9th International Conference on Molluscan Shellfish Safety, Sydney, March 2013

Australian Shellfish Quality Assurance Advisory Committee

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SafeFish

AUSTRALIAN SEAFOOD COOPERATIVE RESEARCH CENTRE

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This project was conducted by the Australian Shellfish Quality Assurance Advisory Committee

The Australian Seafood CRC is established and supported under the Australian Government's Cooperative Research Centres Program. Other investors in the CRC are the Fisheries Research and Development Corporation, Seafood CRC company members, and supporting participants.

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Non-Technical Summary

International Conference on Molluscan Shellfish Safety

PRINCIPAL INVESTIGATOR: Australian Shellfish Quality Assurance Advisory Committee

PROJECT OBJECTIVES:

1. Disseminate ASCRC funded research through a series of presentations by ASCRC participants
2. Provide information to the Australian shellfish industry on paralytic shellfish toxins and how to minimise associated business risk
3. Promote international harmonisation of shellfish safety standards and regulations through ICMSS
4. Limit the health risks associated with microbiological, marine biotoxin and other chemicals
5. Improve effective and efficient management procedures and detection tools to prevent and/or limit the impact of events on industry

OUTCOMES ACHIEVED

- 199 participants from 27 countries attended
- 88 oral presentations and 50 posters were presented on current developments in scientific research and regulatory standards in shellfish safety (bacteria, viruses, biotoxins, etc)
- ASCRC research outcomes internationally disseminated: presentations were delivered from 2 ASCRC PhD students, 1 ASCRC post doc, and five additional ASCRC sponsored researchers.
- Industry knowledge of shellfish safety issues was enhanced through participation of 22 Australian oyster and mussel industry members.
- Technical transfer of knowledge related to viruses and biotoxins in seafood through meetings between international experts and CRC scientists.

LIST OF OUTPUTS PRODUCED

- Report from conference organisers (ICE)
- Proceedings (40 papers submitted for inclusion and peer reviewed) to be published electronically on the FAO website (due April 2014)
- Four reports providing details of the round table discussions and outcomes from field trips.
- Improvement and updating of the Australian Shellfish Quality Assurance Program Manual using up to date knowledge from experts at the conference

ACKNOWLEDGEMENTS

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1. Introduction

The International Conference of Molluscan Shellfish Safety (ICMSS) is the principal shellfish safety event worldwide for industry, government regulators and researchers to share knowledge and experience on shellfish safety issues. ASQAAC won a bid in June 2009 at ICMSS, France to return the 9th ICMSS Conference to Sydney, Australia where it was initiated in 1994. ICMSS is primarily about developing people to assist the industry meet its future shellfish safety needs. ICMSS is designed to forge collaboration, present and discuss implications on new research and knowledge amongst experts and students alike.

The conference aimed to assist the industry to respond to, and take advantage of, increased demand for seafood. Continued delivery of a quality product requires the industry to responsibly address latest shellfish safety information in the context of the Australian production environment. Development of people to assist the industry meet its future needs occurred in a number of ways through hosting ICMSS in Australia:

- Broadening horizons/up-skilling of Australian and international students studying topics related to shellfish safety.
- Collaborations between international and domestic research institutes with a focus on elements of shellfish safety research and development.
- Dissemination of ASCRC research through a series of presentations in the plenary from ASCRC participants. 8 ASCRC researchers participated.

The conference also provided an important forum for increased industry participation in the conference with 3 industry focus sessions (including one on the Tasmanian PST de-brief session). 10 industry registrations were subsidized through ASCRC funding, significantly boosting the number of industry attendees (22 industry attendees). An industry networking session was held at the Sydney Fish Market in conjunction with the conference. The evening was highly successful with 71 participants attending.

1.1 Need

The Australian Shellfish Quality Assurance Advisory Committee (ASQAAC) recognized and supported the need to host the premier international shellfish safety event, ICMSS, in Australia. ASQAAC aimed to deliver a ‘cutting edge’ programme focused on shellfish safety and related disciplines and encouraged participation from a broad range of national and international experts and students. ASQAAC's aim was not to profiteer from hosting the conference but to include as many international experts, local industry and students as possible with the aims of:

- Limiting the health risks associated with microbiological, marine biotoxin and other chemical contamination of shellfish;
- Improvement of effective and efficient management procedures and detection tools to prevent and/or monitor shellfish contamination; and

- Promotion of international harmonisation of shellfish safety standards and regulations.

From a global perspective Australia has an admirably healthy marine environment with respect to potential seafood safety risks, this has resulted in 'high quality safe-to-eat' shellfish. The relatively low shellfish safety risk in Australia has promoted the uptake of risk-based shellfish safety management practices, pragmatic regulation and innovative approaches. Hosting the ICMSS provided a unique opportunity to showcase Australia's point of difference, particularly in discussions of international program harmonisation, and promote the Australian shellfish safety sector as well as the Australian seafood industry in general.

1.2 Objectives

1. Disseminate ASCRC funded research through a series of presentations by ASCRC participants
2. Provide information to the Australian shellfish industry on paralytic shellfish toxins and how to minimise associated business risk
3. Promote international harmonisation of shellfish safety standards and regulations
4. Limit the health risks associated with microbiological, marine biotoxin and other chemicals
5. Improve effective and efficient management procedures and detection tools to prevent and/or limit the impact of events on industry

2. Methods

ICMSS is the premier shellfish safety event worldwide for industry, government regulators and researchers to share knowledge and experience on shellfish safety issues. The major features of the ICMSS programme included:

- Four presentation days
- Two parallel presentation sessions held each day
- Two industry/technical tours (Hawkesbury river and FDA dye tracing study)
- Three industry-focused sessions
- Three round table sessions (two on biotoxins, one on viruses)

ICMSS Sydney 2013 themes:

- Management and mitigation of harmful algal blooms (including PSTs)
- Advances in marine biotoxin and freshwater cyanotoxin monitoring technologies and methods
- The impacts of climate change on shellfish food safety
- Application of sanitary surveys in the microbiological classification of shellfish production areas
- Progress on the development of microbiological and virological analytical methods and standards
- Rapid diagnostic tests for on-farm use
- Chemical contaminants
- Harmonisation of international regulatory standards
- Remediation of high risk shellfish production areas
- Post-harvest treatment
- Epidemiology and human health risk assessment.

The ICMSS Sydney met the ASCRC standard investment conditions, including:

- Promoted ASCRC related projects through presentations at the conference and via posters;
- Acknowledged ASCRC sponsorship, which was highlighted during the conference in advertising, publications, signage, trade stand, and satchel material;
- The budget has been made fully accountable, transparent and is available to the ASCRC on request to the NSW Food Authority (who were responsible for budget management and underwriting of the conference).

3. Results

The conference was successfully held, with no major problems encountered. 199 participants from 27 countries attended. 88 oral presentations were delivered and 50 posters were displayed focusing on current developments in scientific research and regulatory standards in shellfish safety (bacteria, viruses, biotoxins, etc).

Presentations were given by 2 ASCRC PhD students (Tom Madigan and Felicity Brake) and 1 ASCRC post doc (Dr Ian Stewart), and from five additional researchers undertaking ASCRC sponsored research (Catherine McLeod, Gustaaf Hallegraeff, Clinton Wilkinson, Tom Ross, Tim Harwood). This provided an excellent opportunity to showcase ASCRC post harvest research developments.

22 industry members participated in the conference and three industry-focused sessions were held ('adding value', 'de-brief on Tasmanian PST event', 'bloom identification workshop'). Additionally an industry social event was held to encourage interaction between researchers and industry. This enhanced knowledge and understanding of food safety issues amongst industry members.

The 'de-brief on the Tasmanian PST event' created useful linkages between Australian regulators, researchers and industry stakeholders and their international counterparts. Two international experts Dr Philipp Hess (France) and Dr Ana Gago Martinez (Spain) provided important input into a round table session on topics related to the occurrence of PST events and management of these. The information provided was in the context of management of such events in France and Spain. The registration costs of these experts was supported through ASCRC funding. Following the conference, Australian regulators and industry members gained further information on how to improve regulatory oversight and industry management through information elicited from newly developed contacts. A write up of the round table session can be found in Appendix 1.

The three round table discussions enabled Australian regulatory and industry representatives to provide an Australian view on policies currently under development. This included views regarding the potential introduction of viral standards and thresholds for shellfish. In general the Australian view that any such standards should be commensurate with risk was well received. The controversial topic of deregulation of some toxin groups of lesser public health concern was also debated and again provided Australian officials and industry representatives an opportunity to input and be heard by European and US regulators who arguably determine/lead new regulatory trends.

In addition to the opportunity for Australian delegates to up-skill through attending presentations, several specific additional training sessions were held at the conference, including:

- A workshop for industry to learn how to identify harmful algae species in their growing waters;
- A field trip to the Hawkesbury River growing area, during which the impacts of herpes virus were discussed and potential mitigation strategies;

- A field exercise run by US FDA experts to disseminate current faecal source tracking methods, such as the use of tracer dyes to assist industry and regulators understand how to assess the impact of sewage spill events; and
- A laboratory based workshop run by the IAEA on rapid testing methods for PST toxins.

These training sessions provided practical information that has been used by delegates to improve food safety management in Australian growing areas.

4. Discussion

Hosting the ICMSS conference in Australia has improved the knowledge base and general understanding of food safety issues related to shellfish. This will assist the ASQAAC in its endeavours to reduce the public health risks associated with contamination of shellfish. It has also assisted ASQAAC to ensure that its current policies for managing food safety risks are appropriate for 2014, and to incorporate current international trends and innovation into shellfish safety standards in Australia. The conference also provided an important platform from which to promote the Australian perspective on shellfish risk management and international harmonisation of standards, and a unique opportunity to highlight the healthy marine environment in Australia, the safety of Australian seafood products and promote the shellfish sector.

5. Benefits and Adoption

- International linkages were formed between marine toxin experts and Australian industry and regulators. These have been used by the industry to gain advice on new monitoring systems/methods they may be able to utilise at the farm level (particularly regarding rapid test kits for toxins). This provides opportunities for the industry to reduce the potential impact of food safety incidents, such as the Tasmanian PST event in 2012.
- The results of ASCRC research projects were disseminated. After the conference several ASCRC researchers were contacted to provide input into international reviews on topics such as harmful algal blooms and viruses. This has thus increased international awareness of Australia's recent research initiatives and findings on shellfish food safety.
- In general, the conference has raised Australia's profile in the post harvest food safety area. This enhances Australia's reputation as a producer of high quality, safe to eat seafood.
- Following the ICMSS conference, a meeting of the Codex Committee on Fish and Fishery Products was held in Norway in February 2014. Linkages formed during ICMSS were utilised by the Australian delegation to progress the Australian position. These linkages will provide further opportunities to influence international policy setting in the future.

6. Further Development

The next ICMSS conference is being held in Chile in March 2015. In order to further advance Australia's views on food safety research and policy it is suggested that Australian industry, regulators and researchers actively participate in the conference. Mr Anthony Zammit of the NSWFA has been invited to co-chair the Chilean conference and is the key contact for Australians wishing to participate.

7. Planned Outcomes

Public Benefit Outcomes

1. Australian shellfish safety capability has been highlighted within the international shellfish safety field, which is continually engaged in negotiation and discussion. Returning ICMSS to Australia (the first conference was held in Australia in 1994) has allowed Australian scientists, regulators and industry to showcase ability and discuss equivalency in regulations generally driven by northern hemisphere interests.

2. New collaborative international research initiatives and opportunities to develop shellfish safety programs have been identified. This is exemplified by recent successful project applications between Australian and New Zealand research agencies to undertake collaborative biotoxin research, and on going discussions between French and Australian researchers regarding viruses.

Private Benefit Outcomes

1. Australian seafood production has been highlighted internationally, including the relatively unique contaminant free environment.

2. Opportunities for Australian shellfish producers and processors to network 'internationally' were gainfully exploited.

Linkages with CRC Milestone Outcomes

Output 3.4 - Incorporation of external expertise into Research Program 1 activities.
Milestone 3.4.3 - Annual program of professional development training seminars, workshops and forums relevant to Research Program 1 outputs completed.

Output 3.9 - Successful incorporation of external expertise into Research Program 2 activities
Milestone 3.9.3 - Annual program of professional development training seminars, workshops and forums relevant to Research Program 2 outputs completed

8. Conclusion

A successful conference was held in Sydney, benefiting Australian scientists, industry and regulators in terms of expanding knowledge of current research and developments internationally, improving and expanding professional networks for all Australian participants and raising the international profile of Australian science and shellfish products.

A summary of comments from delegates was provided from the conference organiser's survey of participants:

- "Overall conference was great! "
- "Program worked well with 2 streams"
- "Good variety of speakers"
- "Gained a lot of knowledge"
- "Best ICMSS!"

9. References

Not applicable.

Appendix 1: ICMSS 2013 Industry Session 3: Learning Lessons: PST Event in Tasmania

Chair: Prof. Gustaaf Hallegraeff, UTAS: Institute for Marine and Antarctic Studies.
Rapporteur: Dr. Hazel Farrell, SIMS, Sydney

Invited speakers:

- Alison Turnbull, Manager, Tasmanian Shellfish Quality Assurance Program at Department of Health and Human Services, Tasmania.
- Phil Lamb, Managing Director at Spring Bay Seafoods, Tasmania.
- Dr. Chris Bolch, UTAS: Australian Maritime College.

International Observers: Dr Philipp Hess, IFREMER, France; Prof Ana Gago-Martinez, University of Vigo, Spain.

Background

During October 2012, an unprecedented *Alexandrium* toxic dinoflagellate bloom affected more than 200km of coastline on the eastern seaboard of Tasmania, Australia. The event resulted in widespread closures of both commercial and recreational bivalve growing areas, rock lobster, scallop and crab fisheries and sparked a national and international recall of mussels, due to their contamination by paralytic shellfish toxins (PST). No human illnesses related to the event were confirmed. The total economic loss to the affected fisheries has been estimated at $12 million. As part of the ICMSS conference, industry members, government representatives and research scientists were invited to an open discussion, sponsored by the Australian Seafood Cooperative Research Centre (CRC), in order to discuss the development and impact of the bloom, the genetics and toxicology of the species, management of the event and the economic impacts.

The Chair (GH) noted that the discussion would provide a valuable opportunity to assess how well the incident was managed and what could have been done differently. An Incident Review of the event is being undertaken by the relevant stakeholders and is due for completion by 1 July 2013. This ICMSS meeting would allow stakeholders to identify priorities for management and research. Parallels were drawn to the improvements and advances made by the NSW shellfish industry drawn from a Hepatitis A outbreak in Wallis Lake during 1997.

Management of the *Alexandrium* event

Alison Turnbull set the scene for the monitoring procedures in the lead up to the event and also provided a brief summary of previous HAB events in the region. Aquaculture areas along the eastern coast of Tasmania had been assigned a risk classification for biotoxins. Areas that had never been affected by algal blooms were considered to be low risk. High-risk areas were concentrated in the southeast of the state due to the seasonal occurrences of *Gymnodinium catenatum* blooms during the austral autumn (March-May) and occasionally during spring (September - November). Aquaculture regions were typically classified as medium risk zones if they ever had a harvest closure

due to a HAB event. Traditionally, the east coast of Tasmania has had a very low number of harvest closures. As host to one of the largest marine farms affected by the 2012 bloom event, Spring Bay (medium risk area) was classified according to a historical summary of HAB events. Since regular algal monitoring began in 2001, there were no closures due to diarrhetic shellfish toxins (DST) or amnesic shellfish toxins (AST) at Spring Bay. Occurrences of *G. catenatum* were also rare for the region with small events in both 2004 and in 2005 that caused two-week closures. One other high sample was observed in 2008 but flesh tests were non-toxic. *Gymnodinium catenatum* usually occurred in March and the over-winter/early spring period (June-October) was considered to be low-risk. During this low period, water samples were collected on a monthly basis and sampling was increased to fortnightly from October. Prior to 2012, there had been one event of *Alexandrium catenella*, which did not cause any PST in Spring Bay. While *Alexandrium tamarense* was listed on the action level table within the Biotoxin Management Plan for the Tasmanian Shellfish Quality Assurance Program (TSQAP), its presence had not been confirmed in samples prior to 2012.

Phytoplankton samples were collected on 14/10/2012 and 21/10/2012 by Spring Bay Seafoods, as part of their prescribed monitoring program. Due to a delay at the analytical lab and an initial species misidentification, the samples were not confirmed to contain *Alexandrium* by the lab until 1/11/2012. Paralytic shellfish toxins were first detected by the Japanese import-testing program from mussels that were harvested on 21/10/2012. On 29/10/2012, (late afternoon) TSQAP were notified by Phil Lamb (Spring Bay Seafoods) that the mussels had tested positive in Japan and by 30/10/2012 it was confirmed that the toxin levels detected exceeded the Japanese health limits. The Spring Bay growing area was closed. Early on 31/10/2012 it was established that this limit was equivalent to the toxin levels deemed unfit for human consumption in Australia (0.8 mg/kg shellfish flesh) and that the exported mussel samples exceeded this value. At the time of the notification from Japan, Phil Lamb was in Sydney coincidentally with retained mussel samples from the same harvest date and was able to transfer them to Advanced Analytical Laboratories in Sydney for toxin analysis. On 1/11/2012 these mussels were confirmed to contain PST levels above the regulatory limit. A withdrawal of shellfish from the market had begun on the 31/10/2012, however following the confirmation, Spring Bay Seafoods commenced the formal recall of the contaminated product in domestic and international markets.

The time line of available toxicity and cell concentration results indicated that the bloom peak had been missed during sampling, and had likely occurred in the weeks prior to the 21/10/2012. The toxin results reached 10mg/kg shellfish flesh and matched those reported by the Japanese toxin analysis. From the monitoring data it was apparent that the bloom hit the whole of the east coast simultaneously, rather than seeding from adjacent areas. The results showed toxin and cell numbers decreasing rapidly following the high toxicity peak. As a precautionary measure within the biotoxin management plan, the harvest closure action levels for *Alexandrium* had been set at 500 cells l^{-1}, to allow the regulators to assess any potential

impacts of any such event. During the collapse of the bloom, available data indicated that this level could be altered to 1,000 cells l^{-1}. This data and a subsequent event of non-toxic algae (putative *Alexandrium* spp.) during February 2013 resulted in an amendment to the biotoxin management plan.

It was confirmed that the toxin profile from the mussels did not match the known toxin profile of *Gymnodinium catenatum* and an initial taxonomic assessment of the cells described the species as being *A. tamarense*. However, genetic analysis indicated that the species was related to *A. catenella*. Until further analysis the species has been classed as *A. tamarense* Group IV.

TSQAP staff and Spring Bay Seafoods liaised with the public health officers and representatives of the communicable diseases section of the Tasmanian Department of Health and Human Services (DHHS). A public hotline was set up to monitor case definitions of the event. There were 15 reported illnesses. Most of these cases were assessed as not consistent with PSP. There were no clinically referred cases. Two potential cases were identified, however they were unconfirmed as both individuals had preexisting conditions with similar symptoms.

The bloom affected all of the shellfish growing areas on the east coast. *Alexandrium tamarense* was also detected on the west coast although the regional circulation patterns do not account for the movement of this organism from the east coast. During the *Alexandrium* event, a *G. catenatum* bloom occurred on the south coast resulting in mixed blooms and further harvest closures. Several public health warnings, including those banning recreational fishing, were issued and are still current at the time of the meeting.

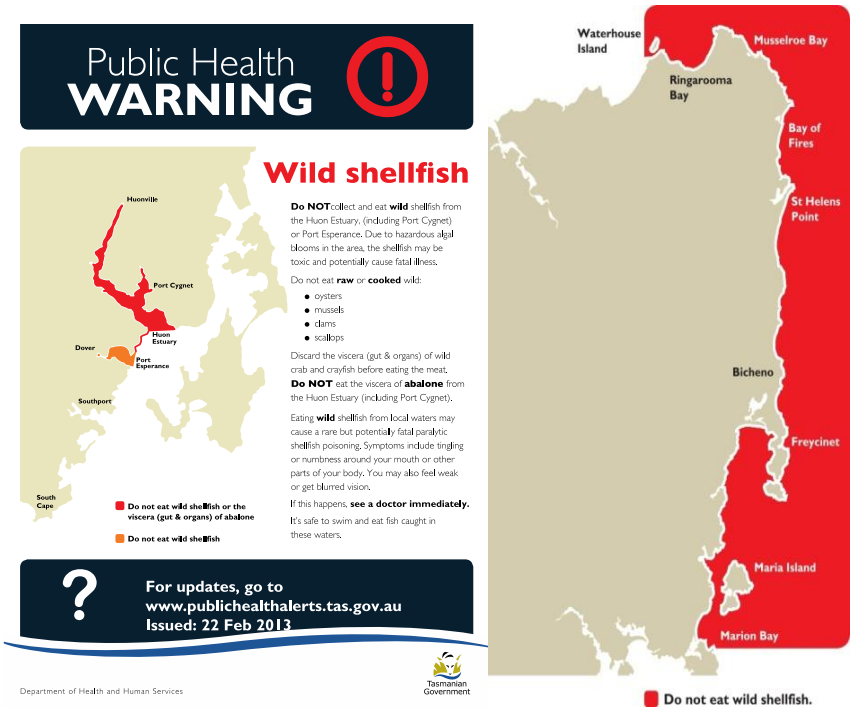


Fig. 1. Traditionally biotoxin problems in Tasmania were exclusively caused by *Gymnodinium catenatum* and mostly confined to the Derwent and Huon estuaries (left); In

Oct-Nov 2012 an unprecedented novel *Alexandrium tamarense* bloom event caused seafood closures along the entire East Coast of Tasmania (right).

Other recreational and commercial fisheries were affected by the *Alexandrium* event. As these fisheries had not been severely impacted by biotoxins in the past, there were no management entities or schemes in place. Abalone and scallop closures were enforced from 2/11/2012. The Tasmanian abalone industry had experienced PST issues during prior *G. catenatum* events and this was beneficial in communicating the 2012 event. The recreational rock lobster fishery had been open prior to the bloom occurring. The commercial season was postponed until the PST content of rock lobsters was assessed. Following testing and the subsequent confirmation of PST content in the viscera it was agreed that the fishery would remain closed. Other species were tested to alleviate public concern and PSTs were not detected in abalone, periwinkle, flat head, sea urchins, squid and banded morwong. Scallops rock lobster and giant crab (the latter from 300m depth off St Helens) were found to contain toxins. This presents serious logistical issues for future biotoxin events. Recreational and commercial fishing from the continental shelf were reopened on 9/2/2013 for rock lobsters and crab with only 3 ½ weeks remaining for the season. The scallop fishery never reopened within the seasonal window. Toward the end of the bloom there was some opportunity for harvesting of scallops. However due to logistical issues, with sampling and testing within a limited time frame, it was decided by those involved to redirect their efforts to other fisheries.

The bloom event created a paradigm shift in biotoxin management in Tasmania. Due to the toxic nature of the species, the widespread distribution of the bloom from an offshore source and the likelihood of the formation of cyst beds, the east coast is now considered to be high risk for future HAB events. Significant changes are being implemented to the biotoxin management plan with baseline monitoring taking place including weekly algal monitoring and monthly toxin uptake data. The trigger levels for flesh testing are being assessed with samples for toxin analysis currently being sampled on a fortnightly basis. It is also recognized that tighter controls are needed for laboratory turn around times. A biotoxin management program for multiple fisheries species is needed.

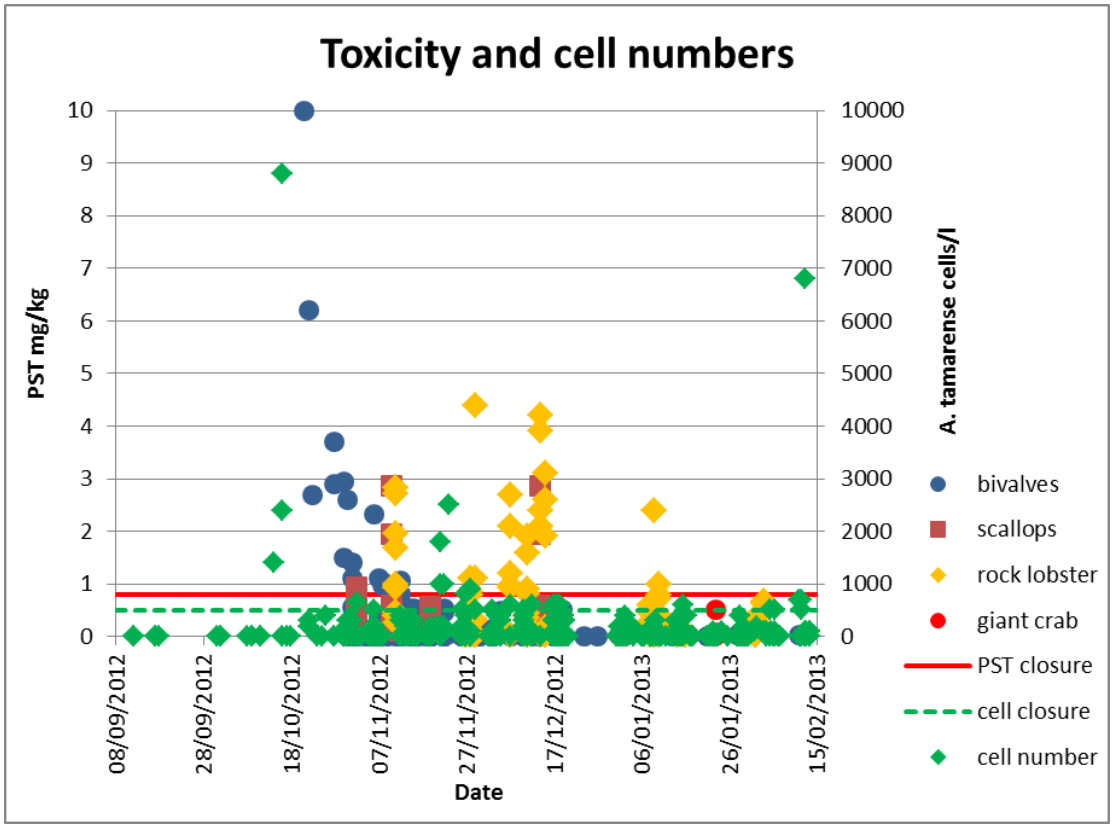
More recent events saw a bloom (ca. 9,000 cells l^{-1}) of a putative *Alexandrium* occurring in Feb 2013. However, there was no toxicity observed in shellfish flesh samples. The biotoxin management plan did not have a contingency for this and a high cell concentration of a potentially harmful species resulted in a harvest area closures. During a three-week closure period a large amount of information was collected. This, along with data collected during the 2012 event allowed the biotoxin management plan to be modified.

The efforts of the DHHS Environmental Health and Communicable diseases and Protection unit were acknowledged. Also credited were members of ASQAAC (including representatives from New Zealand) Cath McLeod at SafeFish, along with Australian research scientists (Shauna Murray at UTS/SIMS, Chris Bolch and Gustaaf Hallegraeff at UTAS).

The TSQAP program manager identified the following future needs:

- Research on short and long term time scales
- Management support – lack of staff and skills to deal with a large program. Suggestion for a management team for big events on a national level. Need to upskill the lab on species identification and confirm the species type.
- Communications- were happy with communications during such a large event but could do better for future events

The first step forward is a review of the event, which has been cofunded by stakeholders, including all fishery and aquaculture sectors.



Time series of *Alexandrium tamarense* cell counts (green diamonds) along the Tasmanian East Coast , and PST toxins in bivalves (blue dots), rock lobster digestive tracts (yellow diamonds), including a single analysis on giant crab (red dot). Data by A. Turnbull, Tas. Dept of Health and Human Services

HAB incident review (due 1 July 2013)

- Enhance risk management by industry and controlling authorities to underpin the public health and market access issues
- To mitigate the business risk
- Assess the current risk management system and its significance for other sectors
- Identify reasons for non compliance
- Reform official response to trading partners

- Identify opportunities for improvement to the national QA manual
- Review and revise cross sector response strategies
- Risk based framework for prioritizing Research & Development – tactical, targeted and inform risk management decisions.

For the review the combined steering committee is represented by industry and control authorities including:

Cath Mcleod (Project Manager)
Al Campbell (NZ, marine biotoxin management)
Andrew Pointon (Food safety and market access specialist)
Cath Nicholls (Communication aspect, including emergency response)
David Hudson (economist, financial implications and cost to industry)

Questions:
Clarification was requested on the timing of delay in the notification of the toxin. The Japanese toxin results were based on the harvest on 21/10/2012. This was not the date of first PST detection.

Lyndon Llewellyn commented that toxicity in the crabs was not surprising, as on other occasions crabs have been found to contain toxin of unknown origin.

How far away are the plankton analytical lab from PCR machines?
Discussions are underway about getting equipment and quality assurance, in talks with Chris Bolch (UTAS) and Shauna Murray (SIMS/UTS).

How do other countries manage abalone and rock lobster during PST events?
Canada, South Africa have issues but no representatives were present at this meeting – Hillary Reville (DPIPWE Wild Fisheries Management) to follow up.

Delay in sample analysis was due to a fish kill priority; the initial result was delayed 14 days. This is a government funded lab that is under-resourced due to government cutbacks.

Industry perspective

Phil Lamb provided background information on Spring Bay Seafoods and their operations. The farm is the largest in the area with three marine farm leases between Triabunna and Maria Island comprising a 1700 hectare lease area for mussel long lines. The farm has a number of sites for phytoplankton sample collection with their location depending on which sections of the farm are undergoing harvest. The leases are exposed to oceanic water conditions due to the wide nature of the passage (approx. 10km). Water flow is 1-3 knots and bottom depth is ca. 25m. The company's hatchery produces mussel spat and oyster spat and harvesting and processing are carried out on the adjacent site. Live musssel products are packed in vacuum bags, bulk packs, and net bags for shipping. Newer lines of product have been developed (e.g. marinated and pickled mussels) and during October 2012 the company launched two new cooked products under the Coles brand. The company is also a supplier for Costco Australia and Japan. At the time of the bloom, the mussels were being exported to six international markets as well as domestically (all states except WA).

The harvesting of the mussels, which were unknown to be toxic, took place on 21/10/2012. The product arrived in Japan on 24/10/2012 and was sold throughout the week. Late on the 29/10/2012 notification from Costco Japan was received that the mussels had tested positive for high levels of PST. At this time Phil was attending a promotional event at the Sydney Costco.

This was the first recall for the company. By the time the results were confirmed in Australia a formal recall was put in place. Domestic and international recalls were coordinated by the company and Food Standards Australia and New Zealand (FSANZ). The recall was complex as there was a range of affected products with a widespread market (Prior to the event over 30 tonne of mussel product had been sold . During the recall approx. 10 tonnes were recovered; the balance was consumed. Due to the perceived risk to human health, while the recall was being organized (i.e. Arranging lists of product, use by/harvest dates, customers affected, markets that received the product) the DHHS issued a public announcement at noon on 2/11/2012.

The recall procedure involved a large amount of interaction with both Coles (in Australia) and Costco (globally) as they were large stakeholders and some of recalled product had been branded as Coles merchandise. Stakeholder engagement also involved liaising with other aquaculture producers in the local area (and throughout Australia) and informing the public to address concerns about the recall. Initially it was thought that the contamination just involved mussels.

Recall costs have been estimated to be in excess of $110,000 and incudes the cost of the initial product, recall costs, communications, public relations.

The recall involved a large amount of reporting to FSANZ and included an interim and final report eventually finalized in Dec 2012. A series of reports were required and finalized in January. Since the event, there has been investigations and consultation with the Australian Dept. of Agriculture, Fisheries and Forestry (DAFF), DHHS, Tasmanian Dept. of Primary Industries (DPI), Australian Mussel Industry Association (AMIA) and TSQAP.

Lost sales during the closure were estimated at $750,000 by Spring Bay Seafoods. Coles were understanding and supportive towards the event and their branded product was relaunched in stages commencing on December 2012; Approx. 25 out of 42 permanent staff members were put on forced annual leave and 8 casuals were laid off. The 125 mt mussels that were scheduled for harvest in November created significant management issues for the company to address and to avoid further losses. The company lost market access to Japan (whose import authority imposed 100% test and hold requirement, which can only be lifted after >300 “clear” shipments or 2 years).

Phil Lamb provided the following summary of issues for consideration and review :

- Lab delays and initial analysis of samples was incorrect
- New problem species, and limited experience with *Alexandrium* events in the area
- Frequency of testing was based on the area being a medium risk class

- Limited understanding of the species and its behaviour for this area
- Limited resources of TSQAP due to the widespread nature of the event.
- Gaining understanding of the relationship between the cell counts and toxicity levels delayed re-opening of farms even though the mussels depurated quickly (management plan was subsequently changed).

Lessons learned/issues to be addressed

- Cell counts and lab accountability, review capabilities and resources – TSQAP program review.
- More frequent water samples tests and meat tests for customer confidence (cost vs. benefit).
- Quick responses required along with an adaptive biotoxin management plan.
- Further abilities for testing (future developments for genetic based testing being considered)
- Desire for a quality assurance program to meet and exceed the standards.
- It is a positive step that the testing and harvest criteria has now been changed based on meat testing results being "clear" during high cell counts of apparently toxic species.
- It is important to try and clarify the uncertainty around the species identification and once it is confirmed to prepare for future events.

Questions:

During the questions that followed his talk it was noted that the media and publicity following the event was very intense but that Spring Bay Seafoods had dealt with the media in a very positive manner. Phil responded that he had had taken an open and honest approach and he had benefited from the advice from media consultants who had advised neighboring businesses and also from staff at TASSAL . The Spring Bay Seafood website, social media websites (Facebook and Twitter) along with emails and press releases were used to keep the public informed about what was happening at the farm and with the product. Alison Turnbull commented that this really assisted in alleviating public concerns. Phil responded by noting that the company regained 95% of sales in the month following the event. It was also noted during Phil's presentation that in the weeks after the PST event the company regained market share quickly and attracted positive promotion from renowned restaurateur Tetsuya Wakuda.

The impact on other fisheries was queried and it was explained that the initial concerns of other farmers and markets were rapidly dissipated. Other industries/markets within Australia reopened quickly after the initial "knee jerk" reaction.

All of the company's previous export markets (except Japan) were reopened following effective representation from DAFF. No illnesses were reported in Japan or elsewhere. Costco (Japan) contacted 600 customers in a number of days during the recall.

Now algae and toxin monitoring takes place on a weekly basis at Spring Bay and of the company's volition.

Identity and distribution of the causative species

Chris Bolch acknowledged a group of researchers (Shauna Murray, Gustaaf Hallegraeff, Miguel de Salas) involved in efforts to identify and characterise the causative species and genotype. To begin, a brief background on identifying *Alexandrium* was provided. *Alexandrium tamarense* is difficult to distinguish from other similar species such as *A. catenella* and *A. fundyense*, and relies on examination of the shape and arrangement of the thecal plates that cover the surface of the cells It takes a lot of experience and practice to visualize these cell features. The presence of a ventral pore on the first apical plate is a key distinguishing characteristic.

Globally, strains of these three species are divided into 5 genetic groups of varying toxicity referred to as Group I to Group V. Group V(low toxicity) and Group IV (toxic) are both previously known from southern Australian waters. Toxic Group I, which contains*Alexandrium catenella /fundense/tamarense* morphotypes are limited to higher latitudes of the northern and southern hemispheres (Lilly et al., 2007). Chris showed a global mean sea-surface temperature map indicating that Group I genotypes are associated with coastal shelf and shelf edge environments primarily below the 15°C isotherm. In the Southern Hemisphere, suitable environments exist at the tip of South Africa, southern South America, Eastern Tasmania, and the southern half of the south Island of New Zealand.

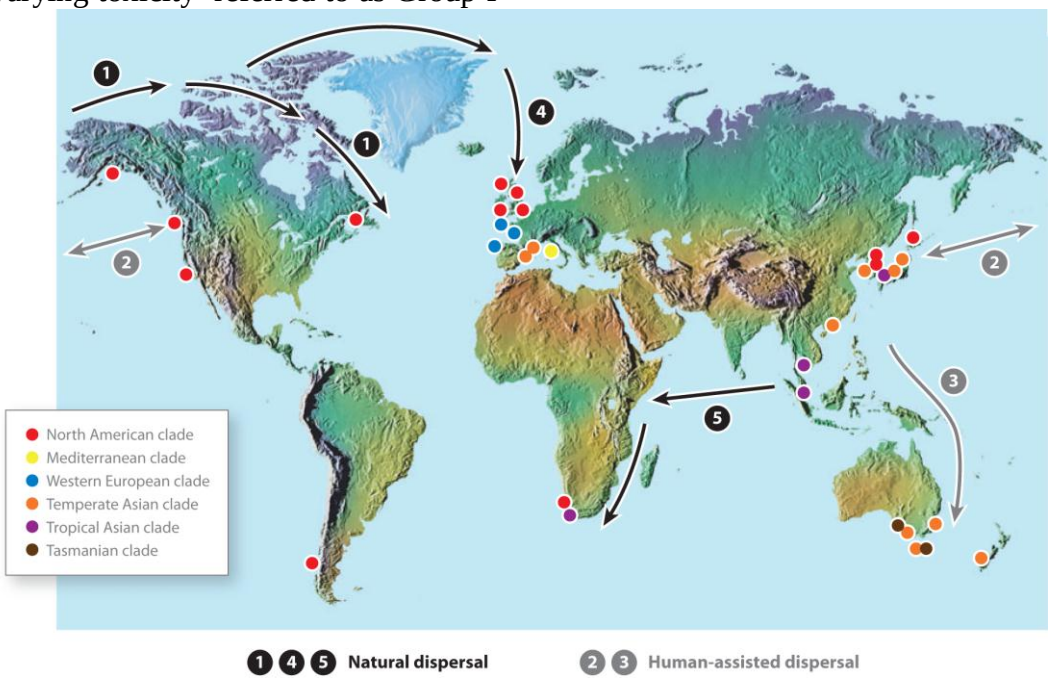


Fig. 3. Globally *Alexandrium tamarense/catenella* occurs as 5-6 genotypes with different toxic potencies and toxin profiles. East Coast Tasmanian populations may represent 2-3 different genotypes, one of which is mostly nontoxic. This severely limits the value of plankton monitoring and calls for routine application of genetic probes (Illustration from Anderson, Cembella, Hallegraeff 2012. *Ann Rev. Mar. Sc.)*

Chris outlined known problematic species of the *Alexandrium tamarense* complex in SE Australia

- *A. catenella* has been known from NSW since as early as the 1930s and has been reported more widely and frequently over time across southeastern Australia. It is not known whether this is as a result of natural spreading or if the species was already widely distributed but cryptic (low cell numbers). . A sediment sample collected from Spring Bay in 1997 contained cysts of *A. catenella*, and cultures established were typed as Group IV (temperate Asian clade) and toxic. A low-level bloom of this species occurred in 2004 in Spring Bay.
- The history of *Alexandrium tamarense* in Australia is more complex. It was first detected in fixed plankton samples from St Helens in 1987. Cultures were established in 1988 from cysts collected on the Tasmanian north coast which proved to be non-toxic, but have since been shown to produce very low levels on some saxitoxins. The genotype of other *A. tamarense* blooms across a range of other mainland locations have rarely been genotyped or cultured therefore the status of most mainland populations is unknown, but have not been linked to shellfish toxicity and were presumed to low toxicity Group V genotypes. Up to 2012 all Australian *A. tamarense* genotypes tested have been determined to be low toxicity Group V low-toxicity (Tasmanian clade). Past cyst studies of cultures established from cyst collected in 1995 from Spring Bay revealed a toxin profile similar to that known for Group I toxic (North American clade), however the culture was lost before it could be genotyped. When considered in total, the historical data indicate that toxic genotypes of *A. tamarense* may have been present along the eastern Tasmanina coast from as early as 1987, however its association with shellfish toxicity is unprecedented.

In other regions of the globe, *A. tamarense* tends to be offshore phenomena, typically associated with upwelling regions near the shelf-edge and slope. In early November 2012 during the tail of 2012 PST toxicity event in Tasmania, Chris Bolch and staff from Spring Bay Seafoods carried out a single cross-shelf transect of 5 sampling stations from Spring Bay. Samples were taken from the surface (integrated 0-7 m) and in the 20-40m range, and a net tow also collected from 0-15m for culturing. Cells were detected only at two inshore stations (Spring Bay, and Oakhampton Bay at the north end of Mercury Passage), and the outermost station beyond the shelf-edge. No cells were detected at three stations on the shelf. The low cell concentrations at the surface and deep sampling, and the presence of a significant amount of cells in the 15m net haul, suggests that the population maximum was located somewhere between 5m and 40m at the off-shelf station.

Initial on board examination detected cells resembling *A. tamarense*, however these were difficult to observe clearly on board, and on return to shore the samples were in poor condition (cells shed their theca under stress) and identification could not be confirmed on-site. On return to AMC laboratories in Launceston, the net samples were diluted and "revived" by addition of algal culture medium and overnight incubation. The next morning, samples contained a mixed community of diatoms (dominated by diatoms including *Pseudo-nitzschia* species) and mobile dinoflagellates dominated by a *Scrippsiella* species, but with a considerable population of *Alexandrium* cells as a sub-dominant dinoflagellate.

Thirty five single cell culture isolates were established. Twenty one isolates incubated at 22-24 °C. died within 48h. All 10 isolates incubated at 16-18 °C. survived and resulted in subsequent establishment of 8 on-going *Alexandrium* cf. *tamarense* cultures.
The surviving cultures from offshore samples prefer high salinity (35ppt) and temperatures less than 20°C. Surface water temperature at the offshore station at the time of sampling was 15°C.

All other live inshore samples collected by Chris during the bloom period contained few or no *A. tamarense* cells. When they were observed in samples, they generally contained contracted and degenerate cell contents suggesting that they were not experiencing an optimal environment for their growth and survival. None of the attempted inshore cultures survived and were likely dead at the time of isolation. In contrast, observation of the suspected *A. tamarense* cells collected beyond the shelf-edge while on-station appeared to be in a much healthier condition and culturing success was high when incubated at appropriate temperatures (18 °C).

Preliminary results of the toxin analysis indicated a per cell toxicity of 16 fmol STX per cell, within the middle of the range published for toxic *A. tamarense*. The PST congeners from dinoflagellates identified were GTX1,4 (90%), C1,2 (7.3%) and NEO (2.7%). Oyster and and mussel PST toxin profiles varied somewhat between but were consistent within shellfish species. Results from the mussel flesh analysis varied considerably between oysters and mussels but on average were dominated by GTX2,3 (40-60%), C1,2 (17-43%) and GTX1,4 (2.3-12%), with minor amounts of dcGTX2,3 (5-7%) NEO (1.5-2.6%) and STX (1.2-4.5%) and dcSTX (0-3.3%). Shifts in toxin profile were evident in cooked product and appeared related to the type of preparation/seasoning – indicating that cooked product presents different risk for consumers. The differences between the cells and mussel/oyster flesh toxin profiles may be the result of biotransformation of toxins by the mussels, however, as there were delays during transit to Advanced Analytical Australia labs in Sydney, it seems more likely that acid or heat conversion in transit may be responsible for the differences.

The toxin profile in shellfish from the 2012 event did not match the toxin profile of *A. catenella* Group IV type strains previously known from Australia and Tasmania , but it is admitted that PST profiles are known to vary considerably .The toxin profile was instead similar to that of the *A. tamarense* culture isolated and tested for toxicity in 1997, and similar to that known for Group I Northern Asian genotypes. Chris indicated that toxin analyses of additional cultures by both Advanced Analytical Australia labs in Sydney, and Cawthron Institute (New Zealand, Tim Harwood) is planned to confirm the preliminary findings.

Data from LSU-rDNA sequencing indicated that that 2 of the 8 cultures were almost identical to Group I toxic strains known for northern high latitudes of the northern atlantic and North Pacific. Shauna Murray at UTS carried out PCR analysis on DNA from mussels from Spring Bay samples which had been confirmed as toxic, and found results that were most similar to an *Alexandrium catenella/tamarense* Group IV. This raises the question as to whether 2012 east coast bloom populations consisted of both Group I and IV genotypes both with proportions and distribution varying in space and

time. Comparison of toxin data from cultures and shellfish also support this hypothesis. Further work is underway to confirm these findings.

Chris also mentioned the complexities we now face in identifying *Alexandrium* species. It is impossible to visually distinguish Group I toxic and Group V low toxicity genotypes, and difficult during routine monitoring to distinguish single cells of Group IV. *A. catenella* from either *A. tamarense* type. There are also similarities in fixed samples between other co-ocurring non-toxic species such as, *A. affine*, *A. ostenfeldii* and *A. margalefii* and *Gonyaulax hyalina.* Some of the discrepancies in cell counts and shellfish toxicity noted during early 2013 may be accounted for either by the presence of low toxicity Group V *A. tamarense* or mis-identification of other related non-toxic species.

Questions:
The question was raised about the temperature that Chris' samples were found at and if temperature could indicate potential toxicity. The temperature was 14.9°C. Temperature boundaries are a broad indication of suitable habitat at larger spatial scales but seasonal extension of cool coastal currents beyond the 15 °C isotherm may provide suitable habitat along lower latitude coastlines .

The point was raised that species can have both toxic and non-toxic strains and the presence/misidentification of other similar species can account for toxin profiles not matching. It is important to know what species are present. Australia is now a high-risk area and molecular detection needs to be part of future risk management. Some of the required work has been funded/supported over the last few years by the NSW Industry and other sources so developments are underway. Further testing and validation is required but we are at least not starting from scratch.

References

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