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NEWSLETTER
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Research report: The taxonomy of the salt-lake gastropod *Coxiella* Smith, 1894

Angus Lawrie (Murdoch University) email: anguslawrie@live.com

Coxiella Smith 1894 is a genus of gastropods that inhabit seasonal and permanent saline lakes throughout southern Australia (1). The current morphotaxonomy of *Coxiella* is inadequate. Current species descriptions are based entirely on external shell and operculum characters. Subsequent studies have found single specimens that exhibit the taxonomic characteristics of multiple morphospecies (1, 2) and include reports of undescribed species (3, 4). Also, operculum characters have been found to vary with salinity (2) or the size of the individual (1). Thus, researchers and managers are currently unable to confidently identify *Coxiella* material to species level (1, 4, 5).

Of the seven extant species of *Coxiella* (note that species that have not been collected within the past 70 years are assumed to be extinct), all but one occur in Western Australia. The exception is *C. striata*, which is broadly distributed in South Australia, Victoria and Tasmania. This species is reported to exhibit considerable morphological variation within and between populations (1, 2) and may be a morphologically variable species and/or comprise multiple species. Genetic data are required to resolve this uncertainty (6).

The main objective of my PhD study is to use genetic (mtDNA and nDNA) and morphological (external and internal) data to resolve the current taxonomy of *Coxiella*. This includes a test of whether *C. striata* is a single morphologically-variable species or a complex of undescribed species. Funding from the MSA is allowing me to include critical samples of *C. striata* from eastern Australia in the analyses.

(continued on page 6)

Adult *Coxiella* shells are typically decollate and between 6 – 17 mm long.
Photos: Angus Lawrie (depicted shells not to scale relative to each other).

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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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 **Tuesday** of the month. In 2020, no meetings in March, May, June, July, September or December.

Membership fees 2020

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

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
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The deadline for articles for the next issue of the Newsletter is Friday 8 May, 2020.

MSA website: http://www.malsocaus.org

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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.

Opalia australis feeding on a small anemone, under-surface of a lower littoral rock, Smiths Beach, Phillip Island, Victoria, Tuesday 10 November, 1998. (Photo: P. Vafiadis)

Feeding in *Opalia australis* (Lamarck, 1822)

The Epitoniidae or 'wentletrap shells' are an attractive family whose members feed on cnidarians (Smith 1998). The temperate Australian species *Opalia australis* is shown at left, feeding on a small anemone (possibly *Aulactinia veratra*) in Bass Strait, central Victoria. Its proboscis is seen extending to the anemone, although further details were not gleaned to minimise the disturbance caused.

Opalia australis grows to 35 mm in length and is found from southern Western Australia to New South Wales, including Tasmania (Phillips et al, 2006).

References and further reading:
Phillips DAB et al (2006). *Coastal Invertebrates of Victoria—an atlas of selected species.* Revised edition. Field Naturalists Club of Victoria Marine Research Group, Melbourne.
Smith BJ (1998). Family Epitoniidae Pp. 814-816 in: Beesley PL, Ross GJB & Wells A (Eds). *Mollusca: the southern synthesis. Fauna of Australia Vol 5.* CSIRO Publishing , Melbourne, Part B viii 565-1234 pp.

P. Vafiadis

President's Report – Annual General Meeting, 27 November 2019

As always, the council has been instrumental in its support of both early career researchers and students through research grants and best paper awards, as well as long-standing and dedicated members of the malacological community through provision of Honorary Membership recognition.

Details of key notable accomplishments include:

- 2019 Malacological Research Grants, with Paige Maroni (first prize) for 'The ecology and evolution of an adaptive marine radiation of Antarctic sea slugs', James Peyla (second prize) for 'Investigating the Long-Term Effects of Ocean Acidification on the Giant Australian Cuttlefish', and Angus Lawrie (third prize) for 'Evaluating the taxonomic status of the endemic salt lake gastropod *Coxiella striata* in south-eastern Australia';

- Molluscan Research Achievement Award for the best paper published in the journal by an early career researcher or amateur in 2018 to Tsuyoshi Takano, for the paper 'DNA-based identification of an echinoderm host for a deep-sea parasitic snail (Gastropoda: Eulimidae)';

- Honorary membership awarded jointly to Don and Val Cram for longstanding contributions to MSA at the national but also branch level (Victoria), in mentoring younger members and ongoing research on *Notocypraea*;

- Steady growth of our online community with regular increases of 100 members each year (27 November 2019: 790 members; 27 November 2018: 665 members; 27 November 2017: 572 members);

- Launching a new slogan 'Molluscs - more than just a shell' (thanks to Steve Smith);

- A clear and recognizable presence (thanks for the sharp T-shirts Kerry Walton) at World Congress of Malacology in Monterey mid year;

- Transitioning to yet another teleconferencing system (Zoom) for council meetings!

Thank you to the MSA Council who again have donated willingly of their time and energy to the Society so we can continue to foster a love of malacology in the region. MSA thrives due to the enthusiasm and commitment of this group. Dedicated members include Platon Vafiadis pushing us to deliver interesting newsletters geared to a range of readers on time, replete with eye-catching photographs and vignettes. Don Colgan ensures Molluscan Research is an attractive outlet for molluscan research and testament to this are the interesting papers that continue to vie for space in our journal. Rachel Przeslawski, our Website Administrator, maintains her presence and her problem solving acumen time and again. Carmel McDougall, our Treasurer, steadies the course and keeps us solidly in the black, a wonderful position for a small society. Matt Nimbs has ensured we continue to grow and our members are well looked after, while Priscila Salloum has handled her new role as Secretary with ease (running our meetings, not to mention organizing the AGM!). Thank you also to our council members from across Australia and New Zealand for their continued attendance at meetings and sage advice when needed.

In 2020, a new decade, we will see another chapter for MSA with new faces in leading roles and a changing of the guard. I would like to take this opportunity as outgoing President to thank everyone who welcomed me to the council and believed in me along the way. I have felt constant support and assistance during my tenure as President, even for quite ambitious initiatives (MSAturns60), and want to say how lovely it has been being part of such a positive community and family, really. I am excited to remain on council (if elected) and also to realize our triennial conference in 2021 for all of you to visit and enjoy my adopted city of Perth and the new museum. I am excited to welcome the incoming President and enjoy the energy and enthusiasm they will bring to the role.

Sincerely,

Lisa Kirkendale, MSA President

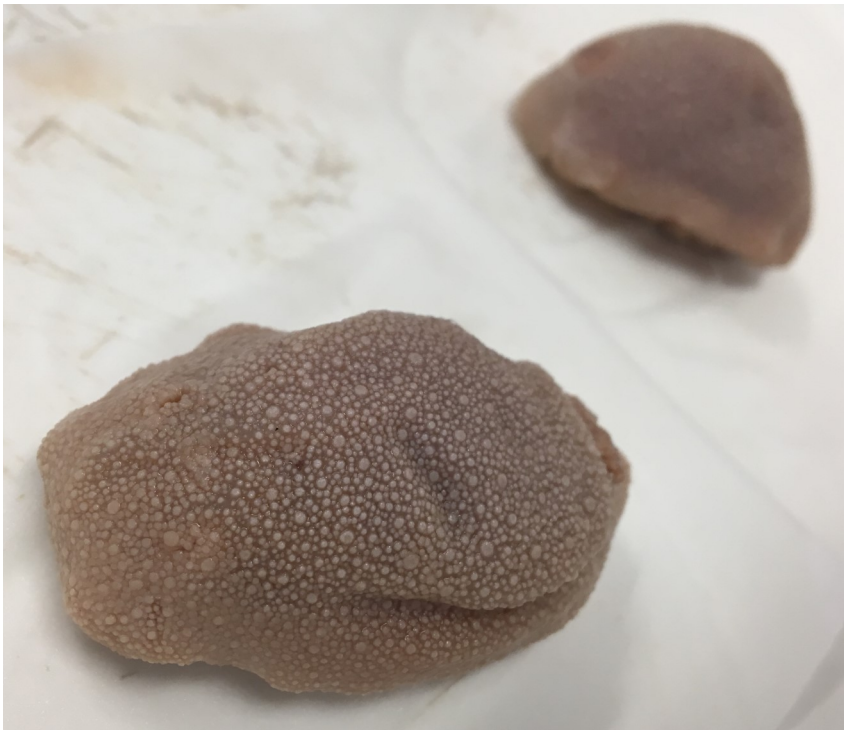
Research report: The ecology and evolution of an adaptive marine radiation of Antarctic sea slugs

Paige Maroni, University of Western Australia. email: paige.maroni@research.uwa.edu.au

I am Paige Maroni, and I am a PhD candidate in the School of Biological Sciences at the University of Western Australia and a research associate at the Western Australian Museum. I am broadly interested in Antarctic benthic marine invertebrates and the evolution of chemical defence mechanisms. I completed my BSc in Conservation and Wildlife Biology at Murdoch University, Perth, and stayed there to complete my BSc (Hons), before pursuing doctoral work with Dr. Nerida Wilson at The Western Australian Museum (and The University of Western Australia).

The first chapter of my PhD, entitled: 'Grasping the diversity of the *Doris 'kerguelenensis'* species complex within the Southern Ocean' focuses on unravelling a marine adaptive radiation of cryptic Antarctic nudibranchs. *Doris 'kerguelenensis'* is one of the most abundant nudibranch species with a circum-Antarctic and Magellanic (southern South American) shelf distribution. Belonging to the Dorididae family, *Doris 'kerguelenensis'* is a direct-developing, simultaneous hermaphrodite, that feeds exclusively on sponges and synthesizes secondary metabolites de-novo (independent of diet). *Doris 'kerguelenensis'* was long-thought to be a single, widespread species based on morphology, but the examination of molecular data revealed a large number of mitochondrial genetic lineages within this 'species', thus revealing an Antarctic sea slug species radiation. This radiation was thought to be caused by a unique combination of selection and allopatry facilitated through millions of years of episodic glacial cycles. This resulted in the segregation of the animals into smaller, reduced populations, which in turn, increased vulnerability to predation pressure.

The first year of my PhD was dedicated to comprehending the extent of the diversity of the *D. 'kerguelenensis'* species complex within the Southern Ocean and has allowed me to generate a single gene phylogeny consisting of 1372 samples, resulting in up to 70 putative mitochondrial lineages. In order to resolve relationships among species, I will next employ a transcriptome-based exon capture approach to increase gene sampling from a single mitochondrial locus to hundreds of genes from the nuclear genome. Additionally, I will incorporate secondary metabolomic profiles into this phylogenetic reconstruction in order further delimit species and potentially aid bioprospecting efforts from pharmaceutical exploration and development. This is important for my research as several tested compounds synthesized by *D. 'kerguelenensis'* have been shown to be successful in inhibiting a human form of leukemia. By resolving this phylogeny and mapping the distribution of these metabolites across the topology of the phylogeny, we will be able to produce important genetic resources that can be used in future work as well as facilitate more systematic testing of compound effectiveness across disease panels.



At left:

Doris 'kerguelenensis' (Bergh, 1884)
Dorididae

Collected from the Weddell Sea, Antarctica (72.5888°S, 18.0566°W) in 2016 at depth of 360.2 meters.

The slug in the foreground is 5.6 cm long and the slug in the background is 4 cm long.

Photograph: Paige Maroni.

Research report: Presenting the shell shape and genetic patterns of a New Zealand chiton at the Molluscs 2018 conference

Priscila M Salloum, University of Auckland email: psal591@aucklanduni.ac.nz

In 2018, I was fortunate to receive a travel grant to present my PhD research at the Molluscs 2018 conference, organized by MSA. The presentation involved my preliminary results for the genetic, genomic and morphometric variation in populations of the brooding chiton *Onithochiton neglectus* Rochebrune, 1881 distributed in a latitudinal gradient across New Zealand and its Sub-Antarctic islands.

Specifically, I wanted to know how populations are connected, and if the genetic patterns would agree with any spatial variation in shell shape.

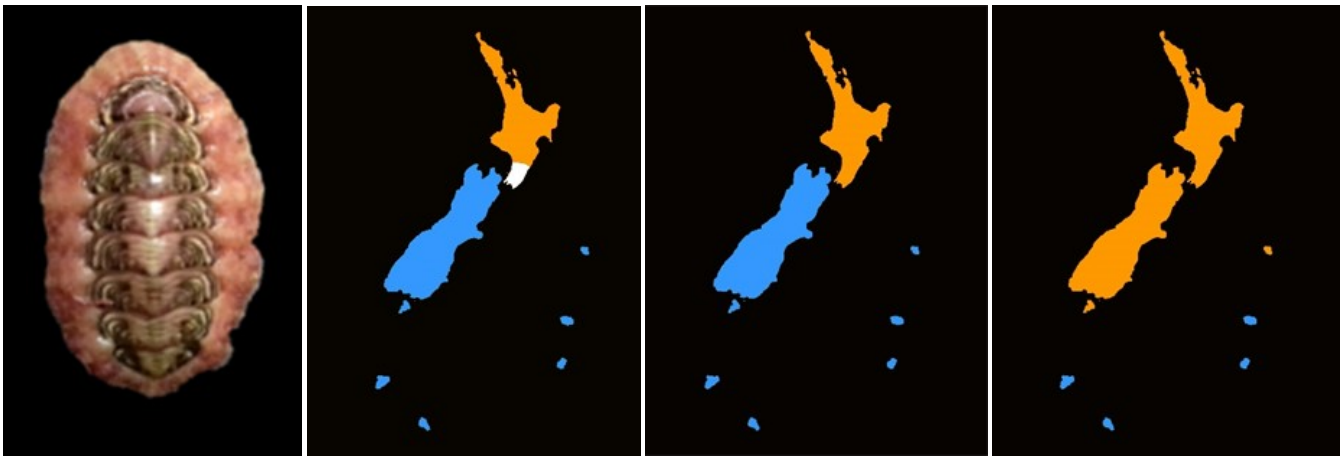
Interestingly, both the genetic data (sequences of the mitochondrial gene cytochrome oxidase I) and the genomic data (5000 SNPs – single nucleotide polymorphisms, or small gene fragments spread across the whole genome) revealed three distinct clusters across New Zealand, and strong population structure, indicating that many populations are quite isolated, particularly in two of the clusters (North Island and Central New Zealand). The third cluster corresponds to populations from the South Island and the Sub-Antarctic Islands, which are connected via rafting on the holdfast of bull kelp for long distances in the southern ocean.

The morphometric data (generated with Elliptic Fourier Analysis of the head, fourth and tail valves) only recovered two of the three distinct genetic clusters, corresponding to a North-South break, in which the Central New Zealand populations have a similar shell shape to the North Island populations.

Further analyses showed that, when compared with other chiton species, *O. neglectus* is monophyletic, but neither the molecular nor the morphometric results are concordant with the current taxonomy within this species (which splits *O. neglectus* into two subspecies, *O. neglectus subantarcticus* Suter 1907 from some of the Sub-Antarctic Islands, and *O. neglectus neglectus* Rochebrune, 1881 from the rest of the distribution).

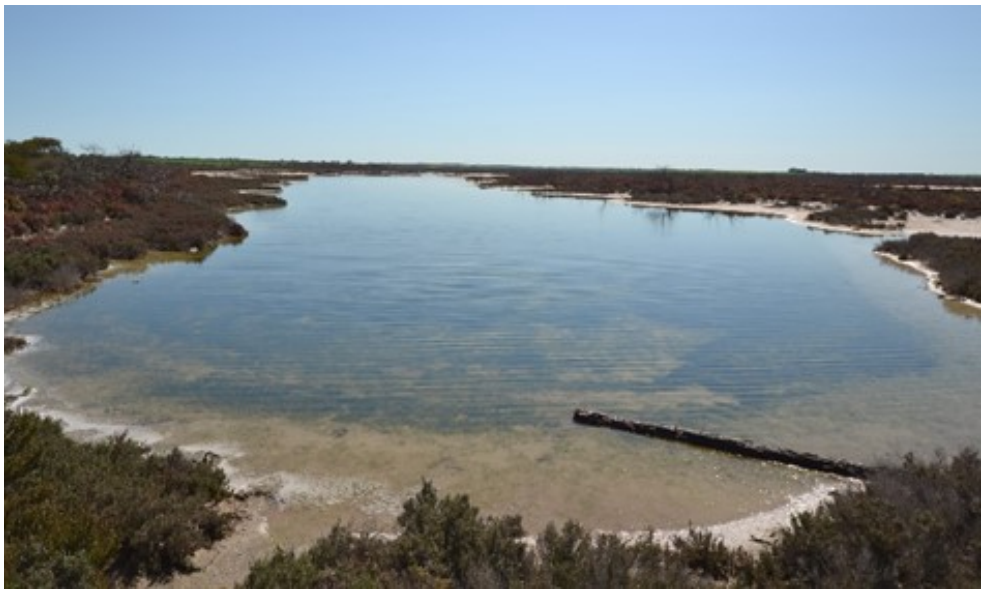
While these findings were recognized with one of the student presentation prizes in the conference, there was, and still is, much work to be done with this species. Beyond the taxonomy incongruence, it is also important to evaluate the potential of *O. neglectus* populations to be locally adapted to specific environmental conditions throughout its broad distribution, and start to understand how these chitons are likely to respond to environmental variability and climate change.

Finally, I sincerely thank the MSA for the opportunity to attend the conference and meet researchers and students with great research projects and so much knowledge to share.

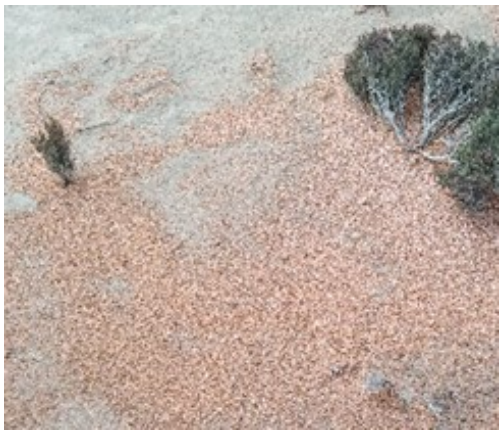


Onithochiton neglectus Rochebrune, 1881, and distribution of subspecies according to recent molecular data, shell shape analysis, and current taxonomic classification. Photograph and diagrams from Priscila Salloum.

Research report: The taxonomy of the salt-lake gastropod *Coxiella* Smith, 1894 (continued from page 1)



At left: *Coxiella striata* is the only *Coxiella* species not found in Western Australia. Above: *Coxiella* habitat; *Coxiella* are hardy beasts; they have been collected from salinities between 0.3 – 123 ppt and can survive desiccation (as aestivating adults) for several months. Below: *Coxiella* shells are often extremely abundant on the shores of salt lakes, occasionally forming dunes.



So far, I have acquired 16 collections of *C. striata* from South Australia, Victoria and Tasmania via three different museums and live-collected snails from three sites in Victoria. I am about to commence the morphological and genetic assessment of this material.

References:

1. Williams W, Mellor M (1991). Ecology of *Coxiella* (Mollusca, Gastropoda, Prosobranchia), a snail endemic to Australian salt lakes. *Palaeogeography, Palaeoclimatology, Palaeoecology* 84 (1-4), 339-55.
2. De Deckker P, Geddes M (1980). Seasonal fauna of ephemeral saline lakes near the Coorong Lagoon, South Australia. *Marine and Freshwater Research* 31(5), 677-99.
3. Pinder AM, Halse SA, McRae JM, Shiel RJ (2005). Occurrence of aquatic invertebrates of the wheatbelt region of Western Australia in relation to salinity. *Hydrobiologia* 543 (1), 1-24.
4. Timms BV (2009). Study of the saline lakes of the Esperance Hinterland, Western Australia, with special reference to the roles of acidity and episodicity. *Natural Resources and Environmental Issues* 15(1), 44.
5. Pinder AM, Halse SA, Shiel RJ, Cale DJ, McRae JM (2002). Halophile aquatic invertebrates in the wheatbelt region of south-western Australia. *Internationale Vereinigung für theoretische und angewandte Limnologie: Verhandlungen.* 28(4), 1687-94.
6. Weigand AM, Jochum A, Pfenninger M, Steinke D, Klussmann-Kolb A (2011) A new approach to an old conundrum—DNA barcoding sheds new light on phenotypic plasticity and morphological stasis in microsnails (Gastropoda, Pulmonata, Carychiidae). *Molecular Ecology Resources* 11(2), 255-65.

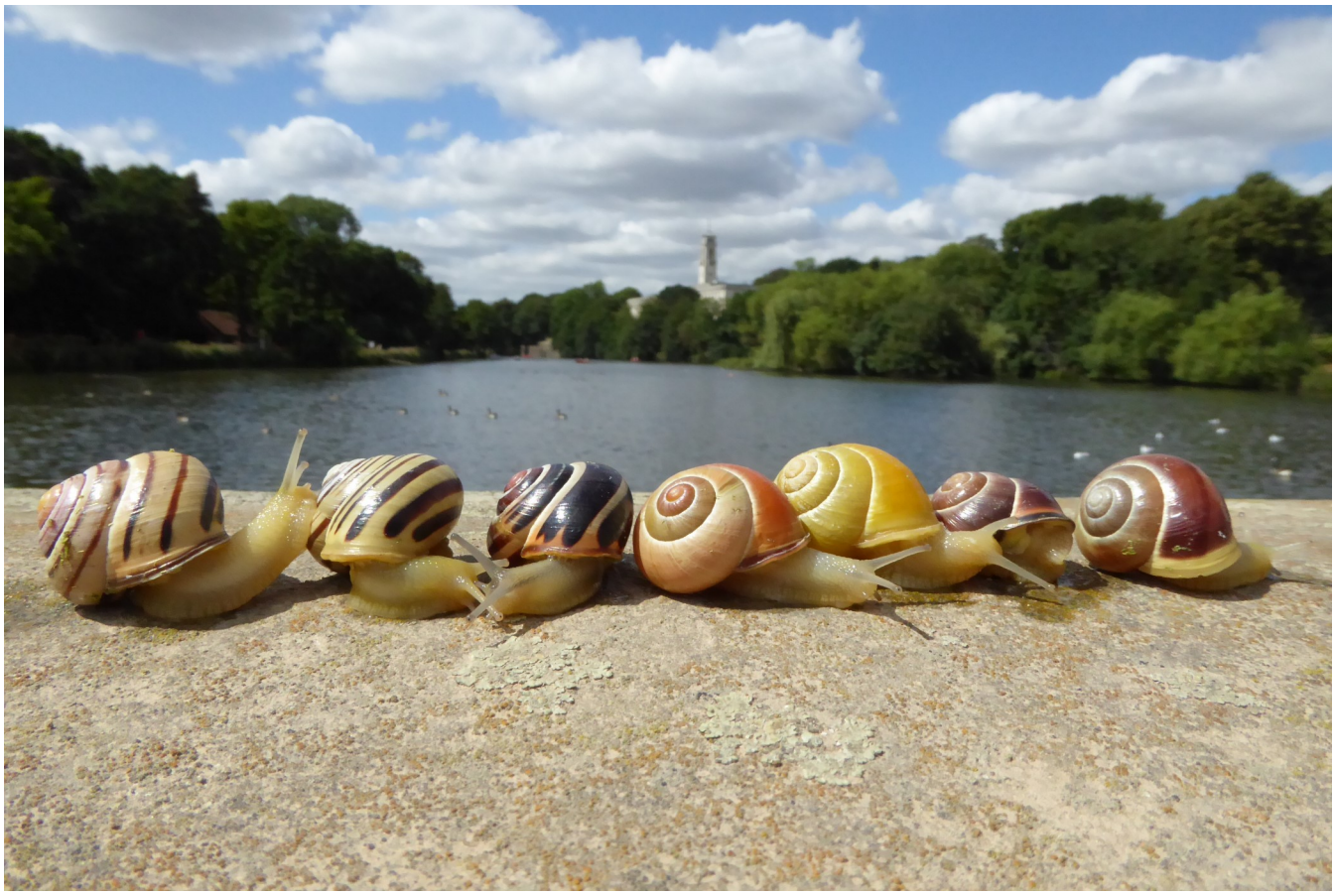
Research report: New approach to understand *Cepaea nemoralis* (Helicidae) polymorphism

Daniel Ramos Gonzales email: Daniel.Ramosgonzalez@nottingham.ac.uk

Understanding how polymorphism is maintained in populations is a longstanding question in evolutionary biology. Perhaps the pre-eminent model, the snail *Cepaea nemoralis*, may help understanding the maintenance of the polymorphism. *C. nemoralis* is a predominantly west European species with a polymorphic shell for three main inherited features controlled by a "supergene", a group of tightly linked loci that co-segregate together; the shell ground colour, banding and band pigmentation. To answer this question a multifaceted research was chosen.

Firstly, fine mapping of the polymorphism may be an important step towards identifying the underlying supergene. Past research has shown that five loci are linked together into one "supergene" . One of the past research limitations was the identification of putative recombination events between loci within the supergene. To resolve this issue, new crosses of *C. nemoralis* were created, with flanking restriction site–associated DNA sequencing (RAD-seq) markers used to identify recombination events. Results showed no evidence that presumed "recombinant" individuals, identified by phenotype, were recombinant between loci within the supergene. Instead, incomplete penetrance and epistasis may be a better explanation for these phenotypes. The findings challenge the previous assumption of the supergene architecture and provides a new resource for the future creation of a fine mapping of the supergene.

Secondly, one of the emerging strengths of working with *Cepaea* is that historic collections can be compared against modern day samples, for instance to understand the impact of changing climate and habitat upon shell morph frequencies, and so infer the potential impact of natural selection. Selective factors, such as the climate or the human impact in the Pyrenees,



Above: the land snail *Cepaea* (Helicidae) showing shell colour polymorphism. Photograph by Daniel Ramos Gonzales (University of Nottingham, United Kingdom)

have significantly changed since 1960. I have attempted to create a new understanding of the forces that may have acted upon shell traits, by comparing the distribution of morph frequencies in the past and those of the present day.

Finally, the phylogeography of species in Europe has had considerable prior research, including preliminary studies using mtDNA in *Cepaea nemoralis*. I have now used a genomic technology, RAD-sequencing, to understand population genomics of this species.

References:

Gonzalez, Daniel Ramos; Amaia Caro Aramendia, and Angus Davison (2019). Recombination within the *Cepaea Nemoralis* supergene is confounded by incomplete penetrance and epistasis. *Heredity* (2019/02/14 2019). Available at: https://doi.org/10.1038/s41437-019-0190-6

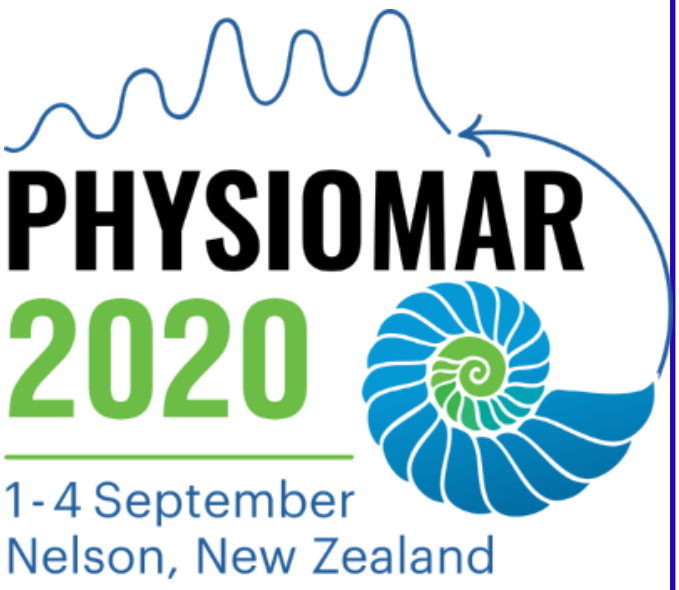
Richards, P. M., M. M. Liu, N. Lowe, J. W. Davey, M. L. Blaxter, and A. Davison (2013). Rad-Seq derived markers flank the shell colour and banding loci of the *Cepaea nemoralis* supergene. *Molecular Ecology* 22(11): 3077—89. Available at: https://doi.org/10.1111/mec.12262

Physiomar 2020

Physiomar is a triennial international forum for discussion of recent advances in all aspects of the physiology of aquatic invertebrates. It is an opportunity to maximise exchange of knowledge and expertise, and encourage collaboration in all areas including functional biology, growth, nutrition, reproduction, and adaptation to an ever-changing environment.

Physiomar 2020 will be held in New Zealand and hosted by the Cawthron Institute, New Zealand's largest independent science organisation. After a welcome function on Monday 31 August at the Cawthron Institute, the conference will take place at Founders Heritage Park, Nelson.

For further information please see:
https://confer.eventsair.com/physiomar-2020/



20th International Conference on Shellfish Restoration, 17 - 20 March 2020, Nelson Bay, New South Wales, Australia

With shellfish restoration efforts and research growing globally each year, this conference will progress the science and practice of shellfish reef restoration by providing a forum to share ideas, experiences and advances from leaders in diverse fields from around the globe. Calls for abstracts have now expired. For further details please see:

https://willorganise.eventsair.com/2020-international-conference-on-shellfish-restoration/destination-port-stephens