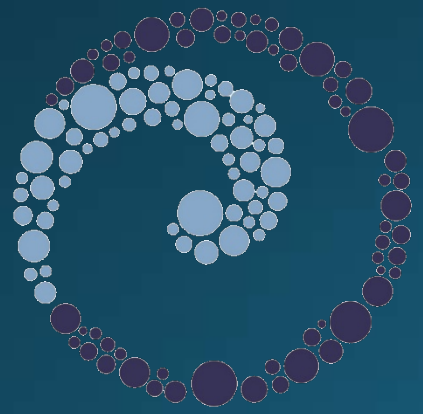
Phytoplankton sampling and its role in marine biotoxin monitoring



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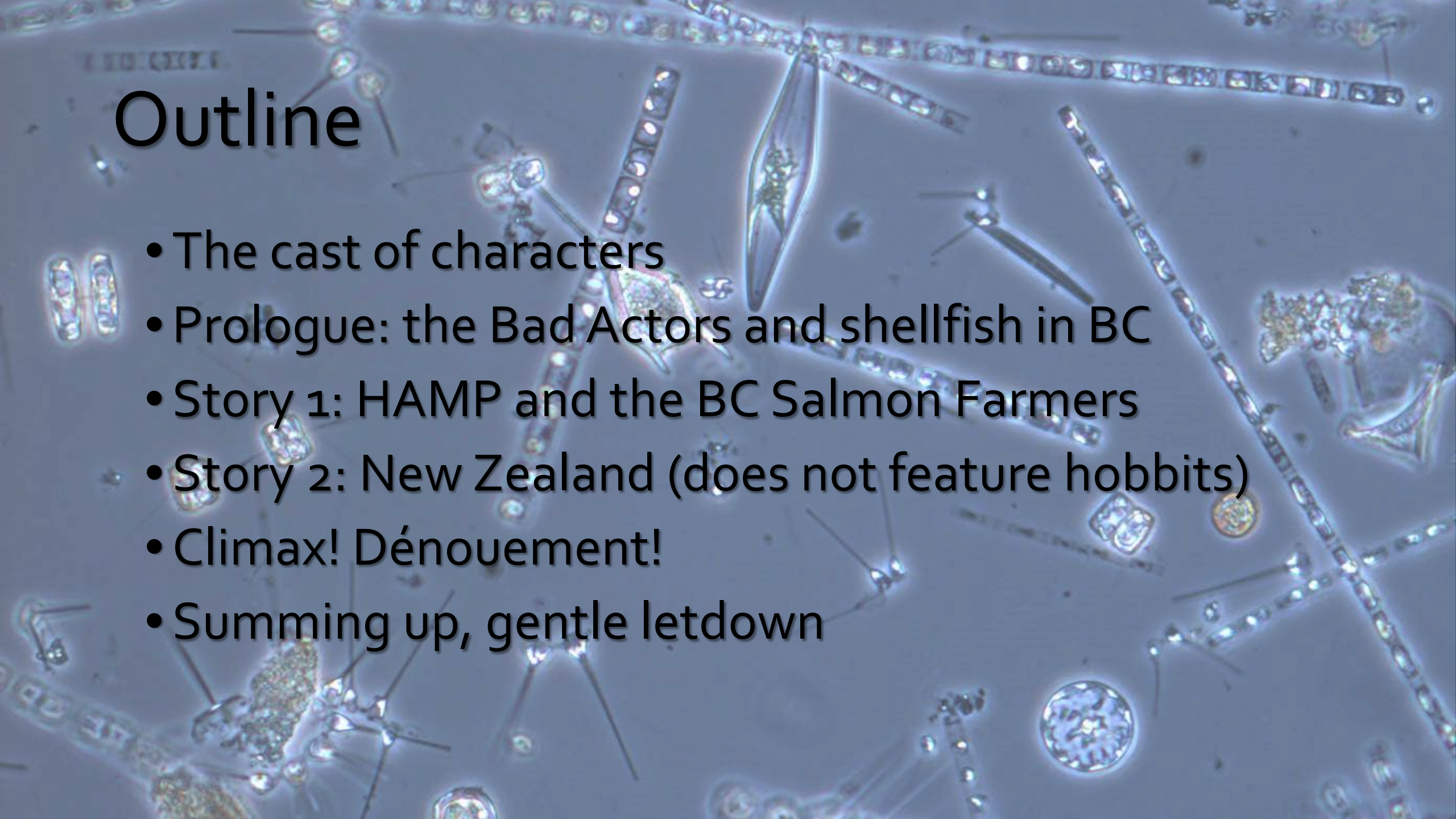
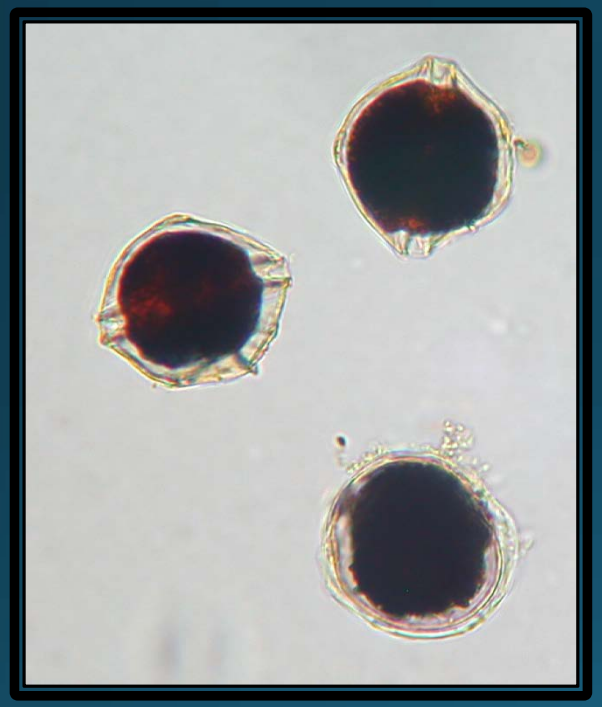


Outline

- The cast of characters
- Prologue: the Bad Actors and shellfish in BC
- Story 1: HAMP and the BC Salmon Farmers
- Story 2: New Zealand (does not feature hobbits)
- Climax! Dénouement!
- Summing up, gentle letdown

The cast of characters: the Bad Actors

Alex the Dino



Alexandrium species (dinoflagellates)

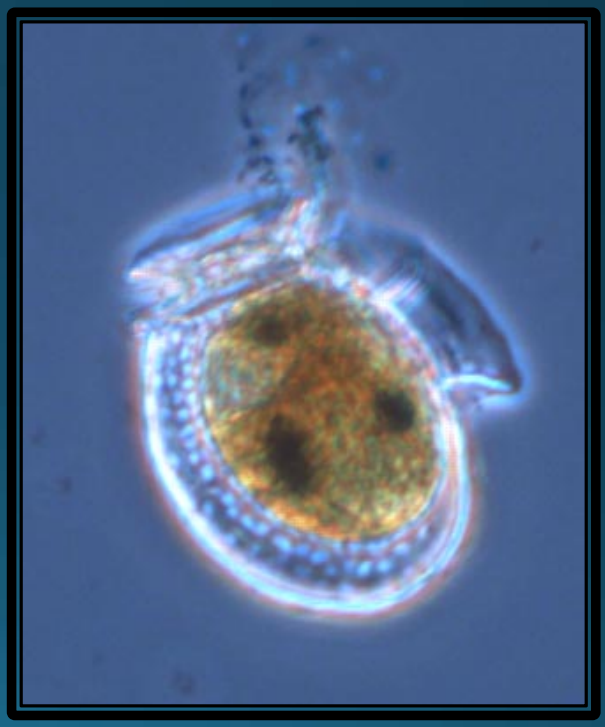
cause PSP (paralytic shellfish poisoning)

PN the Aussie and gang

Pseudo-nitzschia species (diatoms)

Cause ASP, DAP (amnesic shellfish poisoning, domoic acid poisoning)

Dastardly Dinophysis



Dinophysis species (dinoflagellates)

cause DSP (diarrhetic shellfish poisoning)

Prologue: The Bad Actors and Shellfish in BC

The Bad Actors and Shellfish in BC

- Problems with shellfish toxicity have always been known in BC
- Government monitoring (shellfish flesh with mouse bioassay) started in the 1940s due to a poisoning in Barkley Sound
- Toxicity assumed due to Alex the Dino (PSP)
- Some of the bad PN gang found to produce domoic acid since early 1990s in Haida Gwaii and north and western Vancouver Island (ASP)
- Dastardly Dinophysis (DSP) caused poisoning event in 2011
- Monitoring still done by CFIA, now looking for PSP toxins, DA, and DSP toxins in select samples, with HPLC, LC/MS (no more mouse bioassay)
- no routine monitoring of phytoplankton samples

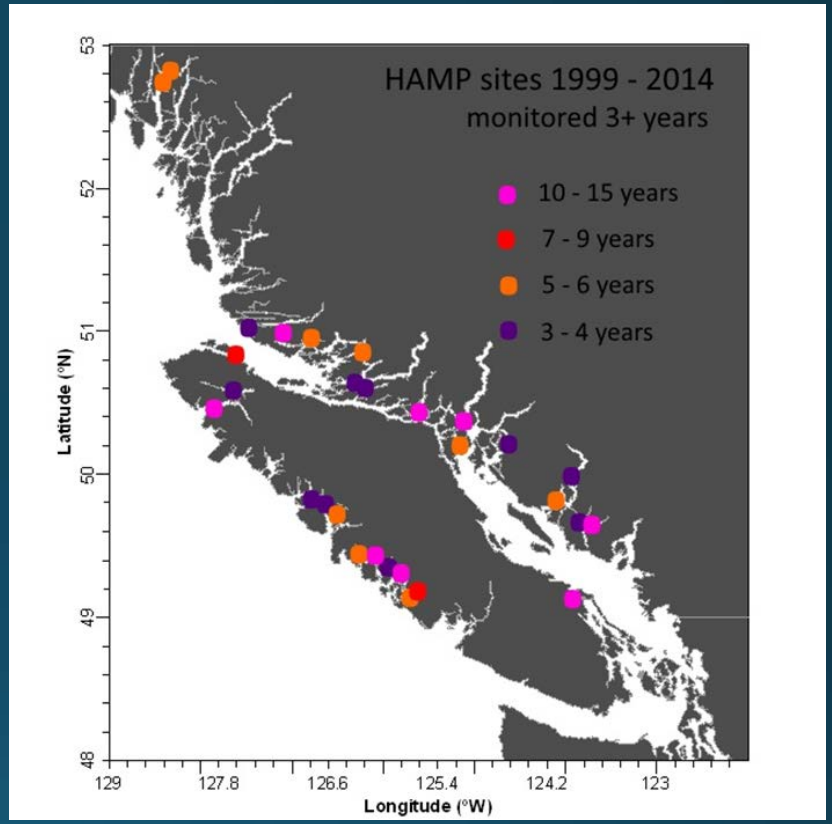
Story 1: HAMP and the BC Salmon Farmers

HAMP and the BC Salmon Farmers

- As soon as fish farming began in BC, problems with plankton started
- Toxic species (*Heterosigma akashiwo*) and mechanically harmful species (*Chaetoceros* species) caused large losses
- 1997 was a terrible year, with widespread *Heterosigma* blooms and large losses
- In 1999 the Harmful Algae Monitoring Program (HAMP) started with Dr Ian Whyte at DFO, 3 salmon farming companies, and me

HAMP mandate

- analysis of weekly water samples from select sites for harmful phytoplankton species (reporting back to farm companies, long-term data collection)
- institution of standard protocols for plankton sampling and sample analysis
- education of farm staff in plankton identification and counting
- support in cases of harmful blooms; new harmful species ID, and lethal level assessment



HAMP is totally funded by the BC salmon farming companies that participate in the program

Phytoplankton Training

- Annual workshops
  - using the microscope
  - samples of harmful species
  - counting plankton

- Online courses @ Microthalassia.ca
  - plankton sampling
  - sample analysis
  - counting plankton
  - harmful species
  - phytoplankton ecology

http://training.microthalassia.ca/

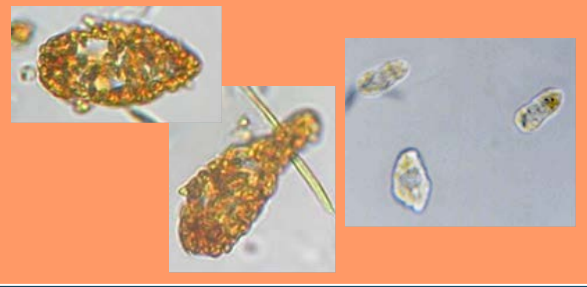
Photo credit: George Fifield

Phytoplankton sampling on fish farms

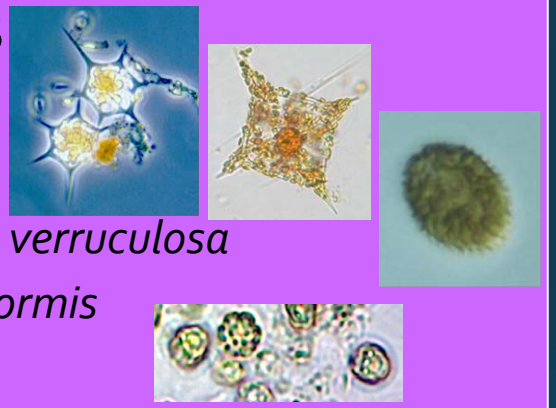
- Sample daily using net tow or bottle
- Identify harmful species and count plankton using rafter slide
- Standard operating procedures when cell counts are above cut-off levels
  - stop feeding
  - start mitigation measures

BC fish-killing HAB species

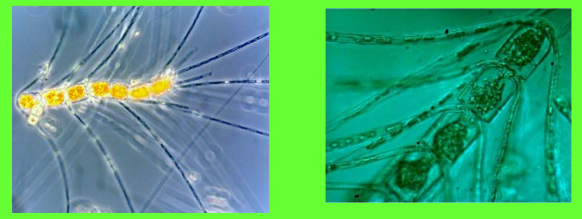
- Raphidophytes
  - *Heterosigma akashiwo*
  - *Chattonella* cf. *marina*



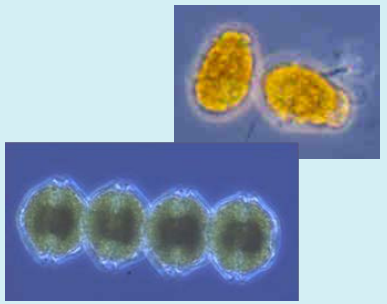
- Dictyochophytes
  - *Dictyocha speculum*
  - *Dictyocha fibula*
  - *Pseudochattonella* cf. *verruculosa*
  - *Pseudopedinella pyriformis*



* Diatoms
  * *Chaetoceros concavicornis*
  * *Chaetoceros convolutus*



* Dinoflagellates
  * *Cochlodinium fulvescens*
  * *Alexandrium catenella*



* Haptophytes
  * *Chrysochromulina* spp.

HAMP and the Bad Actors

- Analysis of routine HAMP plankton samples in the lab also allows us to detect shellfish toxin producers
- e.g. Dastardly Dinophysis in 2011
- e.g. PN the Aussie and others in the PN gang in 2015 and 2016
- e.g. Alex the Dino frequently (also of concern to fish farmers at high concentrations)

Story 2: New Zealand

NZ and the Bad Actors (not hobbits)

- First detection of shellfish toxins in NZ in 1993
- Routine monitoring started – phytoplankton sampling and mouse bioassays
- Monitoring up to 100 sites around NZ for recreational and commercial shellfisheries
- Discrete or integrated pipe water samples, live and preserved
- Government and industry funded, analysed in private research institute (Cawthron)
- One of the best shellfish toxin monitoring programs in the world

NZ and the Bad Actors (not hobbits)

- HAB Research well-funded (new human health risk in NZ)
- Developed new methods for detection of algal biotoxins
- Continued development of program
- In 1996 split in monitoring program between recreational and commercial fisheries

Rhodes, L., K. Smith, and C. Moisan. Shifts and stasis in marine HAB monitoring in New Zealand. Environ Sci Pollut Res (2013) 20:6872–6877

Weekly shellfish toxin sampling (NZ)

Recreational (govt. funded)

phytoplankton samples @ primary sites
microscopic analysis at Cawthron
trigger cell count for harmful species

↓

stop harvest
sample secondary sites
shellfish flesh biotoxin analysis

↓

open/close area
public warnings on gov. website
signs on beaches

Commercial (Industry funded)

phytoplankton samples
and
shellfish flesh biotoxin analysis

↓

stop harvest
sample secondary sites

Phytoplankton sampling vs. shellfish flesh analysis

Phytoplankton sampling

- "gold standard"
- reasonable cost
- rapid results
- BUT may be false positives
  - difficult species to identify
  - some species with variable toxicity

an effective first step in monitoring

Shellfish flesh biotoxin analysis

- often slower to get results
- more expensive equipment and analysis costs
- BUT gives actual toxin data

Climax! Dénouement!

- Phytoplankton sampling is routinely done by BC Salmon Farmers to monitor for harmful species
  - limited training
  - cut-off levels for feeding and increased monitoring

- Phytoplankton sample analysis is best first step in NZ monitoring program for recreational shellfisheries
  - trigger cell count for increased monitoring, biotoxin analysis

Phytoplankton sampling by trained locals could be a viable first step in monitoring for algal biotoxins in remote communities

Summing up, gentle letdown

- Phytoplankton sampling would require
  - acknowledgement that shellfish biotoxins are an issue in communities
  - training of persons in sample analysis
  - equipment (microscope, samplers, etc. – limited costs)
  - commitment to ongoing sampling
  - methods for sharing information between communities and organisations

Thank you

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