

Raising awareness of ciguatera poisoning in Australia: a survey of recreational fishers

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Abstract

In Australia, recreational fishers are repeatedly associated with ciguatera poisoning. Nevertheless, a myriad of misinformation and “old wives” tales circulate regarding the prevalence of ciguatoxin and how to detect ciguateric fish. As part of the ciguatera awareness campaign run by SafeFish (Australian Seafood Safety and Market Access Program), we conducted an online survey of Australian recreational fishers (recruited through social media and recreational fishing groups) to gauge current awareness levels of this risk and how best to improve them. Answered by 236 respondents, the survey revealed that in this group of voluntary respondents, 90% were aware of ciguatera. These individuals predominantly originated from the ciguatera endemic areas of Queensland and the Northern Territory, as well as New South Wales, which has only started recording ciguatera cases in 2016. Twenty-six percent of the individuals identified as having suffered from ciguatera previously, with 40% not having been diagnosed by a health care worker. In terms of the available information, respondents felt that key information on the fish species at risk of carrying ciguatoxins and ciguatera symptoms was lacking. Based on the survey feedback, a detailed ciguatera fact sheet was prepared and circulated through the identical social media channels used to promote the survey. Efforts to raise ciguatera awareness in Australia are ongoing, with a SafeFish facilitated survey of health care workers on the horizon.

Keywords: ciguatera poisoning, awareness, biotoxin, social media, management

<https://doi.org/10.5281/zenodo.7035010>



Introduction

Ciguatera poisoning accounts for the most frequent seafood safety related illness outbreaks in Australia, making up more than 50% of outbreaks (OzFoodNet data, 2001-2015). Traditionally, these cases have occurred in the tropical and subtropical regions of Australia in the Northern Territory and Queensland. However, since 2014, several cases linked to migratory Spanish Mackerel (*Scomberomorus commerson*) have been reported from further South along the east coast of Australia in New South Wales (Farrell *et al.*, 2017). This number of ciguatera cases is subject to significant underreporting by both health care workers and those affected. It is estimated that less than 20% of the cases are reported in Australia (Lehane and Lewis, 2000). Reasons for underreporting by health professionals include difficulty in reporting (time required to file reports, often remote locations), misdiagnosis (individual experience of health care workers, often complicated with ambiguous symptoms) and lack of awareness of reporting system/requirements. Ciguatera sufferers often do not consult their health care providers due to ambiguous symptoms, the lack of effective treatment options and/or distance to the nearest health care provider (can be hundreds of kilometers in remote Queensland and Northern Territory).

Given the prevalence of ciguatera poisoning in Australia and the potential severity of the illness, ciguatera has been identified as a high research priority by SafeFish, a collaborative program that assists the Australian seafood industry with food safety and market access issues. This led to a multidisciplinary ciguatera poisoning workshop that brought

together Australian regulators, commercial fishers, food authorities and researchers to discuss current knowledge and research directions.

The Australian ciguatera research strategy that was born from this meeting highlights the importance of raising ciguatera awareness amongst the population to improve reporting rates and approach closer to the true incidence of ciguatera in Australia (SafeFish, 2019). Health care workers and recreational fishers were identified as two key demographics at different levels in the reporting hierarchy where immediate improvements could be achieved. We here report the findings from an online ciguatera survey of Australian recreational fishers. The survey aimed to collect data on and raise the awareness of ciguatera poisoning amongst the recreational fishing community and guide the subsequent development of additional awareness materials.

Material and Methods

Survey design

The survey was prepared in an online format (SurveyMonkey) and structured into three different sections:

1. Demographic: state of origin, previous experiences with ciguatera and background awareness.
2. Information and awareness materials: level of satisfaction with existing information on ciguatera, trust in that information and areas for improvement.
3. Citizen science: preparedness of respondents to participate in citizen science-type projects and potential use



of a live ciguatera risk map where fishers can enter details of unlucky catches

Recruitment of participants

Participants were recruited predominantly through social media, focusing on Facebook fishing groups in the ciguatera endemic regions of the Northern Territory and Queensland, as well as New South Wales. Other means of recruitment included direct emails to recreational fishing clubs and Australian fishing associations, as well as distribution through SafeFish seafood industry networks.

Ethics

The survey was conducted under Human Research Ethics approval from the Tasmania Social Sciences Human Research Ethics Committee (23815) and the University of Adelaide (H-2020-234). The highest identifying level of data was state/territory of origin and data pooled across responses. Participants were informed of the intended use of the data upfront in a participant information sheet.

Results and Discussion

Demographic and background information

The survey was answered by 236 respondents, the majority of whom originated from Queensland, the Northern Territory, and New South Wales; the three Australian states where ciguatera is most often reported (OzfoodNet, 2001-2015). Of these respondents, 26% identified as having suffered from ciguatera poisoning before, with less than 64% having their diagnosis confirmed by a health care worker. Where these respondents that have suffered from ciguatera originated from within Australia is identified in figure 1. Poisoning reports from states that do not

border waters known to harbor ciguatoxic fish, such as Tasmania and Victoria, outline the risk that interstate tourist travel and fish trade might pose.

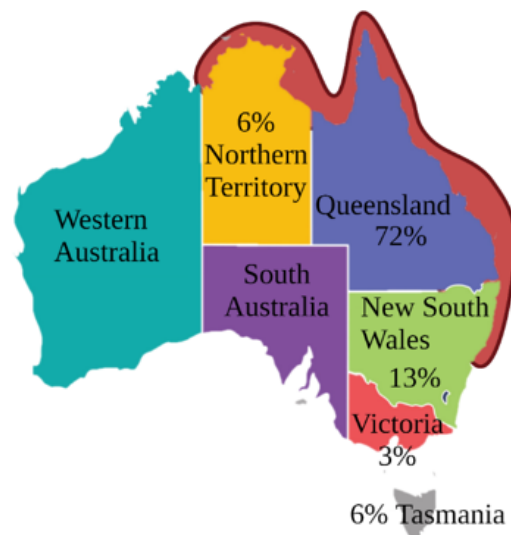


Fig. 1. Map of Australia showing the origin of survey respondents who identified as having suffered from ciguatera in the past (29 out of 236 respondents). The maroon shaded area indicates coastal waters known to harbor ciguatoxic fish.

A prime example is a Maori Wrasse caught in Queensland waters, that was consumed at a Victorian banquet, poisoning 30 diners (Ng and Gregory, 2000). The risk behaviour of the recreational fishers surveyed was dominated by ciguatera conscious individuals that would avoid certain species or sizes of fish (65% of respondents), and those that thought they would be very unlikely to get it (21%). This is comparable to a telephone survey conducted in the Virgin Islands ($n = 807$), where 62% believe certain fish are poisonous and 50% of respondents indicated avoidance of certain species (Radke *et al.*, 2013).

The majority (90%) of Australian respondents had heard of ciguatera poisoning before, suggesting high levels of awareness. A similar survey on the French Polynesian Island of Moorea indicated that 98% of locals were aware of ciguatera, compared to only 24% awareness among visitors to the island (Morin *et al.*, 2016). Given the high average incidence of ciguatera on Moorea Island (eight cases per 10,000 inhabitants), this high awareness level is not surprising. However, comparably high ciguatera awareness in Australia may be skewed by the survey design. There is no register/licensing requirement for recreational fishers in the Northern Territory or Queensland that would allow for random sampling of fishers. Instead, the survey required voluntary participation, which may have led to an inadvertent selection of individuals with a pre-existing interest in ciguatera. Nevertheless, the survey collected valuable information on currently available and desired awareness materials and raised awareness of ciguatera for members of Facebook fishing groups, irrespective of whether they answered the survey.

Ciguatera awareness materials

The majority of respondents (61%) indicated that currently available information on ciguatera does not meet their needs. When questioned about the quality of that information (availability, content, relevance, level of detail), 34% of the surveyed fishers felt neutral and 20% expressed dissatisfaction, particularly in regard to the level of detail of available information. When asked what data format they would find most engaging, respondents displayed strong interest in fact sheets, written articles and infographics (Fig. 2).

The type of information that recreational fishers were most strongly interested in included a list of fish species that are at risk of carrying ciguatoxins, what symptoms to look for and the available treatment options. Background knowledge of toxin uptake pathways, “survivor” stories and the latest scientific news attracted mild interest, while opportunities to be involved in citizen science type projects were lowest on the priority list. Reflecting current information technology trends, fishers are most likely (71% of respondents) to seek this information through the internet (fishing forums, fisheries, or State Health Department websites), followed by other fishermen, Facebook groups and fishing magazines.

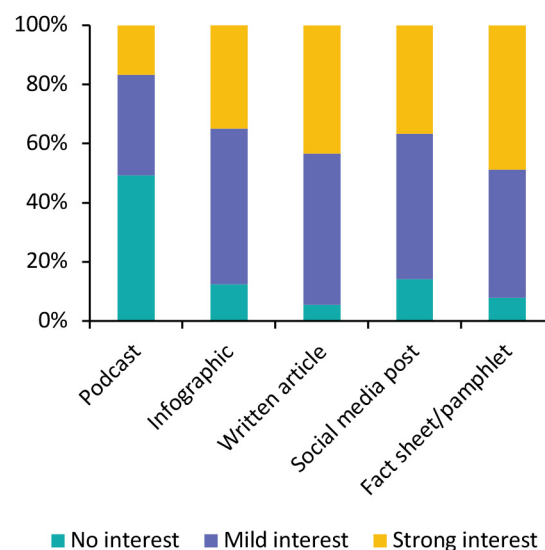


Fig. 2. Ciguatera awareness media format preferences of recreational fishers.

Citizen science

When asked to rate the idea of citizen science-type projects on a scale of 0 (least desirable) to 5 (most desirable), fishers were highly supportive (average rating of 4.1 out of 5). In fact, 30% of respondents had already

participated in citizen science type research. The experiences of these fishers were largely positive (98% had no negative experiences to report regarding the clarity of instructions or project purpose). Communication on past citizen science projects, especially around the outcomes, attracted a few more neutral responses (32% respondents), but experiences were overall positive (56% positive). The idea of an open access platform for recreational fishermen, where they can report the detail of ciguateric fish to warn other fishers of potential risk, was met with strong support (an average rating of 4.2 out of 5). According to the surveyed demographic, such a risk map would ideally be linked to existing navigation or fishing apps (70% of respondents), with 60% of respondents using state government fishing applications.

Conclusion

Raising awareness of ciguatera poisoning is a key step towards improving the reporting rate of individual cases. Our survey of recreational fishers proved to be a valuable tool in this quest, indicating the type, detail, and format of information that fishers felt they required. Based on the information provided in this survey, we developed and distributed a detailed ciguatera Frequently Asked Question (FAQ) fact sheet that is openly available from the SafeFish website SafeFish (2021). While the awareness and ciguatera incident data presented here should be interpreted with care due to the survey likely targeting individuals already interested in ciguatera, sharing the survey through social media in itself has raised awareness among non-respondents. The preparedness of the respondents to participate in citizen science type projects is encouraging and will offer opportunities for both scientists and fishers to benefit, such as a ciguatera risk

map or by providing samples for ciguatoxin analysis (e.g. Kohli *et al.*, 2017). Increasing awareness of ciguatera poisoning is a continuous process and through the SafeFish program we are currently moving to extend our work to a survey aimed at increasing ciguatera awareness among Australian health care workers.

Acknowledgements. This work was facilitated through the [SafeFish Seafood Safety and Market Access](#) partnership of the Australian Fisheries Research and Development Council and the Australian seafood industry through grant numbers 2018-004 and 2021-018. The authors would like to thank Dr. Clémence Gatti for helpful discussion and Dr. Stephen Pahl for reviewing the survey questions. Figure 1 was created using BioRender.com software.

References

- Farrell, H., Murray, S., Zammit, A., Edwards, A. (2017). *Toxins* 9, 367.
- Kohli, G.S., Haslauer, K., Sarowar, C., Kretzschmar, A.L., *et al.*, (2017). *Toxicol. Rep.* 4, 328-334.
- Lehane, L. and Lewis, R.J. (2000). *Int. J. Food Microbiol.* 61, 91-125.
- Morin, E., Gatti, C., Bambridge, T., Chinain, M. (2016). *Harmful Algae* 60, 1-10.
- Ng, S. and Gregory, J. (2000). *Commun. Diss. Intell.* 24, 344-346.



OzfoodNet. (2001-2015). Foodborne disease surveillance network. Australian Department of Health. www1.health.gov.au/internet/main/publishing.nsf/Content/cdna-ozfoodnet.htm. Accessed 10/11/2021.

Radke, E.G., Grattan, L.M., Cook, R.L., Smith, T.B., *et al.*, (2013). Am. J. Trop. Med. Hyg. 88, 908-913.

SafeFish (2019). National ciguatera research strategy: reducing the incidence of ciguatera in Australia through improved risk management. In: Seger, A., Dowsett, N., Turnbull, A. www.safefish.com.au/reports/technical-reports/ciguatera-research-strategy. Accessed 10/11/2021.

SafeFish (2021). Ciguatera (fish) poisoning in Australia - Frequently asked questions. www.safefish.com.au/reports/food-safety-fact-sheets/ciguatera-fish-poisoning-faq. Accessed: 10/11/2021.

