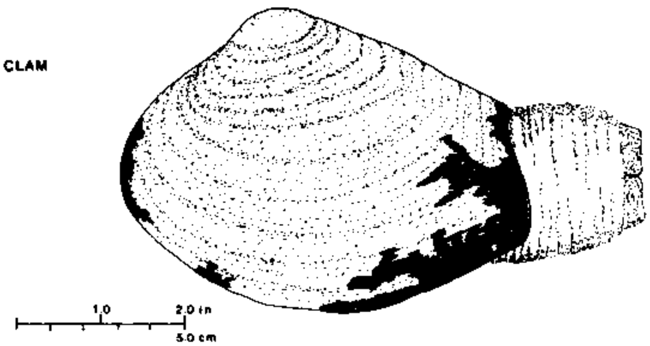
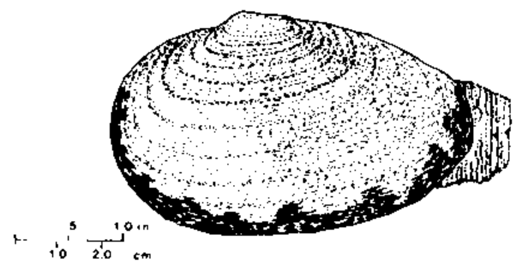
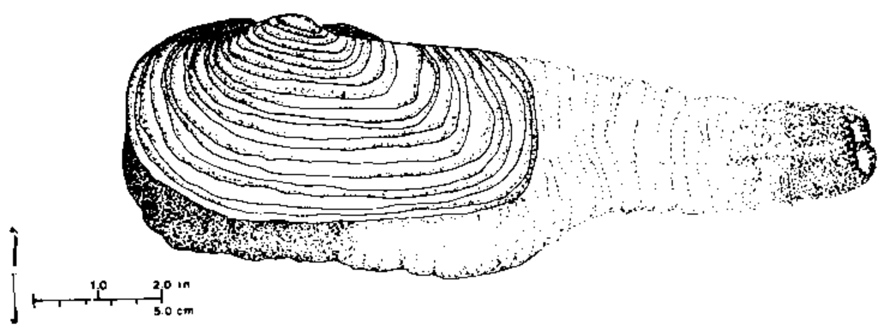


Figure 5



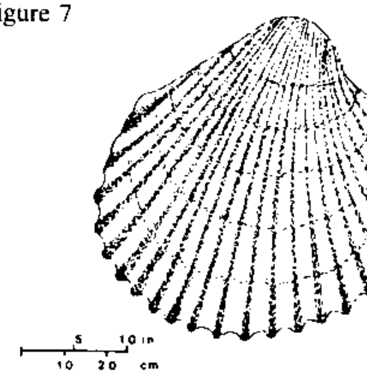
SOFT-SHELL CLAM

Figure 6



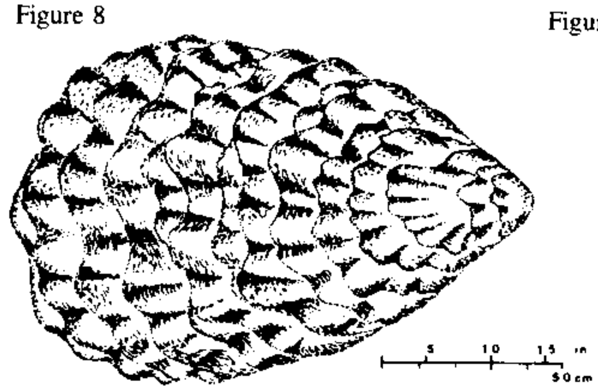
GEODUCK

Figure 7



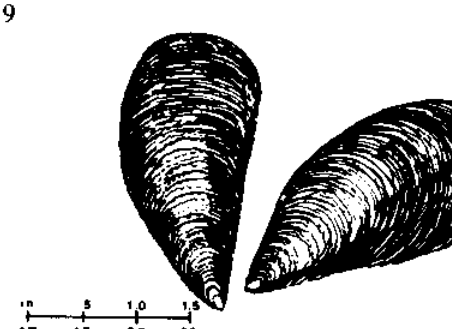
COCKLE

Figure 8



PACIFIC OYSTER

Figure 9



BLUE MUSSELS

even when red tides were present, they can continue to do so. It is essential to sort out the confusion.

The term "red tide" is a misnomer since red tides are not tides at all, and many of them are not even red. Furthermore, "red tide" is widely used (even in dictionaries and on some beach closure signs) to indicate the presence of poisonous shellfish, when, in fact, only a very small percentage of the visible red tides cause shellfish to be unsafe. In Washington, most outbreaks of poisonous shellfish occur when there has been no discoloration of the water at all.

Scientists use the term "red tide" to refer to an area of discolored water—usually amber, brown, purple, red, or pink—that is formed by accumulations of very large numbers of microscopic plants or animals, hundreds of thousands per liter of water. Often the organisms forming a particular red tide belong to one species. A discolored area or red tide may be confined to relatively small patches, or it may cover several acres or even many square miles of the sea.

In the Pacific Northwest, there are many species of plankton (small plants or animals carried along by currents) that cause red tides. One of these is *Mesodinium*, a one-celled animal that frequently causes a red tide varying in color from brick red to purple. Another red tide you may have seen is the color of tomato soup; it is caused by *Noctiluca*, a dinoflagellate or kind of plankton having both plant and animal characteristics. *Noctiluca*, which means "night light," often produces brilliant displays of bioluminescence when the water is disturbed at night. Because it is very buoyant, it is frequently blown into windrows on the water or into bands of orange-red scum along the shore.

Both these red tides are harmless. In fact, of the many species that form red tides in Washington waters, *G. catenella* is the only one known to cause PSP. It, too, is a dinoflagellate, too tiny to be seen without a microscope. It is propelled by two small whips. Each cell is independent, but during periods of rapid growth and division, the cells remain attached to each other in a chain—hence the name *catenella* or "little chain." *G. catenella*, too, can illuminate the water with a blue-white light.

The single-celled cysts of *G. catenella*, which sometimes develop, are heavy-walled and can lie dormant in the bottom sediment through low winter temperatures. As indicated, many of these cysts are eaten by animals or become buried. Others germinate when conditions are favorable, giving rise to another population of swimming cells.

Water discolored by *G. catenella* varies from the color of weak tea to rusty-red, but red tides caused by this species are unusual in Washington waters. As mentioned, however, shellfish filter great volumes of water; thus this organism does not need to be very dense for the shellfish to collect enough poison to require that beaches be closed to harvesting. In fact, most shellfish PSP from Washington to Alaska occurs when *G. catenella* is relatively sparse, not nearly dense enough to discolor the water.

Keep in mind, then, that although a red tide *may* indicate that shellfish are toxic, it is dangerous to assume that lack of a red tide means that shellfish are safe to eat. Determining what shellfish gathering areas in Washington are safe or unsafe is the responsibility of the state and/or counties. Their services are described in the next section.

# PSP Program in Washington

The Washington Department of Health began testing shellfish for PSP in the 1930s, when there were many PSP illnesses and deaths in California. In 1942, harvesting of geoducks, horse clams, hardshell clams, and mussels was prohibited on all beaches from Dungeness Spit to the Columbia River from April 1 through October 31. This closure, based on annual recurrences of toxic shellfish in that area, has been in effect every year since 1942 and is announced in the Sports Fisheries Regulations of the Washington State Department of Fisheries.

Warnings about poisonous clams on other Washington beaches are provided by a PSP monitoring program begun in 1947 after PSP deaths occurred in British Columbia. Under this program, counties have the responsibility for testing the shellfish on beaches used for sports harvesting and then closing beaches to digging when PSP levels are too high. Testing and regulation of harvesting for commercial shellfish operations are the responsibility of the state.

Testing schedules vary, depending on the particular growing area and on the agency responsible. In general, some level of testing occurs from April through October at two-week intervals. Some areas are tested less frequently, whereas others are monitored regularly throughout the year.

Shellfish samples are sent to the State Public Health Laboratory for determination of toxin content by a bioassay method, the only one presently approved by the Food and Drug Administration (FDA). When toxin levels reach 80 micrograms per 100 grams of shellfish meat, closure of harvesting is required according to FDA regulations. The state closes commercial harvesting on an area-by-area basis, and county health departments close sports harvesting areas as they deem necessary. Sometimes in a particular location, closures apply to only one or two species of shellfish, but not to other species with acceptable levels of PSP. The news media are notified of closures, and some—although not all—heavily used beaches are posted with closure signs. (see next page for PSP Hotline information.)

State regulation of commercial shellfish harvesting following present procedures has resulted in an excellent record of protecting the public. Since the start of the program in 1957, only two cases of PSP (in 1988) have been caused by shellfish commercially harvested in Washington and sold in restaurants and retail stores.

## Importance of Closures

Because a person can eat an average meal of shellfish containing 80 micrograms and perhaps even as much as 200 micrograms of toxin per 100 grams of shellfish meat without experiencing any PSP symptoms, many people think that closure of beaches at the 80-microgram level set by the FDA is overprotective, and they ignore closure warnings. There are several important reasons, however, that make it prudent to set the closure level at 80 micrograms per 100 grams of meat.

- Distribution of *G. catenella* can be patchy and is generally not predictable in either timing or location. If some shellfish contain 80 micrograms on the day of testing, it is quite possible that they will contain much more poison a few days later or that shellfish on a nearby beach have much higher levels of toxin. A program based on higher closure levels would require that shellfish sampling be very closely spaced (every half mile in some situations) and done as often as two or three times a week. This is clearly not feasible because the cost of collecting and testing each sample currently exceeds $75 and because sampling more often than every two weeks when a low tide series occurs would be very difficult.
- Different species of shellfish vary in their rates of uptake and loss of poison. It simply is not practical in all cases to sample the species with the fastest uptake and the slowest loss rates.
- People who eat shellfish differ markedly in weight, appetite, and response to the poison. Consumption of alcohol is thought to increase the effect of the toxin, adding still another variable.

## PSP in the Future

Outbreaks of PSP in shellfish in the Pacific Northwest may rise and fall in intensity and duration in coming years. Scientists tell us, however, that the problem probably will not soon diminish to a point totally without risk. The very high population of *G. catenella* that developed in the fall of 1978 apparently stocked Washington inland waters with enough of the organism to continue production of large numbers of this species in following years. Unless a prolonged period of adverse weather and water conditions occurs or some natural enemy increases sufficiently to control *G. catenella*, it is not likely that this toxic organism and the resulting PSP problem will vanish.

## Safety Precautions

In view of the PSP problem, what recourse do you, as a consumer of shellfish, have? Should you give up the enjoyment of gathering your own shellfish, and just hope that the problem will eventually vanish? Such a course is not necessary. If you avoid all do-it-yourself methods of trying to determine whether shellfish are poisonous and instead use the state and county warning system, you will find many times and places to gather safe shellfish.

Please remember—

You can't rely on the color of the water to indicate the presence of PSP since shellfish may be unsafe even if there is no discoloration of the water.

You can't tell if shellfish are toxic:

- by examining them, since poisonous shellfish do not look, taste, or smell any different from nontoxic ones;
- by cooking them with a clove of garlic or a silver spoon to see if the garlic or spoon turns black;
- by using a field or home testing kit since

no reliable kit has yet been developed;

- by using a "sample and see" method since a single shellfish will occasionally contain enough poison to kill an adult, and even if a single one does not cause PSP symptoms, a whole meal could contain a potentially lethal dose.

You can't be sure of getting rid of enough of the poison by any method tried so far:

- Boiling does not destroy the toxin.
- Discarding the water the shellfish are cooked in removes only a small part of the poison.
- Cutting off and discarding the black tip of butter clam necks removes much of the toxin, but the rest of the clam could still contain hazardous amounts of the toxin.
- Soaking the live shellfish in water from a PSP-free area to purge them is unreliable.

So please—

- Do remember that the PSP program carried on by the state and counties offers the best information about areas where shellfish should not be harvested because of PSP.
- Do call the PSP hotline before gathering shellfish. (See numbers listed below).
- Do observe all beach closures.

# PSP Hotline

The state of Washington maintains a hotline with current information on closures for recreational gathering of shellfish as set by counties. The recordings are updated whenever changes in closures are made. You are urged to take advantage of this service and call a hotline number *each time* before gathering shellfish. The hotline numbers of Washington and British Columbia are listed below. If you are heading north, you can also find out about PSP closures by checking with the local fishery officers in British Columbia. Health officers in Alaska warn that shellfish in that state are considered *unsafe at all times*.

**Washington 1–800–562–5632 (toll free)**
**British Columbia 1–604–666–3169 (not toll-free)**



# About the Authors

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