Northwest Fisheries Science Center

Forecasting Harmful Algal Blooms & Pathogens in Puget Sound

2011

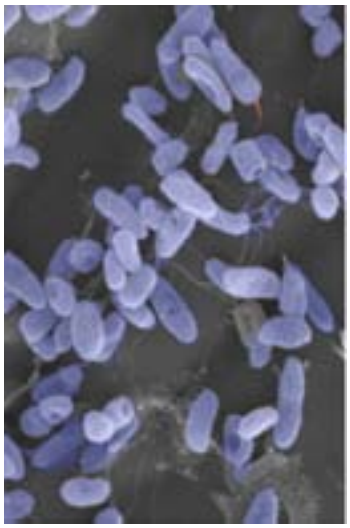
NOAA FISHERIES SERVICE

The Need

Harmful algal blooms or "red tides" are formed by single-celled photosynthetic organisms that can sometimes be harmful to humans, wildlife, and the environment. Some harmful algae, such as the dinoflagellate *Alexandrium catenella*, produce toxins that accumulate in shellfish, making them dangerous to eat. These toxins can be so potent that shellfish can become unsafe for human consumption even if the algae are present in concentrations so low that the water is not colored. Naturally-occurring pathogenic bacteria, such as *Vibrio parahaemolyticus*, can also accumulate in shellfish making them unsafe to eat unless they are cooked. The annual economic cost of pathogens and red tide that cause food-borne disease in the United States is estimated at $350 million (Ralston et al. in press).

Since certain weather and climate conditions can favor the growth and development of red tide and pathogens, forecasts can be used to provide advanced warning of the increased risk of potentially dangerous outbreaks. If harmful algae or pathogens are present in the water at the same time that favorable conditions are forecast, the risk of an outbreak is high. Knowing ahead of time when outbreaks might occur allows health authorities and shellfish growers to be proactive in their management decisions and mitigate economic impacts. However, there are currently no predictive tools available to forecast dangerous algal blooms or pathogens that can contaminate shellfish in Puget Sound.

A non-toxic red tide event in Puget Sound, September 2011 [credit: Megan Black].



Vibrio species have certain characteristics that enable them to colonize shellfish and cause disease, including the ability to attach to and colonize host cells.

The Goal

Develop an integrated forecast system to provide advanced warning of red tide events and pathogenic outbreaks that contaminate shellfish in Puget Sound.

The Plan

Use weather forecasts to predict when conditions are favorable for red tide (a "window of opportunity") and integrate information from a novel biosensor (the Environmental Sample Processer) with an existing monitoring network for harmful algae (SoundToxins) to provide advanced warning of potentially dangerous red tide events.

Learn more & come see us in action

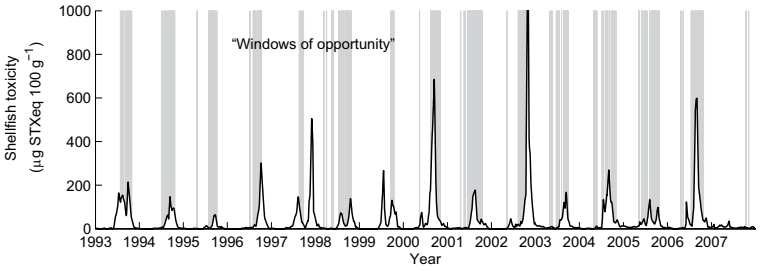
Sharing our work with other scientists, policymakers, resource managers, and the public is important to us. To learn more about what we do, please visit our website at: www.nwfsc.noaa.gov and follow @NOAA_NWFSC on Twitter. To obtain additional information, please call 206-860-3200.

Northwest Fisheries Science Center

Science, Service, Stewardship

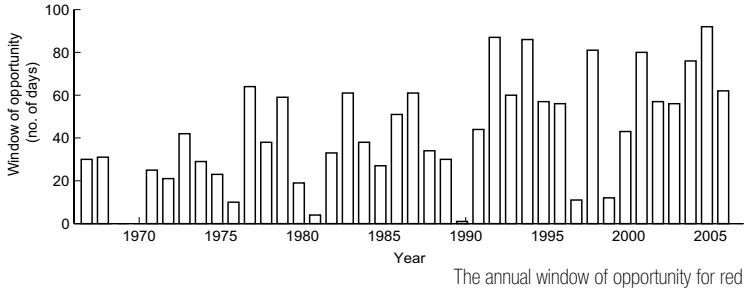
Forecasting a Window of Opportunity

Scientists at NOAA's Northwest Fisheries Science Center have identified a window of opportunity for *Alexandrium catenella* based on a specific combination of environmental conditions. In particular, warm air and water temperatures, weak winds, low streamflow, and small tidal variations favor toxic red tide events. A wider window of opportunity translates into increased risk for toxic red tides.



Windows of opportunity (gray bars) correspond well with time periods when shellfish in Puget Sound contain high levels of toxin.

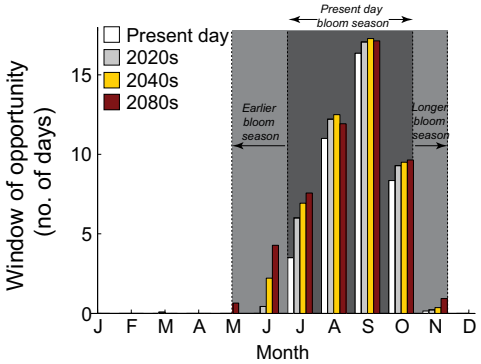
A reconstruction of the window of opportunity using historical records of weather and environmental parameters shows an increase in the risk of toxic red tide events since the late 1960s. This increasing trend is also evident in historical records of shellfish toxicity, suggesting the ability to predict red tide events.



The annual window of opportunity for red tide in Puget Sound from 1967-2006.

Projections of the window of opportunity through the end of the 21st century show that the risk of toxic red tide events is likely to continue to increase as the climate changes.

By integrating weather forecasts into the window of opportunity model, advanced warning of the increased risk of red tide events can be provided on a timescale of a few days to a week. This is the timescale that is most useful for public health managers and shellfish growers.

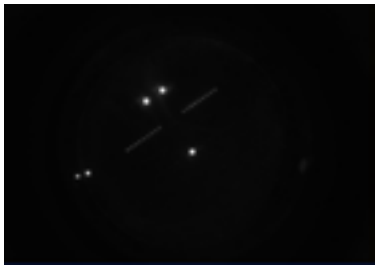


Average monthly values of the window of opportunity for red tide in Puget Sound for the presentday (i.e., 1980s) and for the 2020s, 2040s, and 2080s.

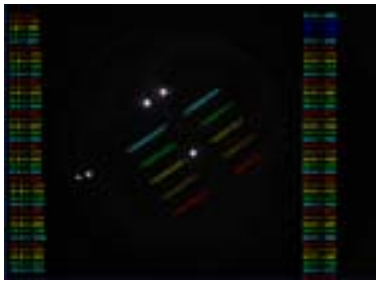
The Environmental Sample Processer

The Environmental Sample Processer (ESP) is an advanced biological sensing system that conducts automated *in situ* collection and analysis of water samples. Using DNA-based technology, the ESP can remotely detect harmful algae and bacterial pathogens and send the results to shore in near-real time via radio or satellite.

The ESP will significantly enhance existing monitoring programs in Puget Sound by eliminating lengthy delays associated with traveling to collect a water sample and transporting it back to the laboratory for analysis. A typical deployment consisting of daily sampling will last for approximately 30 days.



A raw (above) and processed (below) image of a harmful algae array from the ESP. The brightness of the dots is representative of the abundance of the target harmful algal species.



The Environmental Sample Processor (above, left) is an autonomous buoy system that can detect harmful phytoplankton and bacterial pathogens using DNA-based technologies. This is the core system without its pressure housing, and is currently undergoing laboratory testing.

The Product

A risk-based approach to managing red tide and pathogens in Puget Sound that provides advanced warning of outbreaks and identifies opportunities to mitigate impacts. If the risk of an outbreak is high, health managers can increase monitoring and shellfish growers can prepare for closure if necessary.