PARALYTIC SHELLFISH POISONING
THE ALASKA PROBLEM

By
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Alaska Sea Grant Program
Marine Advisory Program
THE HARMFUL ALGAL BLOOM

Red tides do not necessarily mean poison
WHERE DOES PSP COME FROM?

- Produced by a dinoflagellate algae
  - Some name confusion
    » Gonyaulax
    » Protogonyaulax
  - Reclassification combined all toxin producing genera into *Alexandrium*
Alexandrium

- Dinoflagellate microalgae
  - Two flagella
- Species
  - A. ostenfeldii
  - A. fundyense
  - A. catenella
PSP OUTBREAK LOCATIONS

- Fairbanks
- Anchorage
- Kachemak Bay
- Seward
- Kodiak Island
- Baranof Island
- Prince of Wales Island
- Juneau
- Sitka
- Ketchikan

ALASKA
ABOUT THE TOXIN

Saxatoxin

– The 24+ toxins are divided into three groups
  High Toxicity Carbamate Toxins
  Moderate Toxicity Decarbamoyl Toxins
  Low Toxicity N-Sulfacarbamoyl Toxins

– Toxins change form and toxicity through the food chain
  Within the algae based on environmental conditions
  Within the shellfish based on their metabolism
  Within the final animal that eats the shellfish
WHAT IS PSP?

Biotoxin (24+ analogs)

- Naturally occurring toxin
- One of several marine toxins
- Appear to be increasing in frequency
- Range is expanding
- Sodium channel blocking, blocking nervous transmission
PSP IN ALASKA

- PSP NOT always a red tide
  - Red is likely nontoxic likely *Noctaluca* sp.
  - Bloom moves with the current

- Complex problems
  - Bloom dynamics (Highly localized)
  - Oceanographic processes
  - Toxins (10-20 + analogs)
    - B and C; dc; GTX; STX
    - Shellfish often have multiple analogs
  - Shellfish response differs

- 1,000 times more toxic than cyanide

- No beach monitoring program in Alaska
  - Only commercial product

- Myths assumed to be protective
# THE TOXINS AND SHELLFISH

## Toxin types specified by high, moderate, low toxicity forms

<table>
<thead>
<tr>
<th>Shellfish Species</th>
<th>High Toxicity Carbamate Toxins</th>
<th>Moderate Toxicity Decarbamoyl Toxins</th>
<th>Low Toxicity N-Sulfacarbamoyl Toxins</th>
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<tr>
<td>Toxic algae</td>
<td>GTX-III, STX</td>
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<td>Butter clam</td>
<td>STX, GTX-II, GTX-III</td>
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<tr>
<td>Littleneck clam</td>
<td>dc-STX, dc-GTX-II, dc-GTX-III</td>
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**SXT** - Saxitoxin  
**GTX** - Gonyautoxin  
**dc-(STX,GTX)** Decarbamoyl (Saxitoxin, Gonyautoxin)  
**C(1,2) and B(1,2)** - Sulfamate
THE COMPLEX CHEMISTRY OF PSP
MOUSE BIOASSAY TEST

- Animal testing issue
- Tests for toxicity of all toxin analogs at once
- Mouse 18-23 grams
- Time of death 5-7 minutes
- May require dilutions if toxin in hing
- Multiple mice needed
- Mice on hand (order when needed)
Alexandrium CYST FORMATION

Alexandrium Life Cycle

- Pellicle cyst
- Gamete fusion
- Planozygote
- Sulcus
- Hypnocyst
- Young germling
- New motile cell
- Girdle
- Theca plate

Vegetative cell division
PLANKTON CYCLES IN THE MARINE WATERS OF ALASKA

[Graph showing changes in Diatom, Copepod zooplankton, Dinoflagellate, and Meroplankton zooplankton populations throughout the year.]
BLOOMS APPEAR THEN LEAVE

- Explosive blooms and astonishing crashes
- Movement
  - Currents
  - Tides
- Invisible
  - Subsurface
  - Water column stability
  - In darkness
- Frequent sampling (2x per week)

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EFFECTS OF WIND AND CURRENTS
TWO POSSIBILITIES

Wind
River
Current
Freshwater plume
Intense Red tide
High toxicity

Wind
Current
River
Freshwater plume
Disbursed Red tide
Low toxicity
CELL TOXICITY AND WATER COLOR

Red color

Dense Algae
Low toxicity per cell

Equal Toxicity

Colorless

Sparse Algae
High toxicity per cell
Freshwater plume nutrient source

Sea Surface

Freshwater plume
Saltwater Interface

Beneath the surface

Temperature in °C

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

0 2 4 6 8 10 12 14 16 18 20

Depth in Meters

Epilimnion

Thermocline

Hypolimnion

Stable water conditions
OTHER NON-TOXIC ALGAE
BEWARE OF “RED TIDE”
LOCALIZED IMPACT

Sea Otter Sound

Tokeen Bay
November 2010
SEA OTTERSOUND

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<th>Tenass Pass</th>
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LOCALIZED IMPACT

![Map of Tiayasanka Harbor, Letak Inlet, and Mussel PSP Results](image1)

![Map of Letnikof Cove, Chilkat Inlet, and Mussel PSP Results](image2)
Pacific Oyster
*Crasostrea gigas*

**Distribution:** Kachemak Bay to California

**Habitat:** Intertidal in mud to rocky beaches. In Alaska only on aquatic farms, but may be a few small populations in southern southeastern Alaska. Does not reproduce in Alaska waters

**Size:** Up to 8"

**Identification:** Shell irregular shape, rough surface, upper shell cupped while lower shell flat

**Toxicity:** 910 μg toxin

ALL COMMERCIALLY SOLD AND FARmed SHELLFISH HAVE BEEN CERTIFIED
LOCALIZED IMPACTS
Nossuk Bay Area

Klawock Weather Station

- Precipitation
- Wind velocity
- Visibility
TOXIN VARIABILITY IN GEODUCK CLAMS

Year

Toxin level in ug


PERCENTAGE OF FAILED GEODUCK CLAM SAMPLES
Periodic episodes, bad year (2000), and skipped year (2001)

Episodes happened suddenly

All Positive 80 ug or higher occurred between 6/10 to 10/25
## TESTING RESULTS SINCE 1988

### Southeast Alaska

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<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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### Summary

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<th>Total oysters</th>
<th>Total littleneck clams</th>
<th>Total mussels</th>
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## TESTING RESULTS SINCE 1988

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<th>B*</th>
<th>C*</th>
<th>D*</th>
<th>E*</th>
<th>F*</th>
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### Summary

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<td>5</td>
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- All 33 ug except for 3 samples.  
- Onset from 33 to 85ug in 4 days.
- Samples all below 34
ALTERNATIVE TESTING?
The Jellet Biotek Alterm Kit™

Pluses
- Rapid (one hour)
- No toxic chemicals
- No false negatives
- Easy to use
- Inexpensive
  - 40 sample processing kit $120 and $20/test

Minuses
- Large number of false positive
  - California 68%, Alaska 85%
- Errors in reading the results
  - 690 reads (14% error, 7.4 false +, 7.0 false -)
- No longer approved by FDA
ABRAXIS (ELISA) TEST FOR PSP

Alaskan Experience

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<td>269</td>
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Data from Alaska Dept. of Environmental Conservation Laboratory

Haines Blue Mussels 2011

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Testing at Washington Dept. of Health and N.W. Fisheries Science Center
ALASKA SAFE SHELLFISH HARVEST PROGRAM

- Originated from a statewide toxin workgroup.
- Mimics process used to assure safe harvest of commercially harvested shellfish (FDA approved).
- Community based program (Design, sampling, and harvest management)
- ADEC test for toxins
- Monitoring
- Scheduled harvest date
- Sample taken from the harvest
- Hold harvest 24 hrs
- Notification of results
FUTURE EVENTS

• Marine toxin workgroup activities
• Sea Grant website being developed
• Seeking research and monitoring funds
• Development of alternate testing
  • Evaluation of Abraxis
  • Improved Detection Kit for the Toxins Which Cause Paralytic Shellfish Poisoning - Richard Litaker, Thomas Stewart - (North Pacific Research Board)
EATING SHELLFISH FROM PERSONAL HARVEST IN ALASKA CAN BE DANGEROUS.
FOR MORE INFORMATION

- Marine Advisory Program
  - [http://www.uaf.edu/MAP/anch/raypubs.html](http://www.uaf.edu/MAP/anch/raypubs.html)
  - E-mail me at: afrlr@uaa.alaska.edu

- Web Pages
  - [http://www.redtide.whoi.edu/hab/](http://www.redtide.whoi.edu/hab/)