Northwest Fisheries Science Center

Fish Matters

Opening Day Edition
featuring the

NOAA Research Vessel *Harold W. Streeter*

As the workhorse of toxic pollution research, the RV *Harold W. Streeter* spends over 100 days a year collecting sediment and fish samples from highly contaminated and pristine embayments of Puget Sound. With its round-bottom hull, the deck of the *Streeter* often provides a rolling research platform, requiring those onboard to have good sea legs.

The *Streeter* was built in 1962 to conduct water quality sampling on the Columbia and Willamette Rivers in Portland, Oregon for the U.S. Office of Public Health. The Environmental Conservation Division of the Northwest Fisheries Science Center acquired the vessel in 1973 to study the impacts of man-made toxic pollutants on local fishery resources, protected species, and marine habitat. Puget Sound is an excellent location to conduct this type of research because of the abundance of pristine sites which can be compared to polluted sites.

Designed by Edwin Monk, a Seattle designer well known for his adaptation of traditional fishing vessel designs to recreational powerboats, the *Streeter* has had several environmental upgrades since being built in 1962. It is equipped with a system which filters out oily waste which may have accumulated in the bilge prior to pumping the bilge water overboard and a vapor trap system which captures and recycles oil vapors created while the engine is running. The *Streeter* also has a 50 gallon holding tank and disposes or recycles much of the jetsam collected from the trawls.

Originally powered by an engine designed and built in 1942 as a World War II landing craft engine, the *Streeter* had a governor that allowed two maximum operating speeds, one for normal and one for battle operation. During battle operation the engine would be run at battle speed and by the time the landing craft was on

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National Marine Fisheries Service

National Oceanic and Atmospheric Administration

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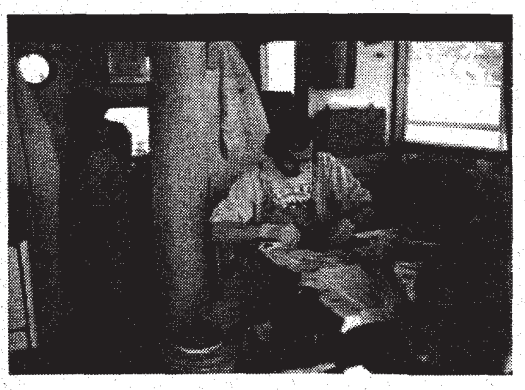
the beach the engine would be destroyed. After 33 years of reliable operation (not at battle speed) the *Streeter* was re-powered in 1995.

Sporting port and starboard aluminum booms equipped with blocks, tackle, and two winches, the *Streeter* can tow small experimental trawls to collect fish and operate sediment grabs to collect contaminants in bottom sediment. A trawl is a small net which is dragged from one of the booms along the bottom and is used to collect samples of bottomfish living in contaminated sites like Elliot Bay, Eagle Harbor, and Commencement Bay and from the many pristine sites that exist in Puget Sound. Bottomfish such as English sole and rock sole, feed on animals living in the top 2 cm of sediment where toxic pollutants accumulate. Toxic pollutants present in the surface sediments enter the food chain when ingested along with target prey. A sediment grab (a claw-like shovel), which is also operated from one of the booms, scoops up sediment a foot deep while leaving the top layer undisturbed for accurate contaminant sampling.

But, the experimental trawls aren't just catching fish. The *Streeter* has hauled up logs, tires, 50 gallon drums, plastic chairs, hard hats, sunglasses, abandoned gill nets and crab pots, a rickshaw bicycle, an Ernie puppet with barnacles, and a high heel shoe (fondly named "True sole"). The most memorable trawl occurred a number of years ago when a series of three trawls captured first a man's leather hat, then a man's leather slipper, and finally a dental bridge with four teeth. By the fourth trawl the crew wondered what might be next!

Once the sample fish have been landed they are sorted. Live specimens are placed in the fish holding tank or coolers, located on the aft deck, which have been filled with seawater from a dedicated pump. A compressed air pump is used to bubble air through the holding tank and coolers. The live specimens are transported to the Center's field station at Mukilteo for long term studies. Specimens needed for tissue samples, which are used to determine the presence of toxic pollutants and the status of the fish's health, are taken to the wet lab in the cabin where they are weighed and measured. The fine necropsy work is done on the galley table (unless it is lunch time) and the tissues (livers, kidneys, stomach contents, gonads, otoliths [ear bones used to determine age], bile, and blood) are collected. Some samples are preserved in a fixative, others are frozen in liquid nitrogen, or kept on ice until the *Streeter* returns to the Montlake laboratory. Sediment samples are collected from the top 2-10 cm of each grab and are preserved as well.

Tissue and sediment samples return with the *Streeter* to dock at the Center's Montlake facility. Tissue samples for histology samples are processed, sectioned and stained, then examined under a light microscope to look for damage to cells and organs. If more specific detail is required the samples can also be examined



under the Center's electron microscope. Tissue and sediment samples are analyzed for their chemical content using a variety of techniques including gas chromatography/mass spectroscopy and gas chromatography/electron capture detection.

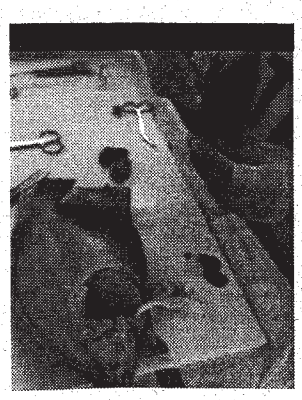
"Without the *Streeter*," suggests Herb Sanborn, fisheries biologist and former captain of the *Streeter*, "the Center would never have been able to establish itself as a center of national expertise on the impact of toxic pollutants on fish and the environment. The Environmental Conservation Division staff have all of the skills in sediment and tissue chemistry, fish histology and pathology, and chemistry necessary to evaluate the impacts and remediation efforts needed in toxic urban embayments around the country."

Since the mid-1970s, Environmental Conservation Division studies on bottomfish in Puget Sound have shown a strong relationship between toxic chemical contaminants in sediments and increased prevalence of liver disease, including cancer, and a wide range of reproductive impairments, including failure to develop eggs, failure to spawn, lowered egg fertility, and decreased production of normal larva. Beginning in the 1980's studies of juvenile salmon began to show that these juveniles were accumulating contaminants as they migrated from freshwater to saltwater and this contaminate exposure was linked to impaired immune function and reduced growth, key elements in early ocean survival. Recent studies also indicate that even though PCBs (from electrical transformers) and DDT (a pesticide) were banned in the 1970s they are still contaminating Puget Sound fish in urban areas. One study shows, that in the Hylebos Waterway in Commencement Bay, there has been little or no improvement in the environmental quality in more than 15 years since these studies began.

What is next for the 36 year old *Streeter*? With the emergence of Harmful Algal Blooms poisoning local shellfish at the highest ever recorded levels anywhere scientists have recruited the *Streeter* to collect plankton suspected of causing these blooms. Harmful Algal Blooms are naturally occurring biotoxins which are suspected to be induced more frequently and with greater intensity by changes in water temperature and nutrient level of local waters and may be aggravated by the presence of agricultural and industrial pollutants. Harmful Algal Blooms can kill some fish including endangered salmon, and accumulate in shellfish which can be passed to humans, birds, marine mammals, and other wildlife at lethal doses. Plankton will be collected in a brand new $70,000 plankton net which is actually a series of 9 nets which can remotely opened and closed at various depths. The net is also equipped with sensors that can measure depth, temperature, salinity as well as measure of the amount of particulated matter and chlorophyll in the water column.

Keeping a 36 year old, 45' wooden vessel like the *Streeter* maintained and operational is an ongoing challenge of the Environmental Conservation Division of the Center. This spring the *Streeter* was hauled out for the first time in 3 years at a cost of $50,000. Splashed just last week the *Streeter* is back on the job for the busy spring sampling season.

"I have many fond memories of the *Streeter*," says Carla Stehr, a fisheries biologist at the Center. "I have been sampling fish and sediment around Puget Sound for over twenty years so the *Streeter* feels like home to me; comfy."



SPECIFICATIONS

Year Built:	1962
Designer:	Edwin Monk, Seattle, WA
Builder:	Weldcraft, Bellingham, WA
Materials:	1 1/4" douglas fir over oak frames
LOA:	45'
Beam:	11' 4"
Draft:	6' 6"
Displacement:	16 tons
Engine:	Detroit Diesel 6-71; 150 horsepower
Hull Speed:	9.2 knots

West Coast Hot Zone

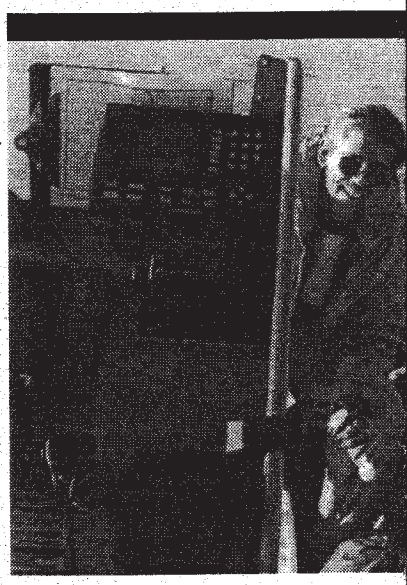
May marks the beginning of the Harmful Algal Bloom or "red tide" season in the Puget Sound area. Paralytic Shellfish Poison (PSP), a particularly lethal toxin, often occurs this month while other toxins typically appear a few months later. Few boaters realize that the world's worst toxin shellfish problem exists along the West Coast of the United States. The highest levels ever recorded of PSP have been found in some Pacific Northwest shellfish. PSP is such a serious problem in Alaska that at least one person dies every year from eating contaminated shellfish.

You can't tell by looking whether fish and shellfish are safe to eat and cooking does not destroy toxins which are water-soluble and heat resistant. The only way to determine the safety of shellfish is through laboratory testing. Most Harmful Algal Blooms (HABs) are invisible. Some of the most dangerous toxins often exist in crystal clear waters while some of the brightest colored "red tides" contain harmless toxins.

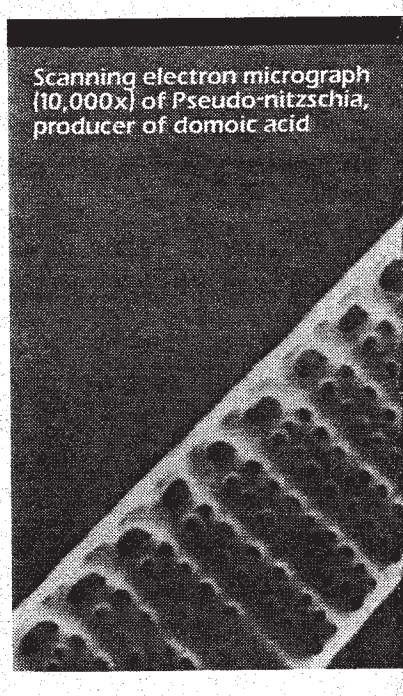
Swimming and boating through HAB infested waters is usually safe but eating contaminated shellfish is dangerous. Those who want to harvest shellfish should always check with one of several hotlines for information on beach closures. Every year Washington State sells about 300,000 licenses to clam diggers, yet very few bother to check if it's safe to eat shellfish. Washington State and King County regularly update their "red tide" hotlines. Cruisers who plan to visit Alaskan waters should be aware that due to serious PSP contamination, there are no certifiable beaches open to recreational shellfish harvesting.

The toxic shellfish epidemic not only endangers human lives but is a serious threat to fish, especially the endangered populations, and their habitats. It is also causing catastrophic economic losses to industry and in tax revenues from Alaska to California. At the center of this toxic hot zone, in Seattle, Washington, a biotoxin "Swat Team", of scientists from the Northwest Fisheries Science Center, stands ready to respond to toxic outbreaks on a moment's notice. Team leader, Dr. Vera Trainer, says the work her team does is crucial to the National Marine Fisheries Service (NMFS) role of protecting the country's living marine resources and their habitats. "We are the only NOAA (National Oceanographic Atmospheric Administration) team in the country that utilizes a rapid response to study field populations of toxic phytoplankton production." Her team is the nation's only group capable of rapidly responding to toxic emergencies, such as HABs.

Center research forms the scientific basis for fish management decisions made by NMFS. The Center plays a key role in protecting endangered fish species and also has pioneered scientific techniques adopted worldwide. It is a national leader in HAB research.



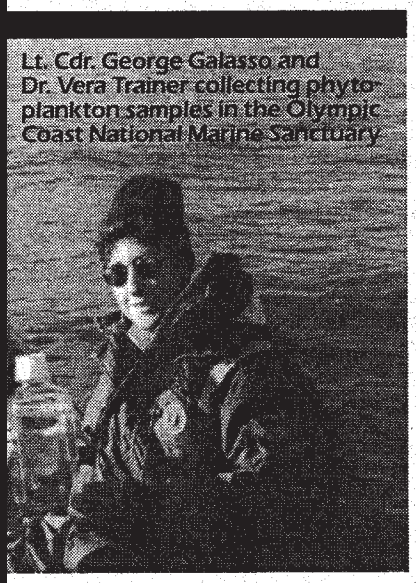
The Center biotoxin team of scientists sails the coastline from Washington to California. Their mission is to investigate what triggers HABs and how to predict where they will strike next. They seek answers to why the West Coast is hit so hard. Trainer says that the Pacific Northwest suffers from some of the world's highest levels of shellfish toxic contamination. PSP was discovered in Puget Sound mussels last year at a level of approximately four lethal human doses per 100 grams. Trainer adds "That's only a quarter pound of shellfish meat! But the highest levels of PSP ever to be reported anywhere were found several years ago in Pacific Northwest mussels. Analytical tests revealed a concentration of 16 lethal human doses per 100 grams." The most dramatic incident occurred this past holiday season when a 1,000-pound load of PSP-contaminated oysters, on the way to Puget Sound area markets, had to be quickly recalled before tragedy struck. Because PSP can cause respiratory arrest



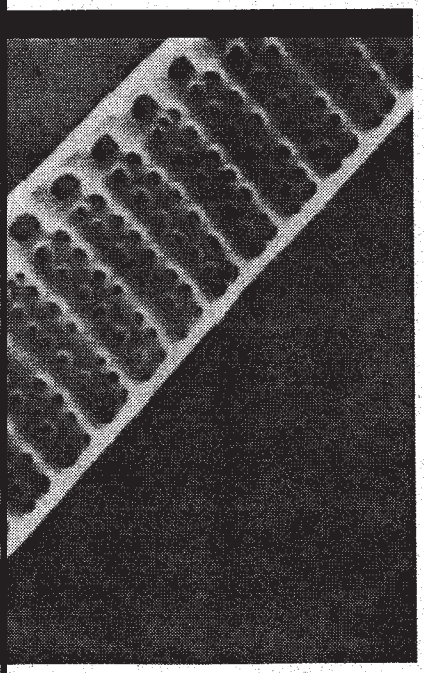
Scanning electron micrograph (10,000x) of Pseudo-nitzschia, producer of domoic acid

within 24 hours of eating tainted seafood and there is no antidote, countless lives may have been saved.

Not only does the Northwest have the world's highest levels of PSP contamination, but it hosts other marine biotoxins as well. Center scientists are also studying domoic acid contamination, which has been measured at dangerous levels off the Washington coast. The West Coast is the only place in the United States where domoic acid occurs at dangerous levels in shellfish. It has already caused several deaths and can cause permanent brain damage. Another marine biotoxin, *Heterosigma akashiwo*, has caused catastrophic losses of cultured and wild salmon throughout the Northwest. A *Heterosigma* outbreak in Puget Sound last summer resulted in the escape of scores of farm-raised salmon and a loss of almost three million dollars to local producers.



Lt. Cdr. George Galasso and Dr. Vera Trainer collecting phytoplankton samples in the Olympic Coast National Marine Sanctuary



Experts are divided about what causes HABs. Some blame man-made pollution, while others suspect changing climate patterns or international shipping, which transports hitchhiking organisms around the globe. They agree, however, that these blooms occur when algae, microscopic plants called phytoplankton, photosynthesize and multiply rapidly. Some blooms contain thousands of algal cells, which are insidious and contain potent toxins. Marine organisms then feed on the algae. Some fish die from harmful toxins while shellfish simply retain the poison in their tissues without serious consequences. The trouble is that a single clam can have enough toxin to kill a human being.

Dr. John Wekell, the biotoxin team member who charts toxin outbreaks and coordinates efforts with state and tribal agencies and the fish industry, says "We need to find out what triggers these blooms and come up with a means of predicting them. Once a harmful bloom occurs it's too late. We can only attempt damage control." Currently there is no formal process for coordinating HAB information along the West Coast or elsewhere. That's why the Center plans to coordinate an early warning system with agencies throughout the West Coast on a single website. Wekell says advance warning of HABs would be invaluable to the fishing industry and to fisheries managers because it would enable risk managers to sample the area in question and allow those in the industry to take steps to protect their products. Currently fisheries management agencies have little choice but to enforce wide-scale harvest closures, which cause significant financial losses. Eventually it will take international cooperation to protect the health of consumers and the world's fisheries from HABs. The Center's "Swat Team" is leading the charge against these tiny but powerful underwater invaders.

NORTHWEST BOATER HOTLINES

FISH HOTLINE:

360-902-2500
Washington State Department Fish and Wildlife
Provides recreational and commercial fishing limits and closures.

CONTAMINATED FISHERIES:

206-296-4784
Seattle/King County Department of Public Health
Fishing and collecting shellfish or seaweed is not recommended in Elliot Bay, the Duamish River, or other urban embayments in King County due to toxic contaminants and fecal coliform.

NOAA FISHERIES NATIONAL ENFORCEMENT HOTLINE:

1-800-853-1964
NOAA Fisheries
Call to report marine mammal strandings, poaching, or enforcement issues.

425-775-1311
Washington State Department of Fish and Wildlife
Reporting emergencies relating to animals.

HARMFUL ALGAL BLOOMS "RED TIDE" HOTLINES:

1-800-562-5632 or 360-753-5992
Washington State Department of Health Marine Biotoxin/PSP (Paralytic Shellfish Poisoning) Hotline. 1..lProvides information on recreational harvest beach closures for shellfish.

206-296-4692
King County Hazard Line
Includes information on Harmful Algal Blooms (HABs) and other hazardous conditions.

604-666-2828
Red Tide and Fisheries Hotline/Department of Fish and Oceans of British Columbia, Canada.

907-465-5285
Alaska's Department of Environmental Conservation
There are no certifiable beaches open to recreational shellfish harvesting. There are no HAB hotlines.

OIL SPILLS/ENVIRONMENTAL EMERGENCIES:

206-217-6232
U.S. Coast Guard
24 hour line for reporting oil spills in navigatable waters.

1-800-258-5990
State Depârtment of Ecology
Washington State Department of Emergency Management
Reporting oil spills and hazards statewide and inland waters.

DAMAGED FLORA:

360-825-1631 (north of King County)
360-856-3500 (south of King County)
Department of Natural Resources
Pesticide spraying near streambeds and rivers, etc.

OTHER HOTLINES:

1-800-368-5647
U.S. Coast Guard
General boater information, e.g., gear requirements, licenses, etc.

What is the Northwest Fisheries Science Center?

The Northwest Fisheries Science Center operates under the following broad mandates:

DEPARTMENT OF COMMERCE (DOC)
DOC's responsibilities include expanding U.S. exports, developing innovative technologies, gathering and disseminating statistical data, measuring economic growth, granting patents, promoting minority entrepreneurship, predicting the weather, and monitoring stewardship.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
NOAA's mission is to describe and predict changes in the Earth's environment and to conserve and manage wisely the Nation's coastal and marine resources.

NATIONAL MARINE FISHERIES SERVICE (NMFS)
NMFS's mission is to provided stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment.

NORTHWEST FISHERIES SCIENCE CENTER
The Center is responsible for providing scientific and technical support for the management, conservation, and development of the Pacific Northwest region's anadromous and marine fishery resources.

Status of Washington State Salmon

Approximately 50% of adult salmon returning to Puget Sound are wild fish and 50% are hatchery fish. About ten percent of hatchery fish can be identified by their clipped adipose fin but the remainder cannot be distinguished from wild salmon. Currently there are no legally protected threatened or endangered species in Puget Sound, however, Puget Sound chinook and Hood Canal Summer-run chum were proposed for listing in March of this year. After a one year public comment period a final determination will be made in March of 1999.

Coho salmon

Candidates for listing[1]:
1) Puget Sound/Strait of Juan Georgia ESU[2] (7/95)
2) Southwest Washington/Lower Columbia River ESU (7/95)

Listing not warranted:
1) Olympic Peninsula ESU (7/95)

Chinook salmon

Proposed listings:
1) Puget Sound ESU (Threatened[3]) (3/98)
2) Lower Columbia River ESU (Threatened)(3/98)
3) Upper Columbia River ESU (Endangered[4]) (3/98)

Listed:
1) Snake River Fall-run ESU (Threatened) (4/92)
2) Snake River Spring/Summer-run ESU (Threatened) (4/92)

Listing not warranted:
1) Washington Coast ESU (3/98)
2) Mid-Columbia River Spring-run ESU (3/98)
3) Upper Columbia River Summer/FAll-run ESU (3/98)

Chum salmon

Proposed listings:
1) Hood Canal Summer-run ESU (Threatened) (3/98)
2) Columbia River ESU (Threatened) (3/98)

Listing not warranted:
1) Puget Sound/Strait of Juan de Fuca ESU (3/98)
2) Pacific Coast ESU (3/98)

Sockeye salmon

Proposed listings:
1) Ozette Lake ESU (Threatened) (3/98)

Listed:
1) Snake River ESU (Endangered) (11/91)

Candidates for listings:
1) Baker River ESU (3/98)

Listing not warranted:
1) Okanogan River ESU (3/98)
2) Lake Wenatchee ESU (3/98)
3) Quinault Lake ESU (3/98)
4) Lake Pleasant ESU (3/98)

Steelhead

Proposed listing:
1) Middle Columbia River ESU (Threatened) (3/98)

Listed:
1) Upper Columbia River ESU (Endangered) (8/97)
2) Snake River Basin ESU (Threatened) (8/97)
3) Lower Columbia River ESU (Threatened) (8/97)

Listing not warranted:
1) Washington Coast ESU (8/96)
2) Olympic Peninsula ESU (8/96)
3) Puget Sound ESU (8/96)

Sea-run cutthroat

Under review:
1) All populations in Washington

1 Species of concern.
2 Evolutionary Significant Unit. A distinct population of salmon which is considered a species under the ESA.
3 Any species which is likely to become an endangered species in the foreseeable future.
4 Any species which is in danger of extinction throughout all or a significant portion of its range.