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NEWSLETTER

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Slugs in Paradise: the Lord Howe Island Sea Slug Census

Steve Smith and Matt Nimbs, National Marine Science Centre, Southern Cross University.
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With humble beginnings at Nelson Bay, NSW in December 2013, the Sea Slug Census (SSC) program has now expanded to a total of 8 locations along Australia's east coast. The program engages with volunteers to document the diversity of heterobranch sea slugs in intertidal and subtidal habitats over a 24-48 hr time period within a nominated geographical area. Participants are simply asked to photograph any species they encounter over the survey period and submit these to the program organisers who collate the data. The census is run as a 'social franchise' with a local group liaising with the science team to deliver the program with a view to ensuring consistent methodology which is applied in a locally relevant context. These events not only deliver comprehensive data on sea slug diversity over the census, but also encourage ongoing image sharing to progressively build regional inventories.

In February 2018, in collaboration with Ian Hutton and Caitlin Woods from the Lord Howe Island Museum, and Sallyann Gudge from the LHI Marine Park, we conducted the inaugural Lord Howe Island Sea Slug Census.

(continued on page 4)

Figure 1 – Aerial drone image of eager Sea Slug Census participants searching the rock pools at sunrise; Middle Beach, Lord Howe Island. Photo: John Turnbull

The MSA's sister society is The Society for the Study of Molluscan Diversity (SSMD). Further information about SSMD can be found at: http://marine1.bio.sci.toho-u.ac.jp/md/index-e.html

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Victorian branch

Secretary: Michael Lyons, 19 Banksia Street, Blackburn, VIC 3130. Phone (03) 9894 1526 or Email: Michael_lyons1@bigpond.com

Meetings are held at the Melbourne Camera Club, corner of Dorcas and Ferrars Streets, South Melbourne, on the third Monday of the month. No meeting in January, March, May, July, September or December.

Membership fees 2018

Includes *Molluscan Research* (published four times per year), the MSA Newsletter (electronic-only publication since Number 158), and discounted registration at the MSA *Molluscs 2018* conference.

Ordinary members (worldwide)	$AU 70
Institutional membership	$AU 100
Student member/concession	$AU 45

Membership fees can be paid (preferably) via the Society's website. Otherwise, send subscriptions via mail to: Malacological Society of Australasia, c/o Matt Nimbs, National Marine Science Centre, PO Box 4321, Coffs Harbour, NSW, Australia, 2450.

Newsletter

Editor: Platon Vafiadis.
Email: newsletter@malsocaus.org
The deadline for articles for the next issue of the Newsletter is Friday 26 October, 2018.

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Note: This publication is not deemed to be valid for taxonomic purposes — see article 8.2 in the International Code of Zoological Nomenclature, 4th Edition. Also, opinions expressed within articles in this newsletter belong to the author(s) and are neither necessarily shared nor endorsed by the MSA.

Australaria australasia (estimated length about 80 mm) feeding on *Lunella undulata*, intertidal zone, McHaffies Reef, Phillip Island, Victoria, 20 April, 2018. Image: P. Vafiadis.

Predatory behaviour of the temperate Australian fasciolarid snail *Australaria australasia*

A recent sighting of *Australaria australasia* attached aperture-to-aperture to the turbinid *Lunella undulata* (a scenario I have observed several times between these species) made me wonder how *A. australasia* actually eats the turbinid. Would not the latter (with its thick, calcareous operculum) be safe once retracted into its shell? Does the fasciolarid bore? However, boring through the heavy operculum would be impossible, and beach-collected *L. undulata* shells do not have holes. Given that the *A. australasia* covers the aperture of its prey, a hypothesis is that it asphyxiates it and continues to apply negative pressure until the columellar muscle of its victim relaxes—and then it can eat. Examples of smothering behaviour in other snails are provided in the reference below.

Additional reading: Vafiadis P (2010). Asphyxiation as a function of the molluscan foot. *Victorian Branch Bulletin of the Malacological Society of Australasia* 255 (Aug-Sept): 5-6.

P. Vafiadis

Molluscs 2018
Upcoming MSA triennial conference at Wellington, New Zealand, 2 - 5 December, 2018

Nicole E. Phillips, Victoria University of Wellington, Wellington, New Zealand
(on behalf of the Organising Committee)

Wellington has been called the coolest little capital in the world, and we are proud to be hosting Molluscs 2018! There is much to enjoy about Wellington and the region while you are here for the conference. It is a compact, vibrant, safe and fun city with easy access to New Zealand's awe-inspiring natural beauty.

The conference venue at our modern national museum, Museum of New Zealand Te Papa Tongarewa, is right on the scenic Wellington Harbour and only minutes from Cuba Street and Courtney Place precincts which are jam-packed with trendy shops, cafes, bars, and restaurants featuring cuisines from around the world as well as a thriving craft brewery scene. Just 10 minutes from the CBD, Zealandia is a must-see eco-attraction and ground-breaking restoration project. Wellington is also home to Otari-Wilton's Bush and the Botanical Gardens, all of which can be explored by scenic forested walking tracks.

View of Wellington from Mt Victoria.
Mt Victoria is one of the best places to get a panoramic, 360-degree view of the city and harbour.
Image: Wellington Resource Hub,
https://resources.wellingtonnz.com/collections/images?page=1

Museum of New Zealand Te Papa Tongarewa is New Zealand's bold and innovative national museum and a recognised world leader in interactive and visitor-focused museum experiences.
Image: Wellington Resource Hub,
https://resources.wellingtonnz.com/collections/images?page=1

Kaka at Zealandia. The kaka is a native New Zealand parrot, and can be seen at Zealandia eco-sanctuary.
Image: Wellington Resource Hub,
https://resources.wellingtonnz.com/collections/images?page=1

A bit further afield, but worth the effort to get there, is the stunning Wellington South Coast on the Cook Strait. The South Coast is home to the Victoria University Coastal Ecology Laboratory (VUCEL), a research facility supporting research excellence in coastal ecology in the School of Biological Sciences. The South Coast also has the Red Rocks fur seal colony and the Taputeranga Marine Reserve, which can be explored by foot on the beaches or rocky shore, or underwater on the snorkel/SCUBA trail.

We look forward to seeing you in what promises to be an engaging and enjoyable conference.

Please also see page 4, which overviews New Zealand's exceptional molluscan fauna, and the conference 'flyer' on the back cover of this newsletter.

For full conference details, including scientific program and registration process, please visit the MSA website at http://www.malsocaus.org

A brief overview of New Zealand's molluscan fauna

Hamish Spencer, University of Otago, Dunedin, New Zealand Email: h.spencer@otago.ac.nz

The New Zealand molluscan fauna exhibits an astounding degree of endemism. Some 85% of the known species are exclusive to the Exclusive Economic Zone (EEZ) one of the largest in the world at >4 million km², which stretches from the Kermadec Islands in the north to Campbell Island in the south. Endemism is especially high among the terrestrial gastropods: <0.5% of the native species occur naturally beyond New Zealand. This last group is of global significance, with a remarkable number of species in some families (e.g. Charopidae, Punctidae) and the complete absence of many other families. About 8.5% of the world's chiton species are found in the New Zealand EEZ.

Certain taxa are outstanding from a biological and ecological perspective. Two species of large chitons stand out - *Cryptoconchus porosus* for its wholly internal shell plates, a character displayed by only one other chiton species in the world, and *Pseudotonicia cuneata* for its life permanently within soft sediments. The nudibranch *Jason mirabilis* has an extremely large body size for an aeolid, yet its radula is so microscopic as to be nearly vestigial. The tiny, white, maggot-like slugs of the genus *Smeagol* live deeply buried in gravel above high-water mark. In unpolluted North Island streams, live members of the endemic family Latiidae - pulmonate snails with a limpet-like shell and the unique ability to produce luminous mucous—are found. *Amphibola crenata*, one of the very few pulmonate snails with an operculum, is common in estuaries. But the most spectacular of all New Zealand's endemic molluscs must be the giant carnivorous land snails of the genus *Powelliphanta*, reaching 90 mm in diameter and living in montane forests. Two bivalve species, the mussel *Perna canaliculus* and the oyster *Ostrea chilensis*, are much esteemed by gastronomes worldwide.

The fossil record of New Zealand's mollusca is also notable. New Zealand has by far the best on-land representation of marine Cenozoic rocks in the Southern Hemisphere and, as a consequence, also has a good record of marine Mollusca for most of the last 65 million years. Cenozoic molluscs are often conspicuous and well-preserved and were among the first fossils to be collected from New Zealand. Because New Zealand has a very good fossil record, particularly in the Pliocene and Pleistocene, it is possible to document many of the most important changes in the marine fauna in some detail. Recent work has begun to link fossil and genetic approaches to problems in molluscan evolution.

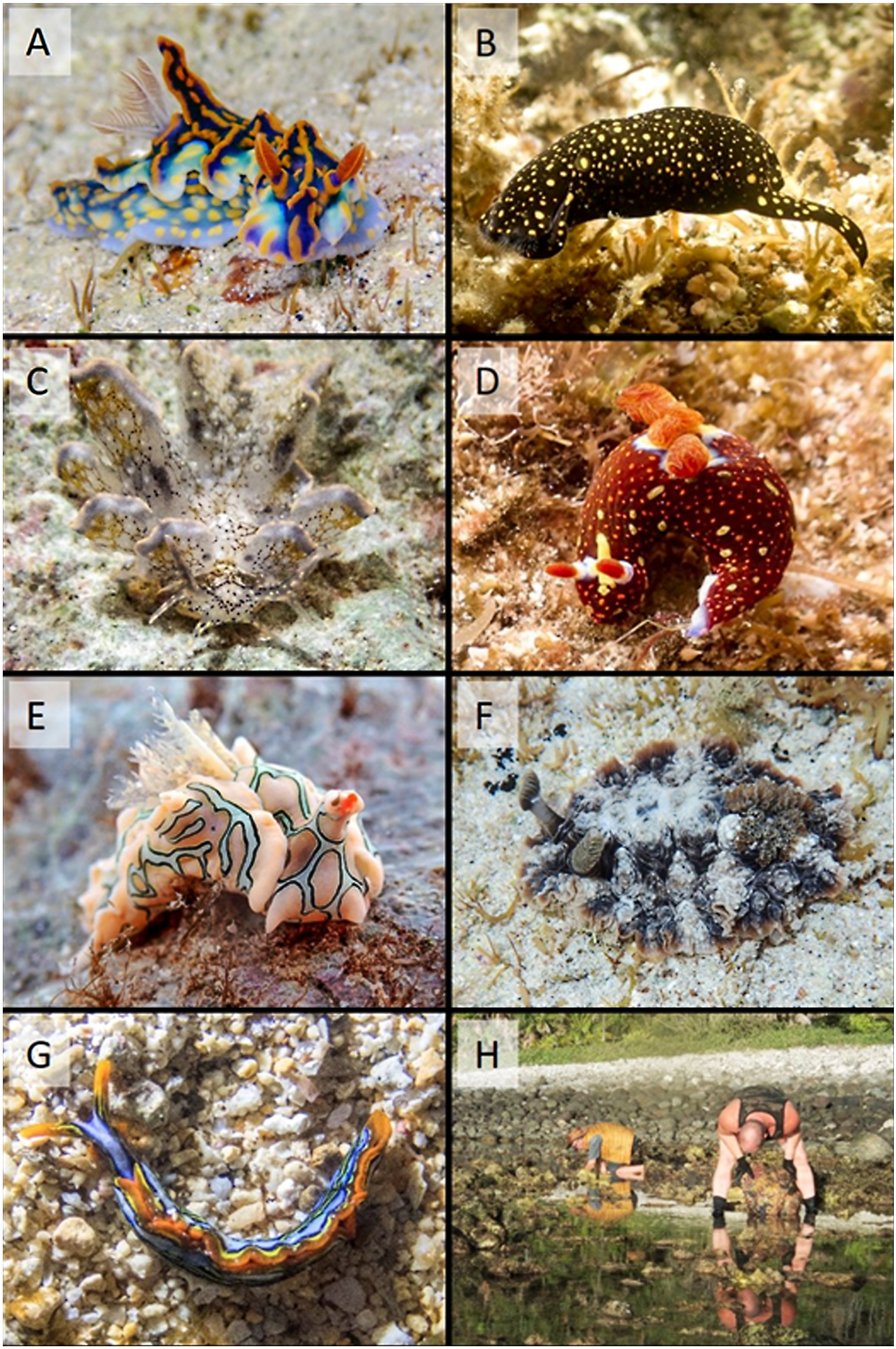
Slugs in Paradise: the Lord Howe Island Sea Slug Census (continued from page 1):

Participation rates were boosted by the presence of a group of divers who regularly participate in sea slug census events at other locations (including the local coordinators for the Nelson Bay events – Tom and Nicola Davis). Over 30 people took part in the event , recording 76 species over the weekend. As has been a feature of the majority of sea slug census events to date, the list of species included many that had not previously been officially recorded from the survey area. At Lord Howe Island, the new records included an undescribed species of the sea hare genus *Petalifera*, which is now being described as part of a PhD focusing on the Australian Aplysiidae (by Matt).

The sea slug census program is continuing to expand, with 2 additional locations in 2018 (Lord Howe Island and Melbourne, Vic) and proposals for events in a number of other locations in 2019, including Coffs Harbour, NSW. The scientific importance of the data is undeniable, and many of the observations have contributed to recent publications in the scientific literature. The success of the program is probably related to a number of key ingredients including: the passion among divers and rock-pool ramblers for sea slugs (especially nudibranchs); the educational component that is factored into every event (with a comprehensive species guide forming the primary report, distributed to all participants, for each census); the knowledge that all information collected is being used for scientific purposes; and the frisson of competition associated with being declared the best spotter for the event.

Lord Howe Island not only supports a diverse sea slug fauna but is home to dramatic scenery (Figure 1 on cover page). Some of the more interesting slugs are shown in Figure 2.

Figure 2 (opposite): From the Lord Howe Island Sea Slug Census, Feb. 2018. (A) *Miamira magnifica* Eliot, 1910; (B) *Mariaglaja tsurugensis* (Baba & Abe, 1959); (C) *Cyerce* sp.; (D) *Nembrotha livingstonei* Allan, 1933; (E) *Sagaminopteron psychedelicum* Carlson & Hoff, 1974; (F) *Dendrodoris tuberculosa* (Quoy & Gaimard, 1832); (G) *Thuridilla splendens* (Baba, 1949); (H) Ian Hutton and Matt Nimbs in the field. Images: A, C, E, F–H by Steve Smith; B, D by Matt Nimbs.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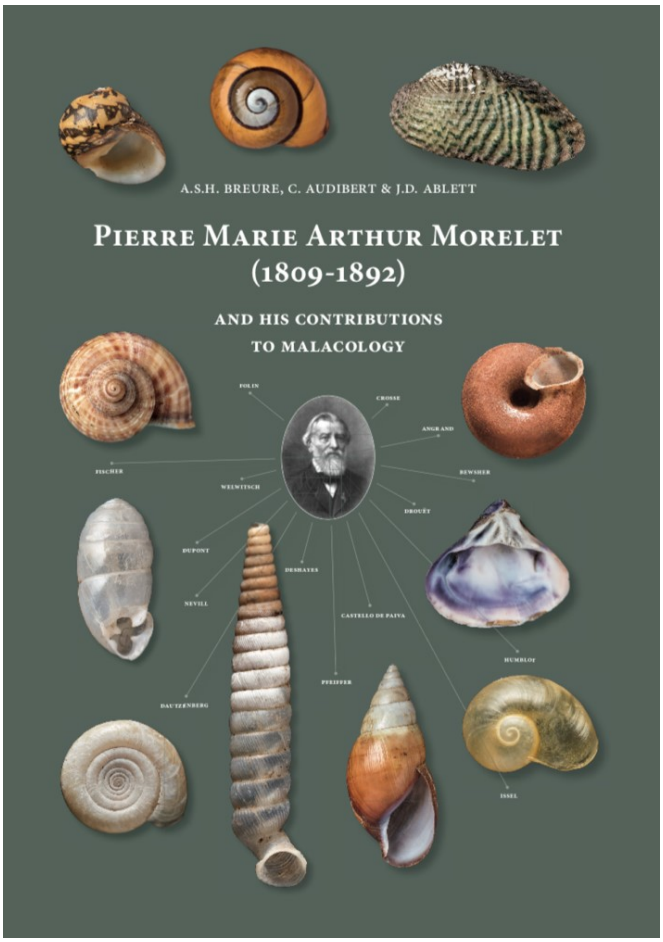
New release: a monograph on the malacologist Pierre Marie Arthur Morelet

Sylvia van Leeuwen, Secretary of the Netherlands Malacological Society.
Email: NMV-secretaris@spirula.nl



Those who are working with non-marine molluscs may have encountered the name of Morelet. He introduced more than 700 species names in, currently, 84 different families of land and freshwater molluscs. Who was Arthur Morelet and what has become of his huge collection?

Pierre Marie Arthur Morelet (1809-1892) was an amateur scientist who devoted himself to both shell collecting and botany. He organised several expeditions, of which those to Cuba and Central America (1846-1848) and the Azores (1857) are especially noteworthy. His contributions to malacology were thus significant and we have reconstructed his legacy with a survey of archival sources and his type material in the historical collections of several museums.

The resulting monograph is made up of two parts.

In the first part, we present a biography, some remarks on the whereabouts of his collection, and more than 200 recovered letters (transcribed and translated) to contemporary malacologists, such as Crosse, Fischer, Baudon and Dautzenberg. His contact network has been reconstructed using data from his correspondence and his publications. This part offers a unique view into the world of malacology in the second half of the 19th century.

In the second part, a bibliography of Morelet is presented, as well as all his newly introduced taxa, with detailed documentation and figures of the species. More than 80 per cent of his type material has been re-found and original figures, if they exist, have been reproduced for the remaining species. Of the taxa represented by actual shell material, more than 150 are now figured for the first time. The book has indices for both taxonomy and persons mentioned and is a must-have for anyone interested in the history of malacology and those dealing with non-marine molluscs.

The book, which has 544 pages and more than 1300 figures, was published on 23 June 2018. Thanks to financial support from Association Cernuelle (France), the Royal Belgian Institute of Natural Sciences (Belgium), the Natural History Museum (United Kingdom), and the Netherlands Malacological Society (Netherlands), the electronic version of the book is freely available at www.spirula.nl/andere-uitgaven/moreletEN.

A printing-on-demand hard cover version of the book can be ordered at www.boekenbestellen.nl (search for title or ISBN) for €67.50 (net price, excluding postage).

It can be referenced as:

Breure, A.S.H., Audibert, C. & Ablett, J.D., 2018. *Pierre Marie Arthur Morelet (1809-1892) and his contributions to Malacology.* Netherlands Malacological Society, Leiden, 544 pp.
ISBN 978-90-815230-2-8 (PDF) / 978-90-815230-0-4 (p.o.d.)

In-vitro and in-vivo anti-inflammatory activity of extracts from a marine mollusc (PhD Thesis summary)

Tarek Belksam Ahmad, Southern Cross University.

(Thesis supervised by Kirsten Benkendorff and Ben Liu, Southern Cross University, in collaboration with Mike Kotiw, University of Southern Queensland)

Inflammation is implicated in almost all animal and human diseases. The available treatments for inflammation include steroidal and non-steroidal anti-inflammatory drugs (NSAIDs), which have many common and sometimes severe side effects. Hence, new anti-inflammatory agents with different structures and/or mode of action are needed. In the last few decades, the search for new biologically active compounds has focused on marine natural products. This focus is driven by the diversity of marine organisms and their production of secondary metabolites with an extensive array of bioactivity. Molluscs, in particular, are well-known for the production of valuable secondary metabolites and have been used in the traditional medicine systems of many cultures to treat inflammatory conditions. A review of the literature in ethnomedicine indicates that there are in excess of 100 different anti-inflammatory preparations described, including 70 preparations from the well-documented traditional Chinese medicine (Ahmad et al, 2017a). Despite this extensive traditional use, only a few studies have investigated the anti-inflammatory activity of marine mollusc extracts in scientifically rigorous in-vitro and in-vivo experiments.

The main aim of this project was to assess the in-vitro and in-vivo anti-inflammatory activity of extracts and associated indole compounds from the marine muricid snail *Dicathais orbita*. The extracts were tested for their ability to inhibit the production of the recognised pro-inflammatory modulator nitric oxide (NO) and cytokines, such as tumour necrosis factor alpha (TNFα) and prostaglandin E2 (PGE2) (Ahmad et al, 2016). Bioassay guided fractionation of the organic extracts was used to help identify the active compounds, along with liquid chromatography-mass spectrometry. In parallel, synthetic indole compounds were tested to compare the relationship between the activity and the chemical structure. Results of this study indicated that chloroform extracts from *D. orbita* hypobranchial glands exhibited promising anti-inflammatory activity as detected by inhibition of NO and TNFα in RAW264.7 macrophages, as well as PGE2 in 3T3 fibroblasts. The chloroform extract of the mollusc egg capsules showed similar activity along with some semi-purified fractions containing brominated indoles. Purified tyrindoleninone and tyriverdin, as well as synthetic 6-bromoisatin, 5-bromoisatin, 6-bromoindole and isatin all inhibited the production of NO in lipopolysaccharide (LPS) - stimulated RAW 264.7 macrophages. A hypobranchial gland extract, 6-bromoindole and 6-bromoisatin significantly downregulated the production of PGE2 in 3T3 fibroblasts ($p < 0.0001$) and blocked the translocation of the inflammatory nuclear transcription factor kappa B (NFκB) into the nucleus of LPS-stimulated RAW 264.7 macrophages ($p<0.0001$), as demonstrated by confocal microscopy. The structure-activity relationship experiments revealed that the brominated indoles were more active than non-brominated indoles and that the position of the bromine atom on the indole ring affects the activity with C5 > C6 > C7. Simple indoles were more active than dimers and may reflect the fact that dimer molecules were significantly less soluble than monomers. These outcomes suggest that simple brominated indoles may be a valuable source of anti-

Above: The author on the rocky coastline with the focus of his study, the muricid snail *Dicathais orbita*. (Images from Tarek Belksam Ahmad).

inflammatory drug leads and support the further development of extracts from the Australian muricid *D. orbita*, as a new potential medicine for the treatment of inflammation.

The active hypobranchial gland (HBG) extract and 6-bromiosatin were further tested for their anti-inflammatory activity in-vivo using a murine LPS-induced acute lung inflammation model in C57 Black/6 mice (Ahmad et al. 2017b). Mice were pre-treated orally with three doses of HBG extract or 6-bromoisatin using oral gavage prior to stimulation with LPS intranasally. The chloroform extract of the HBG along with 6-bromoisatin demonstrated significant anti-inflammatory activity ($p<0.0001$) in-vivo, preventing the development of LPS-stimulated acute lung inflammation in mice. The anti-inflammatory activity was confirmed by the inhibition of alveolar neutrophil infiltration, reduction of TNFα, interleukin-1β (1IL-1β) and protein levels in bronchioalveolar lavage, as well as the preservation of the lung tissue morphology. These results confirm the in-vitro anti-inflammatory activity of the HBG extract from *D. orbita* and the abundant brominated compound in this extract, 6-bromoisatin, in an in-vivo model and provide more support for their potential for development as natural therapeutic agents for inflammation.

Finally, lipid extracts from the foot tissue and viscera of *D. orbita* were characterised and tested for anti-inflammatory activity using in-vitro assays. The fatty acid profile of these lipid extracts was compared to lipid extracts derived from common seafoods including salmon, sardine, school prawn, octopus and squid using gas chromatography fatty acids methyl esters analysis. The anti-inflammatory activity was tested in-vitro by investigating the ability of the lipid extracts to inhibit the production of NO and down-regulate the levels of TNFα in LPS-stimulated RAW 264.7 macrophages. These results are withheld prior to publication.

Overall, this work represents the first study assessing the in-vitro and in-vivo anti-inflammatory activity of extracts from the muricid marine mollusc *D. orbita*. Further testing of the biologically active extracts and the simple brominated indoles to characterise their modes of action could lead to promising outcomes. The data from this study demonstrated that the Australian muricid *D. orbita* is a source of naturally occurring anti-inflammatory agents that have potential for further development as pharmaceuticals and nutraceuticals.

Thesis publications:

Ahmad TB, Rudd D, Smith J, Kotiw M, Mouatt P, Seymour L, Liu L, Benkendorff K. (2017a). Anti-inflammatory activity and structure-activity relationships of brominated indoles from a marine mollusc. *Marine Drugs* 15 (5), 133-152. doi:10.3390/md15050133

Ahmad TB, Rudd D, Benkendorff K, Mahdi LK, Pratt KA, Dooley L, Wei C, Kotiw M. (2017b). Brominated indoles from a marine mollusc inhibit inflammation in a murine model of acute lung injury. *PLoS One* 12(10) e0186904 https://doi. org/10.1371/journal.pone.0186904

Ahmad TB, Liu L, Kotiw M, Benkendorff K. (2018). Review of anti-inflammatory, immune-modulatory and wound healing properties of molluscs. *Journal of Ethnopharmacology* 210: 156–178.

Can whelks contribute to food security and human health? (PhD Thesis summary)

Bijayalakshmi Devi Nongmaithem, Marine Ecology Research Centre, Southern Cross University

(Principal supervisor: Kirsten Benkendorff; co-supervisor: Caroline Sullivan)

Food security is a fundamentally important challenge faced by society. The Food and Agriculture Organisation (FAO) indicate that, along with minimization of food waste, the incorporation of under-utilized functional foods will be increasingly important in the future. This inter-disciplinary research project investigates the extent to which marine whelks in Australia and India can be more effectively utilized to help contribute towards food security. Whelks are predatory marine molluscs that are considered under-utilised in many countries, including Australia. Furthermore, it is unknown whether whelk resources are discarded as waste in the shell industry in countries like India where they are harvested for their beautiful ornamental shells. Whelks also have the potential to be developed as a functional food because they are used in traditional medicines and contain biomedically important compounds having anti-cancer, anti-

The author (left) with Dr. Kirsten Benkendorff, and, far right, *Dicathais orbita* and operculae. (Images from Bijayalakshmi Devi Nongmaithem)

microbial, anti-inflammatory and muscle relaxing properties. The broad aim of this thesis was to assess the potential for value adding the whelk resources in Australia and India.

The first objective was to assess the current use of muricid resources that are by-products of the shell fisheries in India. A survey was conducted of 115 respondents from the shell fisheries industry on the southeast coast of India. It revealed that locally harvested whelks are utilised for ornamental shells and shell craft, opercula for fragrances, poultry feed, and lime production. The whelk meat is eaten in the fishing villages. However, whelk meat collected from large fisheries operations in other regions along the 5422 km of the east and west coasts of India is rotten by the time it reaches the shell processing factories on the southeast coast. The meat of the large species *Chicoreus ramosus* was found to be high in protein and micronutrients. The workers in the shell fishing villages were found to be in the lowest socioeconomic class in India and would benefit from new strategic opportunities. The nutritionally rich meat currently wasted from the shell industry could be better utilised with an organized cold chain marketing structure.

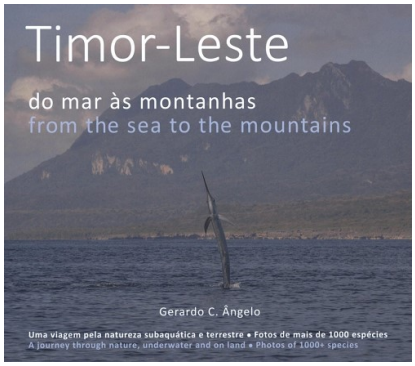
The second objective was to undertake industry and government surveys to assess the potential for creating a Muricidae industry in Australia by diversifying the species cultured on existing molluscan aquaculture farms. A survey was carried out on a representative selection of oyster and abalone aquaculture farms in Australia. The majority of the industry respondents (10/12) were ready to diversify into polyculture with whelks on their current farms. The main impediments to whelk production identified by the Australian mollusc industry respondents were marketing and lack of consumer awareness. To identify any unanticipated impediments to the establishment of a whelk aquaculture industry from a governance perspective, key informant interviews with government representatives from all seven coastal states of Australia were also conducted. Introduction of any new species for aquaculture in Australia has to comply with detailed regulations to safeguard and ensure environmental sustainability.

The third objective was to investigate the effect of cooking on the nutritional content and bioactive secondary metabolites in the flesh of the Australian muricid *Dicathais orbita* (Nongmaithem, et al. 2018. *Food Chemistry* 266: 38-46 doi :10.1016/ j.foodchem. 2018.05.102). This study provides evidence that whelk flesh is high in protein (>75 mg/100 mg dry weight). There was a significant percent increase in protein (3.4 %) and amino acids (53.73 %) after cooking, associated with a loss of moisture and lipids. The flesh also has a high proportion of polyunsaturated fatty acids (PUFAs) (>49 %) with high levels (over 1000 mg/100 g serve) of docosahexaenoic acid and eicosapentaenoic acid. The uncommon omega 3 fatty acid docosapentaenoic acid was dominant in the flesh comprising 16-18 % of all fatty acids. Cooking has no negative impact on the levels of PUFAs. The main anticancer compound produced by the whelks "6-bromoisatin" can be retained after cooking. This study helps demonstrate that the functional food properties of *Dicathais orbita* are not negatively impacted by cooking.

The final objective was to assess the chemical properties of the muricid operculum for further investigation of its ancient and current uses (Nongmaithem, et al. 2017. *Scientific Reports* 7: 17404 doi:10.1038/s41598-017-17551-3). Chemical analysis of operculum smoke and extracts revealed that it contains aromatic phenols, which act as fragrance stabilisers and produce a medicinal (antiseptic) odour. Chemical analysis of operculum lipid and polar extract revealed the presence of pharmaceutically active compounds, including brominated indoles, choline esters and adenosine, consistent with their traditional medicinal applications.

In summary, this thesis shows the potential to further develop underutilized whelk resources as functional foods and natural medicines by maximum utilization of the whelk resources. For value-addition of the whelk industry, it is imperative that a sustainable supply is first established.

New book release: *Timor Leste: from the sea to the mountains* by Gerardo C. Ângelo



This new publication on the nature of Timor-Leste includes photographs of more than 900 marine species (of which living molluscs feature prominently) in their natural habitats, and more than 100 species of birds, reptiles and mammals, many of them endemic, some rare and rarely documented. It is also an account of the experiences of travelling to some of the most secluded places in the country. Species are identified by common and scientific names, with a comprehensive taxonomic species index and detailed location information for each photograph. The book is bilingual (English and Portuguese) and can be ordered at: https://www.nhbs.com/timor-leste-from-the-sea-to-the-mountains-do-mar-as-montanhas-book

MOLLUSCS 2018

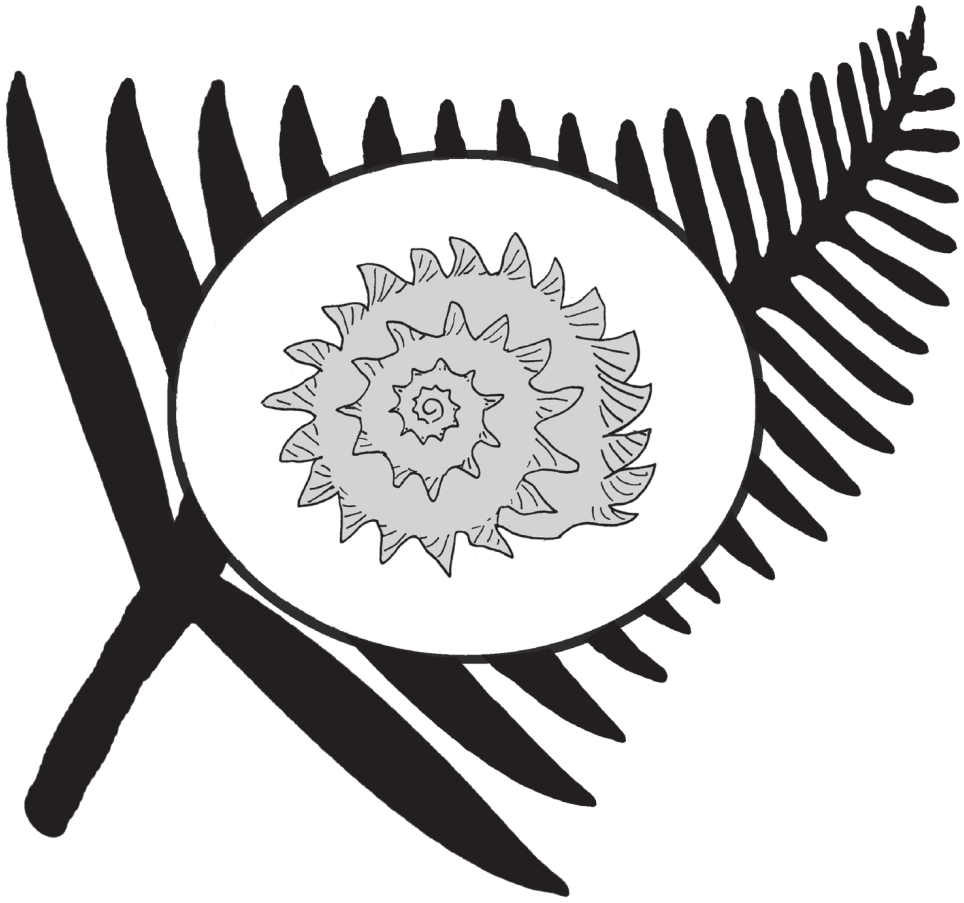
2-5 December 2018
Te Papa Museum, Wellington, NZ

Organising committee:
Simon Hills
Hamish Spencer
Nicole Phillips
Carmel McDougall
Kerry Walton
Kat Bolstad

Key dates:
Abstract submission deadline
31 October
Registration deadline
Early bird September 14

Conference themes
Systematics and taxonomy
Aquaculture and fisheries
Ecology and biogeography
Biochemistry and physiology
Conservation and reef restoration
Invasive species and biosecurity
Palaeontology
Genomics and molecular biology
Endemism
Climate science
Citizen science

Workshop
Introductory genomics



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