CICCM: new acquisitions and new descriptions of historical cultures

Lesley Rhodes*, Kirsty Smith, Tomohiro Nishimura, Sarah Challenger, Krystyna Ponikla, Juliette Butler, Lucy Thompson, Jacqui Stuart

Cawthron Institute, 98 Halifax Street East, Private Bag 2, Nelson, 7010, Nelson, New Zealand.

**corresponding author's email:* lesley.rhodes@cawthron.org.nz

Abstract

The Cawthron Institute Culture Collection of Micro-algae (CICCM) in New Zealand includes more than 600 unique marine and freshwater microalgae and cyanobacteria isolates from tropical, temperate, and polar regions. Half of the collection is cryopreserved, and the other half is regularly sub-cultured. Live cultures, DNA extracts and chemical compounds may be purchased for research purposes, and all have a full description and toxin profile accompanying them (see www.cultures.cawthron.on-line). To date, isolates have enabled the description of new species, the preparation of biotoxin standards to underpin chemical tests, and the carrying out of toxicity studies amongst other research endeavours. For example, extracts of mass cultures of *Alexandrium pacificum* have been supplied to pharmaceutical companies for the preparation of paralytic shellfish toxin standards. Additions to the CICCM since 2019 include 10 dinoflagellate species, 14 diatom species and 11 cyanobacteria species. New descriptions of historic cultures in the collection include *Pavlomulina ranunculiformis* from the newly erected haptophyte class, Rappephyceae.

Keywords: CICCM, Cawthron Institute Culture Collection of Micro-algae, dinoflagellates, haptophytes, cyanobacteria

https://doi.org/10.5281/zenodo.7035104

Introduction

The CICCM includes more than 600 unique marine and freshwater microalgae and cyanobacteria isolates from tropical, temperate, and polar regions. There is a focus on the Pacific region, where increasing sea temperatures are expected to impact microalgal bloom species which will in turn affect marine life, including corals and, in the case of toxic blooms, human health. Live cultures, DNA extracts or chemical compounds may be purchased for research purposes (Fig. 1). Complete strain information is available, including toxin profiles (see www.cultures.cawthron.org.nz). Half the collection comprises cryopreserved cyanobacteria; given they require thawing and on-growing before being dispatched, they may take longer to reach their destination than sub-cultured isolates.

To date, isolates have enabled the description of new species, the preparation of biotoxin standards, the carrying out of toxicity studies and the development of molecular tools. For example, extracts of mass cultures of *Alexandrium pacificum* have been supplied to pharmaceutical companies for the preparation of paralytic shellfish toxin standards. These are essential when toxin tests are carried out to ensure seafood is safe for consumers.

Isolates are also needed to underpin development of molecular detection and quantification assays. To this end, species within the diatom genus *Pseudo-nitzschia*, including four new species records for New Zealand (Nishimura *et al*., 2021), have enabled the development of new molecular monitoring tools for these domoic acid producing diatoms. The assays will refine and increase the speed of risk alerts of potential amnesic shellfish poisoning for shellfish aquaculture managers.

Additions to the CICCM since 2019 include 45 dinoflagellate isolates (10 species), 32 diatom isolates (14 species), 49 cyanobacteria isolates (11 species), and one chlorophyte.

Dinoflagellates

Additions to the CICCM in the last two years include marine species in the genera *Akashiwo, Azadinium, Biecheleria, Bysmatrum, Coolia, Fukuyoa, Gambierdiscus, Ostreopsis, Prorocentrum* and *Vulcanodinium.*

Nine species of *Gambierdiscus* (28 isolates) are maintained and are being investigated for ciguatera-related compounds (Murray *et al*., 2021). Strains of *G. cheloniae* (Smith *et al*., 2016a) from the Cook Islands and *G. honu* from Rangitāhua/Kermadec Islands (Rhodes *et al*., 2017) provided the data that underpinned these two descriptions.

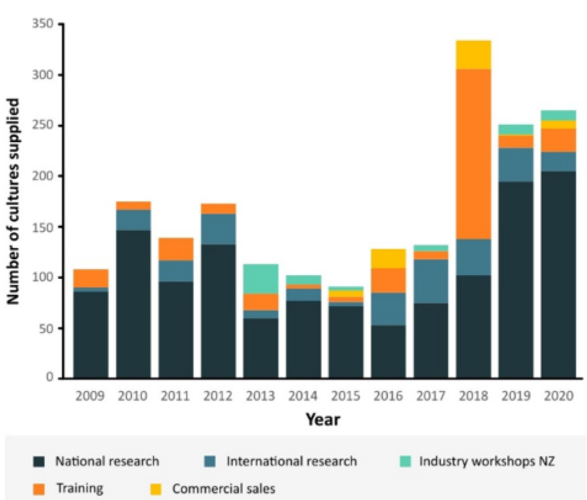
Twenty-eight strains of *A. pacificum* are held in the CICCM due to the value of the biotoxins produced. Extracts from mass cultures produced by Cawthron's Natural Compounds group are supplied to pharmaceutical companies for purification for paralytic shellfish toxin standards.

Azaspiracids have been shown to occur, albeit at low concentrations, in some New Zealand shellfish. Isolates of *Azadinium* and *Amphidoma* have helped with the development of molecular identification assays to aid in the determination of the producer of these toxins in New Zealand (Smith *et al*., 2016b; Balci *et al*., 2021).

Haptophyta

A haptophyte isolated in 1998 from Tapeka (Northland, New Zealand) was tentatively named *Pavlomulina* ‘kotuku’ and was deposited in the CICCM as CAWP21 (Fig. 2). It is now officially named *P. ranunculiformis* Sym, Pienaar & Kawachi (Kawachi *et al.*, 2021) and belongs to the new haptophyte class Rappephyceae (a sister class to Prymnesiophyceae). The species may be mixotrophic as cells have been observed attaching to oyster larvae and becoming engorged, possibly as they feed (Fig. 2; Rhodes *et al.*, 2011).

The detailed characterisation of *Pavlomulina* has allowed for a reconstruction of the ancient evolutionary history of the Haptophyta, one of the most important components of extant marine phytoplankton communities. Thus, the acquisition of novel strains to the collection has facilitated the fundamental science of protistan taxonomy for the benefit of the research community.



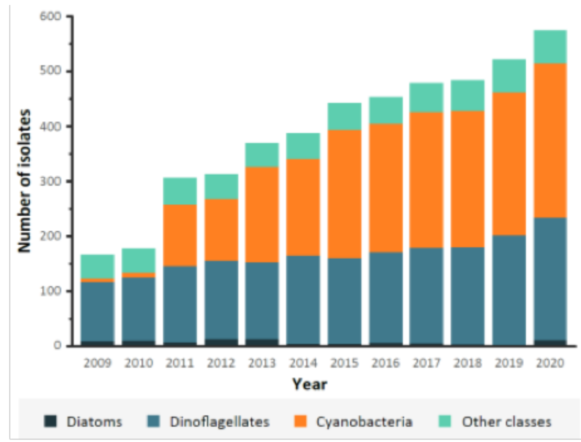


Fig. 1. Cawthron Institute Culture Collection of Micro-algae 2009-2020: Top: cultures supplied to end-users; Bottom: number of isolates of major groups of microalgae available.

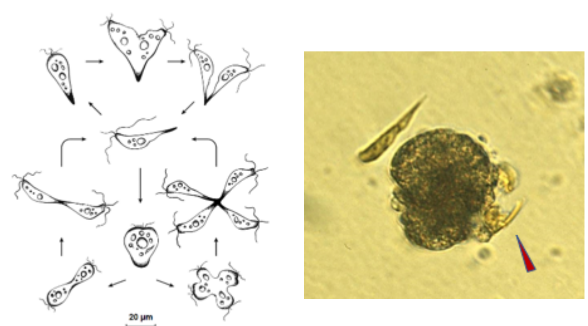


Fig. 2. *Pavlomulina ranunculiformis*. Left: details of life cycle (from Othman Bojo’s unpublished PhD thesis, 2002, UoOtago, NZ); Right: Cell of *P. ranunculiformis* (CAWP21) attached to a Pacific oyster larva (arrow highlights microalgal cell).

Conclusion

In New Zealand, development of freshwater regulations has in part been supported by research into the cyanobacteria collection and the determination of toxin concentrations for different species. The growing tropical collection has proved a resource for novel compound discovery, as well as a baseline for tracking climate change impacts in New Zealand (Rhodes *et al*., 2020).

In conclusion, the CICCM continues to underpin research globally (Fig. 3). The collection continues to grow and support global research, predominantly with new additions from New Zealand's freshwater and marine coastal waters and from the wider Pacific region. Many more cyanobacteria isolates are being investigated for impacts on the environment and on human health and selected strains will be cryopreserved and curated within the CICCM.

Fig. 3. Global distribution of cultures from the CICCM, both purchased as DNA or chemical extracts or provided live for collaborative research programmes. Blue circles: Key collaborators; Red circles: developing contacts.

Acknowledgements. The CICCM is supported by the NZ Ministry of Business, Innovation and Employment, contract: CAWX0902.

References

Balci, M., Rhodes, L.L., Nishimura, T., Murray, J.S., *et al*., (2021). N. Z. J. Mar. Freshw. Res. 1-16.

Kawachi, M., Nakayama, T., Kayama, M., Nomura, M., *et al*., (2021). Curr. Biol. 31, 2395-2403.

Murray, J.S., Finch, S.C., Rhodes, L.L., Puddick, J., *et al*., (2021). Toxins 13, 333.

Nishimura, T., Murray, J.S., Boundy, M.J., Balci, M., *et al*., (2021). Toxins 13, 637.

Rhodes *et al*. 2011. Phylum Haptophyte. In: Gordon (Ed.), New Zealand Inventory of Biodiversity 3, 312-321.

Rhodes, L., Smith, K.F., Verma, A., Curley, B.G., *et al*., (2017). Harmful Algae 65, 61-70.

Rhodes, L.L., Smith, K.F., Murray, J.S., Nishimura, T., Finch, S.C. (2020). Toxins 12, 50.

Smith, K.F., Rhodes, L., Harwood, D.T., Adamson, J., *et al*., (2016b). J. Appl. Phycol. 28, 1125-1132.

Smith, K.F., Rhodes, L., Verma, A., Curley, B.G., *et al*., (2016a). Harmful Algae 60, 45-56.