From Fieldwork to Prediction: How scientists forecast Red Tide events

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Phytoplankton

- Single celled plants
- Live in fresh and salt water
- “Grass of the sea”, first step of the food chain
- Food for many animals, from whales to anchovies
Harmful Algal Blooms

- When phytoplankton grow and reproduce quickly, they can change the color of the water or form a scum on the surface.
- When the cells die, the decomposing matter removes oxygen from the water.
- Some phytoplankton produce toxins that can be retained in the cells or released into the water.
- Toxins can accumulate in shellfish, fish and other biota.
- Both the toxins and the low oxygen be a health hazard for humans and animals.
What are the risks to health?

- Eating contaminated shellfish or fish
  - Amnesic shellfish poisoning (domoic acid: damages neurons in brain and causes gastrointestinal symptoms, loss of short term memory)
  - Paralytic shellfish poisoning (saxitoxin: gastrointestinal symptoms, loss of coordination, tingling, confusion, slurred speech)
  - Neurotoxic shellfish poisoning (brevetoxin: vomiting, diarrhea, slurred speech)
  - Diarrhetic shellfish poisoning (okadaic acid: diarrhea, vomiting, cramps)
  - Ciguatera fish poisoning (ciguatoxin, others: gastrointestinal symptoms, headaches, hallucinations, numbness, vertigo)

- Toxins can be picked up via drinking water, swimming, breathing spray, consuming contaminated shellfish, and other forms of contact
Where do they occur?

Credit: WHOI
What causes HABs?

• Phytoplankton occur naturally in marine and freshwater
• Conditions can cause population explosions (blooms)
  • Warm temperatures
  • Sunlight
  • Ocean circulation
  • Too much nutrients
  • Combination of factors
What can we do?

• To stop HABs from occurring?
  • Lakes, bays, and ponds: control nutrients, balance system
  • Oceans: ?

• To limit impacts on people?
  • Educate
  • Better monitoring
  • Forecast
  • Partner to distribute information about coming events
Gulf of Maine

- Important shellfisheries, both commercial and recreational
- Red tide events cause the closure of the shellfish beds, sometimes for the entire year
- Risk of paralytic shellfish poisoning
- Forecasts allow the beds to be closed and opened to protect human health, while still allowing the fishery to exist
How do you create forecast?

• Study the species (*Alexandrium catenella*) and learn what triggers it to bloom
• Create a model that uses environmental variables to predict when and where the species will occur and in what abundance
• Collect data from the field, from satellites and from monitoring stations to create predictions.
• Work with managers to provide them the information they need in a format they can easily use.
NOAA vessel Henry B. Bigelow
- Launched Sept 2005
- 208 ft long fisheries research vessel
2020 bloom outlook:
Products for a bloom season- **Experimental weekly Nowcast/Forecast**

Distributed via WHOI NortheastPSP listserver.

- Provided hindcast and real-time forecast of surface atmospheric conditions, and *A. catenella* cell concentrations in the Gulf of Maine
- Model simulated surface *A. catenella* concentration at Maine and New Hampshire Coastal Waters
- Model outputs were served on NOAA cloud server (in netcdf format).