Karenia spp. blooms in New Zealand

CAWTHRON

Tim Harwood - SA HAB symposium 2/3 June 2026

History of major *Karenia* events in NZ

1992-1993: Hauraki Gulf *Karenia* bloom

- Several hundred human illnesses
- Event started on the east coast of North Island just before Christmas
- By the end of Jan whole of the country closed for shellfish harvesting
- Brevetoxins detected in shellfish using MBA*
- Toxin producer not conclusively identified
- Sentinel event led to establishment of NZ marine biotoxin monitoring


Shellfish industry on ropes


THE PRESS

Shellfish ban rocks $80m industry

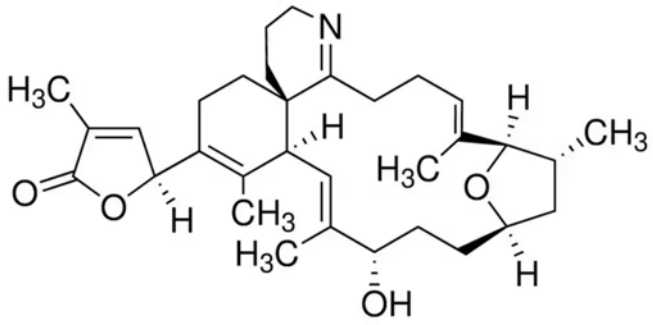

Weekend Magazine

Invasion of the shellfish toxins

History of major *Karenia* events in NZ

1992 & 1994: *Karenia selliformis*

- Blooms associated with mortality of a variety fish and shellfish along SE coast
- +ve MBA results oysters
- Led to discovery of gymnodimine



Gymnodimine

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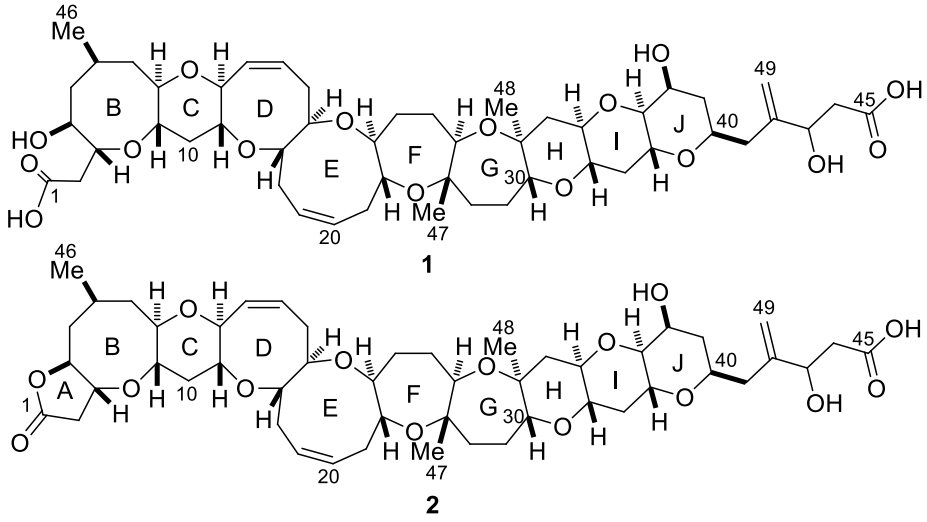
- Wellington Harbour event
- Killed all marine life in the harbour including large fin fish
- Also human respiratory illness
- No brevetoxins but several novel toxins identified



Suzuki, R. et al. (2014) Org Letters

Estuarine, Coastal and Shelf Science

Volume 67, Issue 4, May 2006, Pages 589-604

Long-term effects of a toxic algal bloom on subtidal soft-sediment macroinvertebrate communities in Wellington Harbour, New Zealand

Kerstin Kröger [a b], Jonathan P.A. Gardner [a], Ashley A. Rowden [b], Robert G. Wear [a]

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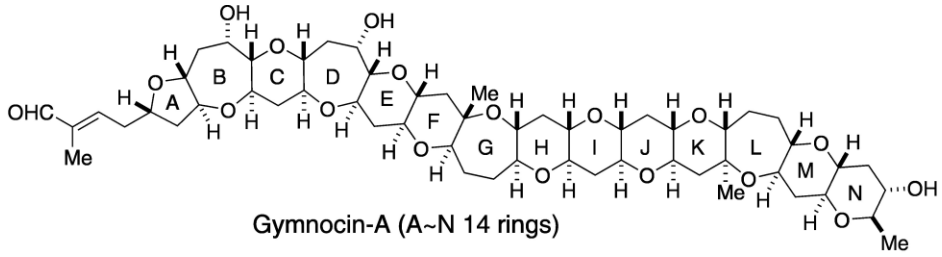
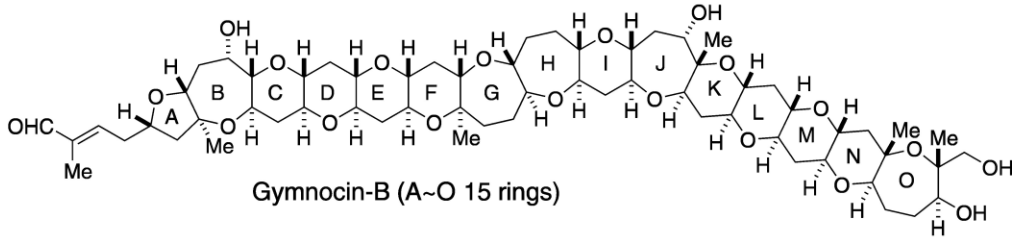
2002-2007: *Karenia mikimotoi*

- Hauraki Gulf fish deaths
- Causes large-scale marine fauna mortalities globally
- Produces toxins such as gymnocins, ROS and hemolysins

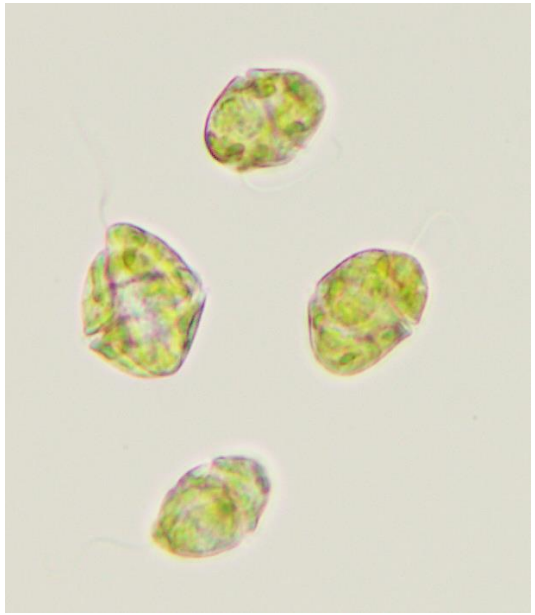


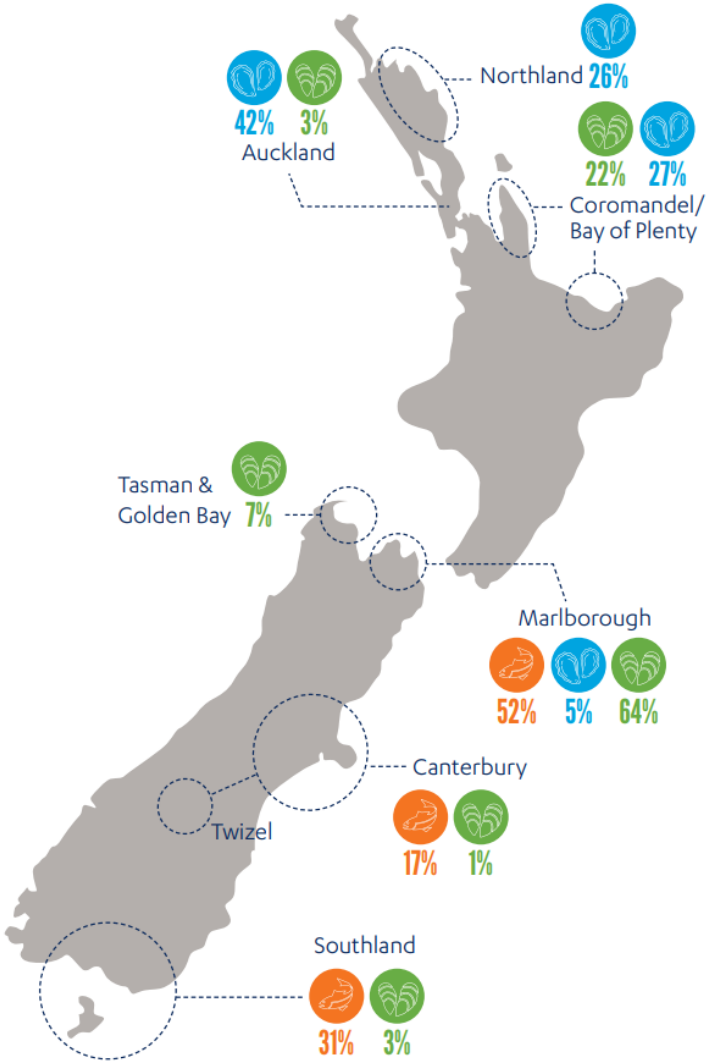


History of major *Karenia* events in NZ

Recent: re-occurring *Karenia longicanalis* (*umbella*) blooms

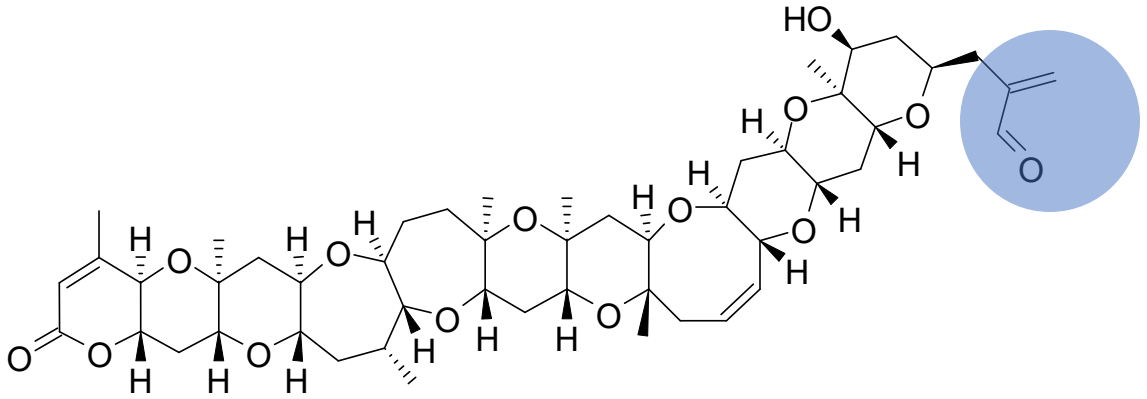
- Farmed salmon mortality events in Akaroa Harbour
- Gill irritation/mucus production leading to suffocation
- Toxicity currently unknown





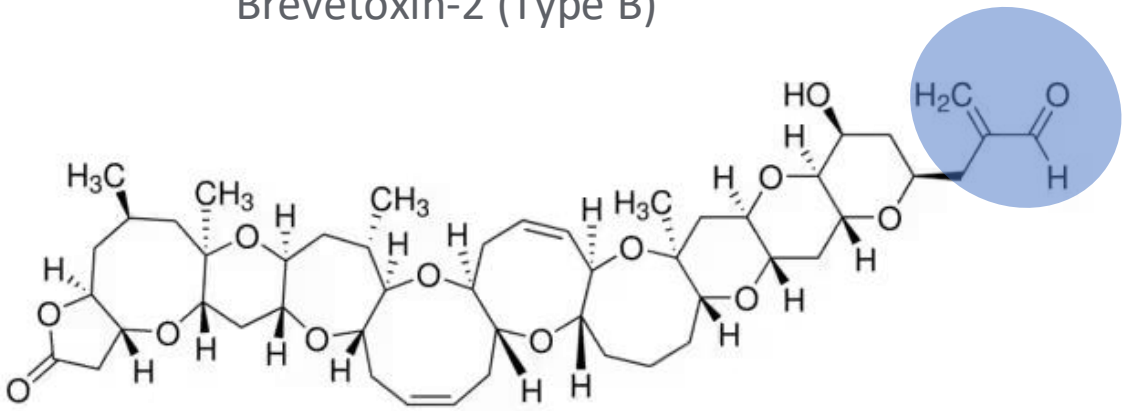
Brevetoxins

K. brevis



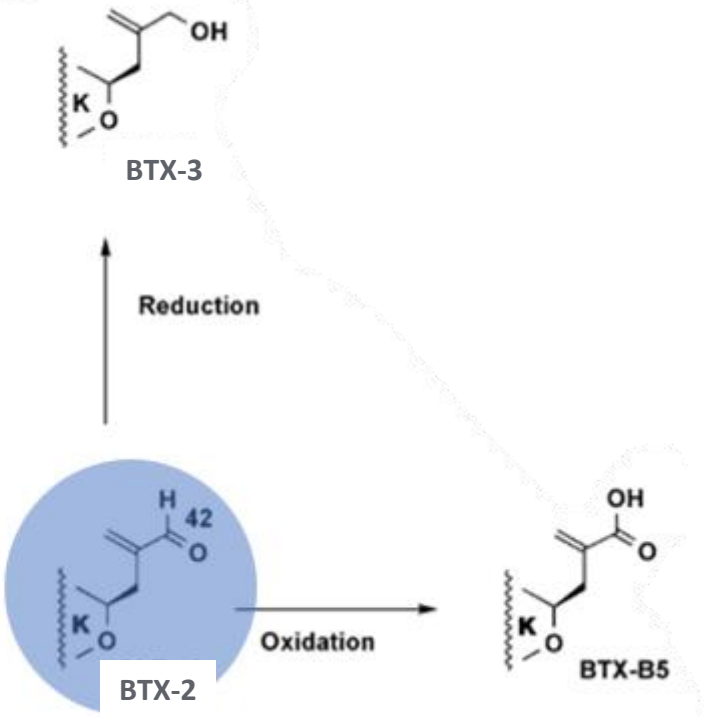
Brevetoxin-2 (Type B)

K. cristata



Brevetoxin-1 (Type A)

Brevetoxins



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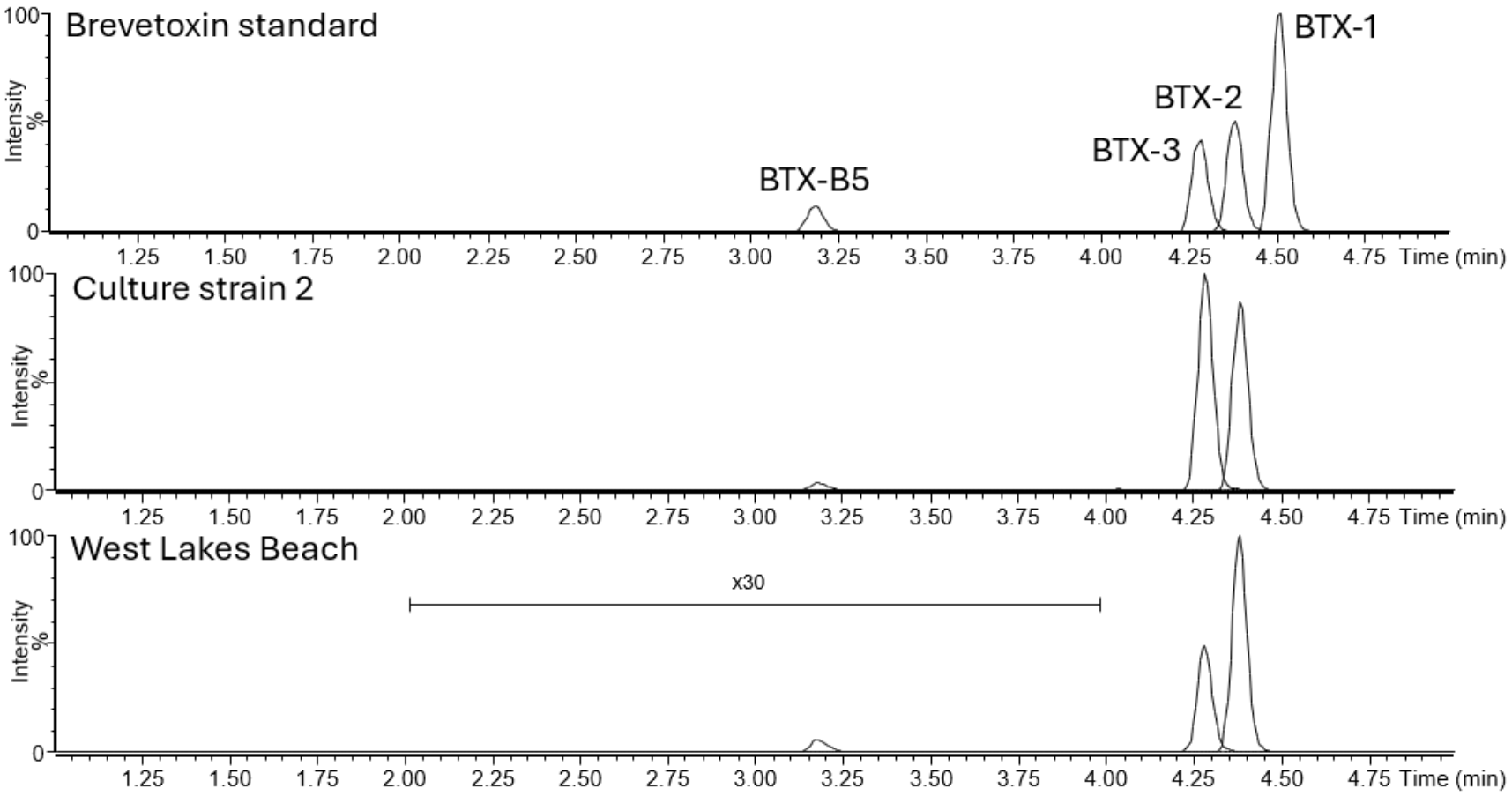
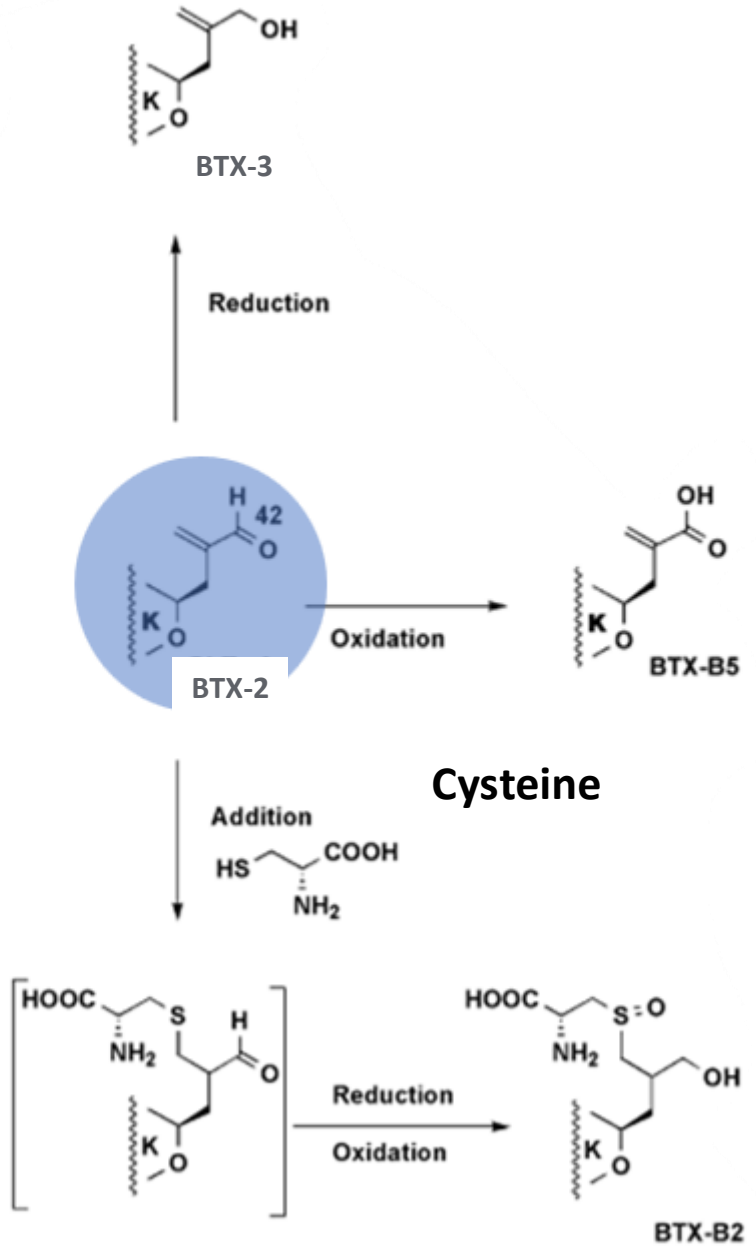
SA bloom samples - seawater



doi: https://doi.org/10.1101/2025.10.31.685766

Brevetoxins – shellfish metabolites



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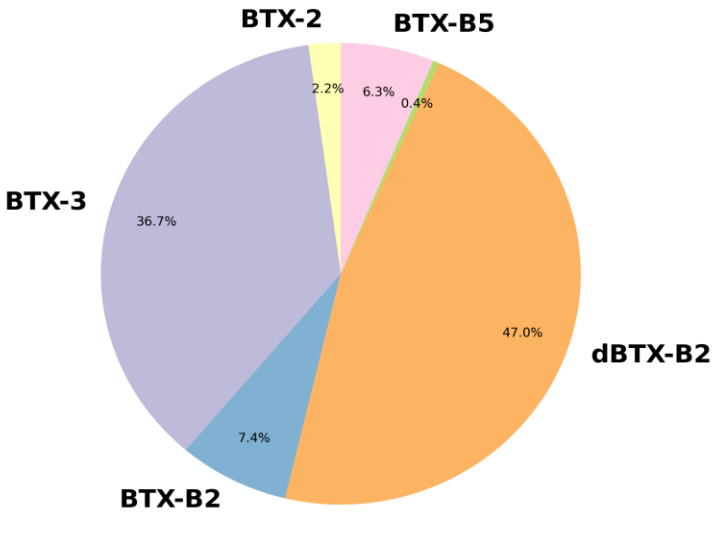
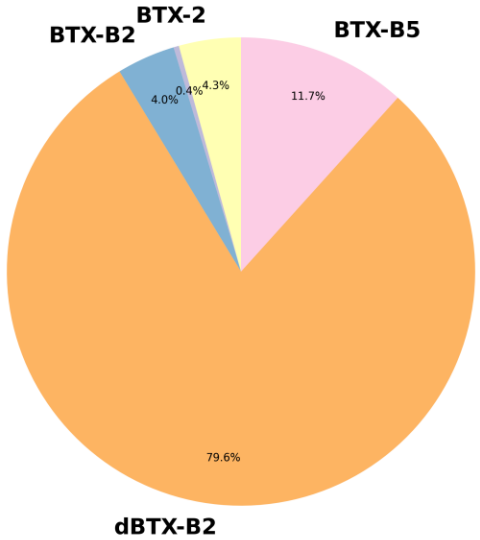
SA bloom samples - shellfish

Oyster



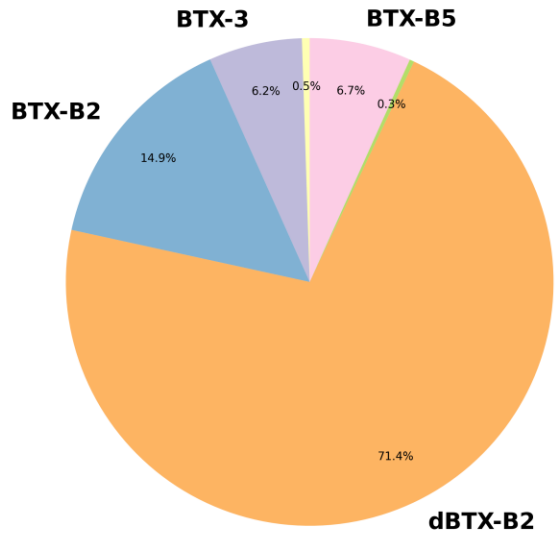
N = 224

Blue mussel



N = 116

Pipi



N = 132

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Brevetoxin monitoring & regulation

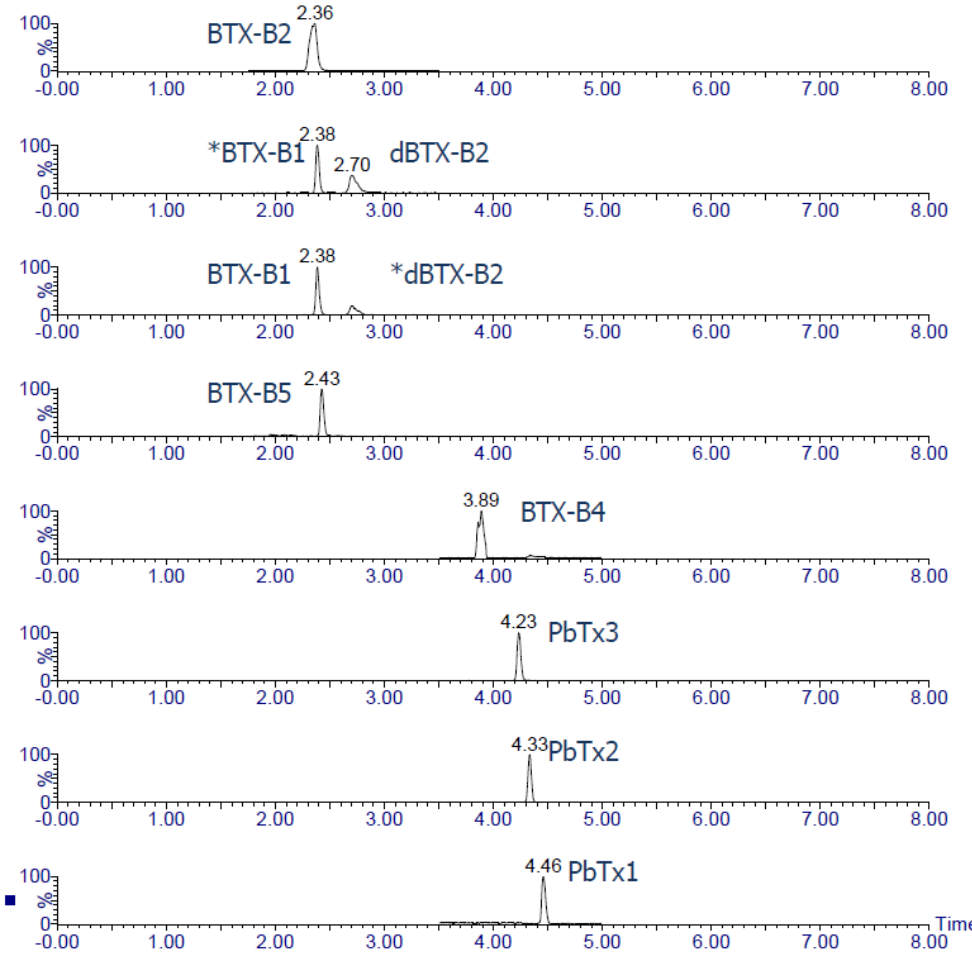
- NSP (brevetoxin) mouse bioassay developed in the US in the 1960s and adopted by US NSSP
- Developed when v little was known about the chemistry and toxicology of brevetoxins
- Action limit of 20 mouse units (MU)/100 g established based on human intoxications (Eastern oysters)
- Demonstrated to be protective of public health
- For alternative methods of analysis need to convert MU into amount of brevetoxin (BTX-2)
- Determined that 1 MU = 4 µg BTX-2, so 20 MU = 80 µg BTX-2
- Therefore, regulatory limit = 80 µg BTX-2 eq/100g (0.8 mg BTX-2 eq/kg)

Brevetoxin regulation & monitoring

- LC-MS method able to quantify individual BTX analogues
- TEFs required to convert levels of analogues into BTX-2 eq
- TEFs not currently available as limited toxicity information
- Current approach sums levels of each BTX analogue

Toxin	Code	Standard (Y/N)	Calibration reference
Brevetoxin-1	BTX-1 (PbTx-1)	N	BTX-2
Brevetoxin-2	BTX-2 (PbTx-2)	Y	BTX-2
Brevetoxin-3	BTX-3 (PbTx-3)	Y	BTX-3
Brevetoxin-B1	BTX-B1	N	dBTX-B2
Brevetoxin-B2	BTX-B2	N	dBTX-B2
s-deoxy brevetoxin-B2	dBTX-B2	Y	dBTX-B2
Brevetoxin-B4	BTX-B4	N	dBTX-B2
Brevetoxin-B5	BTX-B5	Y	BTX-B5

IANZ accredited brevetoxin method



Questions and data gaps

- **Is the instrumental method used for brevetoxin (NSP) monitoring fit-for-purpose?**
  - Action limit (0.8 mg BTX-2 eq/kg) based on historical MBA settings
  - Some evidence that LC-MS method is more conservative
  - Brevetoxin reference materials now available for toxicological assessment (PIRSA supported)

- **Development of *Karenia cristata* trigger levels for risk management.**
  - Establish quantitative relationship between *K. cristata* cell densities and brevetoxin levels in shellfish
  - What trigger levels provide appropriate protection while minimizing unnecessary harvest disruptions?
  - HAB cell monitoring provides a reliable, early and cost-effective proxy for toxin risk

- **What is the ecotoxicological impact of *K. cristata* on marine flora and fauna?**
  - What proportion of observed toxicity can be attributed to known brevetoxins?
  - What fraction of toxicity remains unexplained (e.g. short-lived vs stable)?
  - Isolate and chemically characterise unidentified toxic compounds

Thank you!

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
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Department of Primary Industries and Regions

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