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Sinistrality in the gastropod *Zemira australis* (Sowerby, 1833) (Pseudolividae) from the NSW south coast

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With a few notable exceptions, chirality (or 'handedness') in gastropods is generally fixed: all members of a given species coil either dextrally (the usual arrangement) or sinistrally. Despite this, rare examples of the 'wrong' chirality are now known among a wide range of species. To this select club, we now add the 'false-olive' *Zemira australis* (Sowerby, 1833).

The genus *Zemira* is endemic to eastern Australia; indeed the two species in the genus are Australia's only representatives of the small but geographically widespread neogastropod family Pseudolividae. *Zemira australis* occurs in the shallow subtidal down to a depth of about 150 m, and can be found from near Bicheno in north-eastern Tasmania, through eastern Bass Strait, along the coast of New South Wales as far north as Fraser Island, Queensland. According to Des Beechey's *Seashells of NSW* website (http://seashellsofnsw.org.au), the ranges of *Z. australis* and the second species in the genus, *Z. bodalla*, overlap near Tweed Heads, with *Z. bodalla* extending further north in Queensland to about Swain Reefs and tending to live in deeper waters (150–350 m).

While processing and curating material recently from a series of benthic sled samples from the Tasman Sea and eastern Bass Strait, we came across two sinistral specimens and six dextral specimens of *Z. australis*. All appeared to have been live-caught, though some lacked their operculum and their shells bore various encrustations.

The samples had been collected in 1993, as part of a survey investigating the demersal fish communities in the South East Fisheries between southern New South Wales, eastern Victoria and north-eastern Tasmania (CSIRO, 1993). The sample in question was collected on 03/09/1993, and came from east of Disaster Bay, NSW (Station 136), in 72–67 m of water at latitude 37°17.7´S, longitude 150° 03.8´E.

We checked other available samples from the same survey. Four others, from off Disaster Bay and Bermagui in NSW and from off Point Hicks in Victoria, produced a total of another 11 *Zemira* specimens; all were from waters 24–32 m deep and all had been live-caught apart from the five from Bermagui, whose shells were occupied by hermit-crabs. All were dextral.

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The eight Zemira australis specimens, two of them sinistral, extracted from a 1993 benthic sled sample from east of Disaster Bay, NSW and now held at TMAG. Shell lengths range from 22 to 29 mm. Photo: S. Grove.

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We then asked colleagues in other Australian museums to check their *Zemira* holdings (*Z. australis* and/or *Z. bodalla*) and to let us know whether any of their specimens were sinistral. The response was gratifyingly rapid, but disappointing in that no further sinistral specimens came to light. Winston Ponder (AM) reported 96 dry and 35 wet lots of *Z. australis*, and 16 dry lots of *Z. bodalla*, many with multiple specimens; Richard Willan (MAGNT) reported 15 shells in six dry lots (one lot of two shells comprised *Z. bodalla*); John Healy (QM) reported six *Z. australis* and six *Z. bodalla*; Julian Finn (MV) reported 60 lots, many with multiple specimens (two of these *Z. bodalla*); and Andrea Crowther (SAM) reported six lots of 32 specimens, all *Z. australis*. Lisa Kirkendale (WAM) reported no *Zemira* holdings. In total, these reports account for well over 200 specimens, and perhaps closer to 300.

Our findings beg the question as to why a single sampling event was able to produce not one but two sinistral specimens, contrasting with the complete absence of sinistrality amongst all the other samples held in museum collections around Australia. It is unlikely that the cause of sinistrality was a developmental hiccup — after all, why would this happen twice, and in the same location at the same time? More likely, it was the result of past mutation.

It is believed that while several genes may be involved in orchestrating chirality, a mutation in one of these may cause an individual's chirality to 'flip'. Typically, the standard (and usually dominant) allele codes for the species' 'right' chirality while a mutant version (usually recessive) codes for the 'wrong' chirality (reverse coiling). Under a normal Mendelian system of inheritance, the reverse-coiled offspring could arise if at least one parent was itself reverse-coiled, or if both parents were normal but each was heterozygous, bearing a single copy of the recessive allele coding for reverse coiling. But in a peculiar form of inheritance displayed by some pulmonate gastropods, chirality is not determined by which alleles the individual itself carries, but by which alleles its mother carried; this is known as maternal delayed inheritance (Freeman and Lundelius, 1982). In such species, an individual's chirality is decided very early on in its development, and is mediated by maternal messenger RNA or proteins acting on the as-yet unfertilised egg; those agents are of course the product of the maternal genotype, so the phenotype of the offspring reflects her genotype rather than theirs (Schilthuizen and Davison, 2005).

Of course, pondering modes of inheritance cannot solve the question as to the *origin* of sinistrality in the sampled *Zemira*; at best, it only pushes the possible origin back by one generation. Neither can a single sample in time determine how, or whether, sinistrality is being maintained in the population.

Intriguingly, we have not been able to unearth any other instances of sinistrality in members of the family Pseudolividae. However, the phenomenon occurs in other neogastropod families. Indeed there is some suggestion that it occurs more in neogastropods than in other gastropod clades; of the 102 reverse-coiled gastropod species amassed by Florida collector Harold G. Lee, all but 11 are neogastropods (see http://www.jaxshells.org/reverse.htm). Why this might be so is not clear; the separate sexes and copulatory mating systems of neogastropods, including false-olives (Ponder and Darragh, 1975) ought to militate against the propagation of reverse-coiling, since chirality has a bearing on the orientation of the genitalia. This means that successful interchiral matings (between dextral and sinistral individuals) seem highly improbable, particularly for low-spired species that engage in 'face-to-face' mating (Schilthuizen and Davison, 2005), as would be the case for many neogastropods. This copulatory barrier implies that the proportion of sinistral individuals in an otherwise dextral species should seldom rise to the equilibrium that would be predicted by population genetics alone, even if there were no other selection pressure disfavouring reverse-coiled individuals.

However, chance may at times dictate that two sinistral individuals do indeed meet and mate. In such rare circumstances, there would be no copulatory barrier, and the proportion of sinistrality in the local population could indeed climb. This must be a rare occurrence, since there are very few documented cases of established sinistral populations of otherwise dextral neogastropod species. Valero (1972) reported finding nine live sinistral specimens of *Conus ventricosus* (Conidae) in close proximity to each other, near the shores of the Mediterranean at Cap Benat, near Toulon in France. Also on Mediterranean shores, Donati *et al.* (1984) reported finding eleven sinistral specimens of *Conus mediterraneus* (Conidae) over a period of two days in the vicinity of Mediba, Sardinia; this find followed discovering five sinistral specimens in the same area in 1973.

Our finds leave open the possibility, therefore, that there is a self-sustaining population of sinistral *Zemira australis* in the vicinity of the point of origin of our two specimens. Twenty years on, perhaps it's time someone with a boat and some sort of benthic sampling device revisited the locality to try and find out?

Postscript

Having written this article, we heard from Lynton Stephens that there is a sinistral specimen of *Zemira australis* on display at the Griffiths Sea Shell Museum & Marine Display in Lakes Entrance, Vic. Coralie

(Continued on page 4)

Griffiths, the proprietor, has now confirmed that the sinistral specimen was trawled, alongside a dextral one, in 50 m of water from about 10 km east of Lakes Entrance on 9th November 1960, by Max Griffiths.

Acknowledgements

We thank the museum curators mentioned above for their timely responses to our request for information on the chirality of *Zemira* in their respective holdings. Thanks also to Kirrily Moore at TMAG for preparing the bulk sled samples.

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Hidden in plain sight: cryptic diversity in *Tridacna*

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Giant clams in the genus *Tridacna* are among the most spectacular of marine bivalves. They are distinctive, not only in their large size and attractive shell structure, but also their ability to feed by harnessing the photosynthesic products of algal symbionts. All members of the genus are listed under CITES Appendix II and appear on the IUCN Red List. There are currently eight recognised *Tridacna* species, all limited to the Indian and Pacific Oceans. *Tridacna maxima* has the largest geographic range, and also contains a broad morphological diversity of shell characters. As a measure of this diversity, the present day species *T. maxima* was previously recognised as several species until these were all placed under their current name by Rosewater (1965).

An example of the mystery species at Coral Bay, Western Australia. Photo: E. Treml.

In 2011 I was lucky enough to be awarded a Molluscan Research Grant for a project looking at the phylogeography of *Tridacna maxima* and *T. crocea* around Australia and the Indo-Pacific. The project aimed to discover whether there is reduced gene flow through the Torres Strait in these two species, by combining new collections with existing data from Indonesia and the Philippines. Previous studies by DeBoer *et al.* (2008), Kochzius and Nuryanto (2008), and Nuryanto and Kochzius (2009) had found strong population structure in the Indonesian archipelago for both *T. maxima* and *T. crocea* using maternally inherited markers. These studies had sampled intensively in the Indonesian archipelago but sampling did not extend further east into the Pacific or south into Australia. We aimed to complement these earlier studies by sampling Australian and west Pacific populations of these iconic molluscs. Sampling took place between 2009 and 2013 and covered 10 sites around Australia. Early expeditions were to Heron Island, Lizard Island, Lihou Reef and Ningaloo Reef. Later, we ventured to the Torres Strait, the western Solomon Islands, Orpheus Island and Papua New Guinea. While on SCUBA or free-diving we sampled *T. maxima, T. squamosa* and *T. crocea* using a non-lethal biopsy method (see photo on the next page). This method has the unfortunate consequence of making it difficult to match DNA sequences with morphology, but more about that later!

Back in the lab we used mitochondrial and nuclear DNA markers to build phylogenetic trees showing the evolutionary relationships both within and between species. These trees showed some interesting patterns in terms of gene flow in the region but the really surprising result was that we found a number of clams that didn't match any of the currently known species with DNA records. The DNA from these clams was remarkably similar to that collected from a few clams in Taiwan in 2005. These sequences formed part of a Masters thesis, as yet unpublished but available in the original Mandarin from the National Taiwan Ocean University. The author, Ying-Ching Tang, described morphological differences between a novel clam type from Taiwan and *T. maxima*. Our DNA sequence data supports Tang's initial findings, placing this unknown species as a closer relative to *T. crocea* and *T. squamosa* than to *T. maxima*.

These results were published in Nov. 2013 (PLOS ONE 10.1371/journal.pone.0080858). The species remains undescribed at present, but work is underway to formally describe it with a holotype recently being accessioned into Museum and Art Gallery of NT by Shane Penny. Now that we know we have an unknown species on our hands things get a little more exciting, and a little more frustrating, because by collecting only non-lethal biopsies we don't really know what this new species looks like! What we do know is that we mistakenly collected it while targeting *T. maxima,* and that we missed *T. maxima* entirely at Ningaloo Reef. So, my question to readers is this: do you think you have found *Tridacna maxima* at Ningaloo? If you do, please get in touch, I'm dying to know if it actually occurs there! Better still, if you have permits to collect tissues from *T. maxima*, please send me some.

A mantle biopsy being taken from T. squamosa in the Torres Strait Islands. Photo: J. Keyse .

Future events

- **Octopus Symposium and Workshop**, Seattle Aquarium, 29th March 2014, http://www.SeattleAquarium.org/octopus-workshop
- **Marine Imaging Workshop** Southhampton, UK, 7th–10th April, 2014, http://marine-imaging-workshop
- **GEOHAB** Marine Geological Pattern in Marine Systems, Lorne, Victoria, 5th–9th May, 2014, http://www.geohab2014.org
- **Mollusca 2014**: The meeting of the Americas, Mexico City, 23rd–27th June 2014, http://www.mollusca2014.unam.mx/index_ing.html
- **AMSA2014** Australian Marine Science Association: Investigating our Marine Nation. Canberra, ACT, 6th –10th July 2014, http://www.amsaconference.com.au
- **17th International Congress on Marine Corrosion and Fouling**, Singapore, 6th–10th July 2014, http://www.icmcf.org
- **3rd International Marine Conservation Congress:** Making Marine Science Matter, Glasgow, UK, 14th–18th August 2014, http://www.conbio.org/mini-sites/imcc-2014
- **23rd CIAC** Cephalopod International Advisory Council Conference, Hakodate, Japan 2015, http://www.abdn.ac.uk/CIAC

Newsflash!

'I received advice from the NSW Scientific Committee today advising that they have made a final determination to list the Mt Kaputar high elevation and dry rainforest land snail and slug community as an endangered ecological community under the NSW Threatened Species Conservation Act 1995. This is the first entire land snail community to be listed as endangered in Australia.' *Michael Murphy 23 Dec. 2013*

For more information about Mt Kaputar molluscs see Michael Murphy's article in MSA Newsletter 148, September 2013.

Use of shell banding to construct size-at-age growth curves in three cockles

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Fig. 1. (a) External shell of E. kingicola with Myochama sp. attached; (b) external shell of G. grayana and, (c) external shell of C. kingii with radial length shown as a red line. Photos: P. Beaver.

On the southern coast of New South Wales a small commercial fishery exists for a group of bivalve mollusc species that are marketed as 'cockles', 'flame dog cockles', 'baby clams' or 'surf clams' (Rowling *et al.*, 2010). The fishery currently has a single licenced operator and has been identified by NSW Fisheries as having potential for future expansion. The three species targeted by this fishery are *Eucrassatella kingicola* (family Crassatellidae), *Glycymeris grayana* (family Glycymerididae) and *Callista (Notocallista) kinigii* (family Veneridae) (Fig. 1).

Little research has been undertaken to examine their biology and ecology although anecdotal observations by the fisher (Broadhurst, Allan OCF Fisherman, 2012, pers. comm.) suggest that even with the small amount of effort currently exerted changes may have occurred in size distribution and species composition within the fished area over the past 14 years. As a preliminary step towards understanding the perceived stock changes and to determine the rate at which these species can sustain commercial harvesting it is necessary to know their growth pattern, age at maturity, age at capture and the possible recruitment periods.

The aim of this study was to determine whether there are easily identifiable internal annual growth marks in the shells of these three species that could be used to construct size-at-age growth curves. The internal growth marks in the structure of shells are easily observed and counted and have been used successfully in previous studies on bivalve and fish age and growth (Richardson *et al.*, 1990; Steingrimsson, 1989). We also know that shell growth usually slows during winter when temperature, metabolic rate and food are at a minimum (Kennish, 1980; Steingrimsson, 1989). A number of factors have been shown to influence growth in bivalve molluscs, with temperature and food availability thought to be the two most important factors (Steingrimsson, 1989).

Results confirmed that the shells of all three species showed regular distinct patterns with wide opaque regions separated by thin translucent bands and they were laid down during the coldest period of the year (Figs 2–4). The results indicate that *C. kingii* is the fastest growing with a shorter life span than *G. grayana* and *E. kingicola*. These growth characteristics may explain the anecdotal observation by the fisher that *C. kingii* has increased in relative abundance in recent catches and is relatively rare in unfished areas.

The oldest *Eucrassatella* was confidently aged as 27.7 years, however it is believed that this species lives much longer than this, with one individual believed to be 41 years old (to be confirmed).

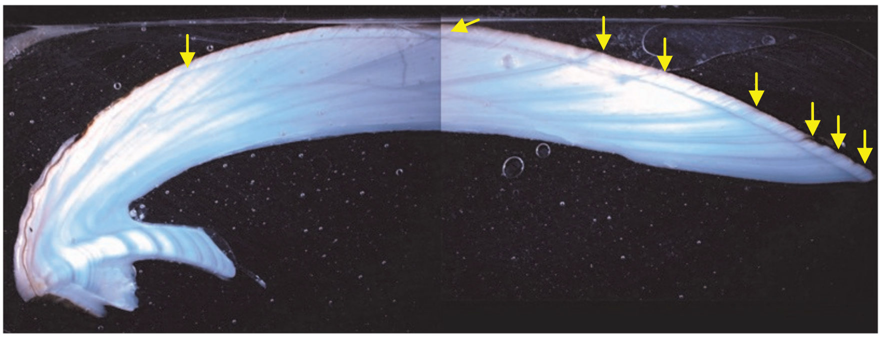

Fig. 2. Polished radial section of E. kingicola individual EK034 (8.5 years of age), yellow arrows indicating annual translucent bands. Note the clarity of growth checks in the cardinal tooth. Photo: P. Beaver.

The oldest *Glycymeris* individual that was confidently aged was 30.3 years. The oldest individual for *C. kingii* was 21.2 years of age and this species appears to have a shorter lifespan than *E. kingicola* and *G. grayana*.

The study was further supported by a tag and recapture study that was intended to validate the annual periodicity and time of year that the growth bands were laid down for all three species. A total of 197 individuals were tagged between 24/09/2011 and 27/12/2011. The average recovery rate was 10% or 19 individuals over a 2-year period with all three species represented by between one and five individuals. The results validated that growth bands were laid down between the time of tagging to when they were re-captured as indicated by comparison of the individuals' radial lengths (Fig. 1c). These results support the assumption that a translucent band is formed annually.

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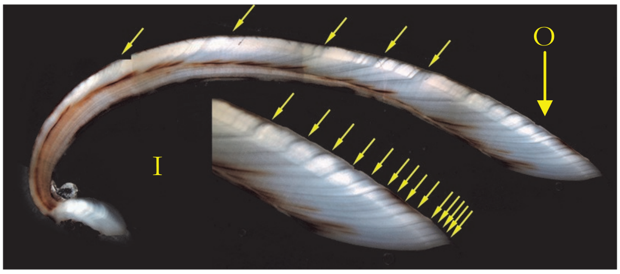

Fig. 3. Polished radial section of G. grayana individual GG039, 19.5 years of age. (I) major inner shell layer, (O) major outer shell layer, yellow arrows indicate annual growth bands or slow growth periods which appear as dark lines with reflected light. Photo: P. Beaver.

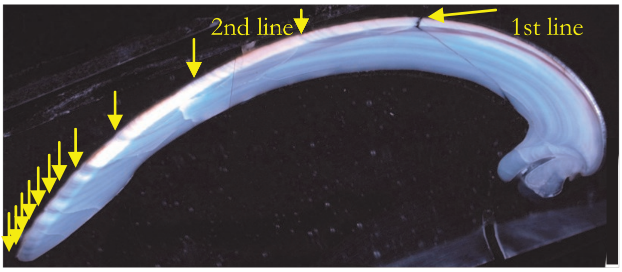

Fig. 4. Polished radial section through individual C. kingii NK034, 13.5 years of age. Yellow arrows indicate annual translucent bands. Photo: P. Beaver.

Between a rock and a hard place: habitat variation drives speciation in an island snail

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Islands are widely considered the best places for relaxation and refuge. For many, mere mention of the word 'island' triggers images of tropical vegetation, foreign accents and diverse cocktail menus. When British explorer and naturalist William Dampier went ashore a small island off the west Australian coast in the year 1699, he clearly had refuge in mind. He was in search of water to resupply his ship, *HMS Roebuck*, which was on the first British scientific expedition to Australia. He found nothing, and described the landscape as, '…dry, mostly rocky and barren' (Dampier, 1703). After naming the island Rosemary after a shrub that reminded him of the herb, he set sail for greener pastures.

More than three centuries later, Rosemary Island is essentially unchanged. It is still arid, unpopulated and of little interest to those seeking creature comforts. But for those studying evolution, it delivers beyond wildest expectations. Despite its small size, only 11 km², the island has been the site of a striking evolutionary radiation of *Rhagada* land snails (Stankowski, 2011). They are like nothing that has been seen in *Rhagada* on the mainland or on any other island. Their shells vary in size, shape, sculpture and banding pattern. The variation in shell shape really catches the eye, ranging from globose — the typical shape you see in garden snails — to a unique flat-spired form, which is only found Rosemary Island.

Despite the striking morphological differences, the *Rhagada* from Rosemary Island are very closely related (Stankowski, 2011; Johnson *et al.*, 2012). The analysis of mitochondrial DNA sequences indicates that the flat-spired form has evolved recently on the island from a globose-shelled ancestor.

Detailed studies show that the different shaped shells are the product of ecological adaptation (Stankowski, 2013). The flat-spired form has evolved on top of two isolated rocky hills, while the globose-spired populations inhabit the surrounding grassy plains. The flat and globose forms meet and mate at the narrow boundary between the rocky hilltop and low lying and grassy habitats, leading to the formation of an area of genetic mixing, commonly known as a 'hybrid zone'. The hybrid zone is kept very narrow (about 170 meters wide) by strong natural selection that stops ecologically important genes, such as those that determine shell shape, from crossing the habitat boundary. Thus, the sharp habitat transition acts as a strong barrier to gene flow, which stops the forms from merging together.

The fact that these different forms can mate and exchange genes indicates that they are part of the same biological species. Despite this, there is clear evidence that they are undergoing speciation (Stankowski, 2013). Although natural selection is only acting on genes that determine ecologically important traits (such as those that determine shells shape), it is so strong that it has started to slow the movement of other 'neutral' genes that have no biological function. Moreover, the strength of the barrier varies in different parts of the island. In some locations, it is so strong that the flat-spired and globose forms can coexist in the same location with only minimal genetic mixing; in others places, it is relatively weak, and mixing is extensive. While these snails provide a rare and striking example of ecological speciation in progress, many questions remain. First, is the barrier to gene flow created entirely by natural selection, or have snails subsequently evolved mating preferences, so that snails with different shaped shells no longer find each other sexually attractive? Also, the transition between the habitats appears to be sharper in some places than others. Sharper transitions would mean stronger natural selection, which may explain the local variation in the strength of the barrier to gene flow. Finally, what is happening across the rest of the genome? Past research was based on a handful of neutral genes; new DNA sequencing techniques have made it possible to study tens of thousands of them.

As a naturalist, Dampier would almost certainly be surprised that Rosemary Island has become an important natural laboratory for scientific research. Future studies will deepen our understanding of the genetics of adaptation and the role that it plays in the formation of new species.

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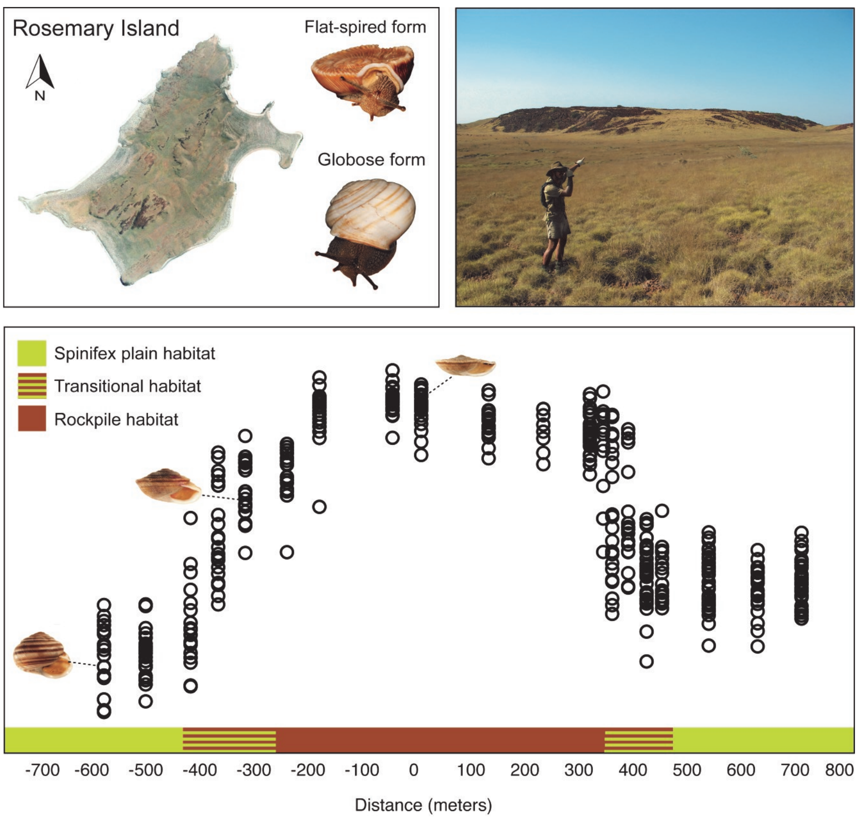

Top left: Rosemary Island with the endemic flat-spired form of Rhagada *and the typical globose shelled form. Top right: one of the rocky hills where the flat spired form is found. Bottom: Variation in shell shape along a transect that extends up onto the rocky hill and back down onto the valley floor. The x-axis shows the distance along the transect in meters. The three colour bar shows the distribution of the two distinct habitat types, and the transition zone between them. Each black circle represents the shape score for a single shell. The change in shell shape closely matches the change in habitat. Note that the transition between the flat-spired and globose forms is much sharper of the right-hand side.*

MSA member profile: Thora Whitehead

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I was born in Valparaiso, Chile to English parents, on January 27 1936. My father was a printer by trade and my mother a very strict and determined school teacher. When I was very young we lived in England where work was difficult for my father to find during and after WWII. My first experience of shells was a shoe box full cowries with which my mother taught me to count. I must have payed so much attention to the treasures that my maths did not progress well — in fact I have mathematical dyslexia. Even simple calculations are a difficulty.

My father finally got a job in Trinidad in the West Indies. In Trinidad I started my education at a girls' high school where at age 15 we sat for the General Certificate of Education, with exam papers sent out from the UK. I did well and won a scholarship for further education, but there were no advanced science courses there. My father then packed me off to a very 'snooty' English boarding school where I studied Botany, Zoology, Physics and Chemistry at advanced level, and ordinary level Latin. I only just scraped a pass in Latin. I had no idea how useful it would be in later life! I emerged from this draconian place at age 18 with no academic ambition at all.

I travelled back to Trinidad and got a job as a technician at a Rockefeller-funded virus laboratory. Just as in Australia, the endemic wildlife carried viruses that affected human populations. Animals were trapped, held in a large airy animal house, were bled, and their serum was tested in mice and eggs. It was an interesting job, and the highlight was a friendly porcupine that used to come down to see me to have its chin scratched. I don't think this animal was ever bled due to its very sharp quills!

After some enjoyable years in Trinidad, my father persuaded me to go to Bristol University in the UK where I studied veterinary science. It was a tough course, and I passed all subjects up to the beginning of the final year, but then gave it away, deciding to marry and to go to Tanzania. Conditions were primitive and one had to adapt to a totally different life, but it was all a fun adventure.

In 1962 my husband was posted to the coast in south Tanzania, and in Mtwara my interest in marine molluscs began. I was attracted at first by the amazing colour variation among *Nerita polita* forma *rumphii* (Mienis in litt.). Soon there was a wash-in of *Janthina*, and from then on I was a shell collector, and wandered further afield to add to my small collection armed with Mr Justice Spry's 'Seashells of Dar-es-Salaam'. My interest in molluscs has since then never waned.

I collect all marine shells. My favourite groups are *Haliotidae* and *Conidae*. *Haliotis* really puzzled me as at first because I thought they were one half of a bivalve! Once back again in the UK I purchased part of an old collection in a box labelled 'Cones to be sorted after the war', which started my interest in this family.

We came to Australia in 1965 as 'Ten pound Poms' and lived in Perth. I soon joined the Western Australian Shell Club and then volunteered for two years for Barry Wilson at WAM sorting the cone collection. The highlight was finding a small *Conus gloriamaris* from one of the Mariel King Expeditions that Barry had been on. It was a very rare species at that time and I was quick to tell Barry the good news. He happened to be with the WAM public relations officer at the time so it was all in the newspaper the next day, and what I initially thought was a hoax call turned out to be the ABC wanting to visit and photograph my shell collection!

I have never had a paid job in Malacology, but have had an interesting career volunteering for some years at the Queensland Museum sorting the bivalve collection, and taking marine enquiries. A highlight was being lent to the Marine Archaeology Dept to identify the shells and artefacts found on the wreck of the 'Pandora'; all the species were common western Pacific species, but it was not possible to tell where they were collected.

I had several secretarial jobs, for a short time as secretary of the Cairns Shell Club and later for some years as secretary for the Brisbane branch of the MSA. Also for some time I was corresponding secretary for Australia for *Hawaiian Shell News*, and I was on the Council of the MSA during Richard Willan's term of office.

Another interesting job came about when Queensland Fishery officers asked MSA members to a meeting, as shell collecting was classed as a Harvest Fishery that they had to regulate. Subsequently, two officials attended one of our meetings and I ended being appointed to the Harvest Management Advisory Committee. Not a paid job, but they covered my cabcharge, airfares and accommodation. Most meetings were in Cairns or Townsville. I was the only non-commercial-focussed person on the committee. My mission was to convince the regulators that shell collectors do not pillage reefs but are students in basic malacology. Four regulatory government bodies were concerned with protecting the Harvest Fisheries. At that time private shell collectors who wanted to exchange with others overseas had to obtain an export permit costing $150, which included a list of the species of shells to be sent. This had to be submitted to Sustainable Fisheries in Canberra. After a long battle I eventually succeeded in having this requirement removed for private collectors. I also served on 'Harvestmac' for ten years; it was interesting to learn about the other fisheries, such as Beche-de-Mer, coral and aquarium fish.

The main highlights of my career are the many published articles on molluscs, and, of course, being co-author of *Bivalves of Australia Volume 1 (1992)*. This took eleven years of hard work, and finally nine months to edit the text. It was published without errata, but there have been taxonomic changes since the first publication in 1992, so my next project will be to revise the text.

During my sorties with shell club trips I have had some interesting finds, two that specially come to mind are a live specimen of *Phyllocoma convoluta* under a huge round rock half buried in sand on a reef off Cairns, and a fine large *Lotoria armata* on Boult Reef in the Bunker Group off Central Queensland. It was a dead specimen but in good condition, and is considered to be the rarest of the ranellids.

My days of reef walking are over now, but I still enjoy adding to my collection by exchange, or purchase at shell shows, and in my shell room there is always something to study when new publications arrive in the mail.

Morula whiteheadae Houart, 2004 (Muricidae).
Photo: T. Whitehead.

Honorary member: Thora Whitehead

The MSA Council is pleased to announce that Thora Whitehead has accepted our offer of Honorary Membership. Thora has been extensively involved with shell clubs and collecting for over 55 years, especially in Africa (Tanzania) and Australia. She developed an extensive scientific collection of molluscan shells during this period, with particular emphasis on Australian material collected by herself from northern Australia to Tasmania and almost everywhere in between. She has also collected during several overseas visits; hence her collection is of international significance.

Her knowledge of molluscs and shells has developed from firsthand experience in handling material and collecting. Keen as always to share her knowledge with other collectors and professionals she has contributed extensively to the popular literature (*Australian Shell News*, *Keppel Bay Tidings*, *Queensland Radula* and many other local and overseas shell/ malacological newsletters) on molluscs and their shells, covering all aspects of collecting, biology and also the history behind famous or culturally/ biologically significant molluscs.

In addition she has been an extremely active member on field trips, mostly to the Great Barrier Reef and Western Australia and locally around Moreton Bay, and such trips have been documented by her both in the Malacological Society of Australia (Qld branch) records of trips and in various club magazines. Such records have proven of great scientific interest as they constitute a snapshot of field finds over 40+ years of trips, and indeed these records have been utilised as sources of species records for recent scientifically compiled checklists of Moreton Bay's molluscan fauna.

In peer-reviewed scientific papers she has described as new to science several species of bivalves from families as varied as dog cockles (Glycymerididae) to venus clams (Veneridae) and has herself had a number of mollusc species named after her including: *Callocardia thorae* Vokes, 1985 (Veneridae), *Morula whiteheadae* Houart, 2004 (Muricidae) (see above) and *Nassarius whiteheadae* Cernohorsky, 1984 (Nassariidae).

With Kevin Lamprell she wrote *Bivalves of Australia*, Volume 1 (1992), which dealt with most of the more popularly collected families of bivalve molluscs, some of which like the scallops (Pectinidae) and venus clams (Veneridae) may also be of great economic and ecological importance. This volume, along with *Bivalves of Australia* Volume 2 (Lamprell and Healy, 1998), constitute the first publications to cover most of the known bivalve species occurring within Australian waters. ~ *Dr John Healy*

Investigating the diversity and distribution of apple snails (Ampullariidae) of the Malay peninsula

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With funding received from a Malacological Society of Australasia Research Grant 2013, my study aims to: *1*, provide the first diversity and distribution map of Ampullariidae in Peninsular Malaysia, and *2*, to collect specimens for a subsequent population genetic study of *Pila scutata* (Ampullariidae) of the Malay peninsula.

The distribution of the Ampullariidae (apple snails), the largest freshwater snails of the Malay peninsula (Peninsular Malaysia and Singapore), has not been well studied although the family has been recorded from Peninsular Malaysia since the 1800s (see Maassen, 2001). Conversely, the distribution of ampullariid species in Thailand has been mapped, and molecular studies of the Thai species have been undertaken (e.g., Keawjam, 1986; Keawjam & Upatham, 1990). Knowledge of Ampullariidae phylogeography (especially that of the native *Pila* species) in the region therefore remains incomplete. They have, however, been the focus of medical studies because *Pila* spp. are parasite hosts (e.g., Lim *et al*., 1978).

Four species of *Pila* have been recognised from Peninsular Malaysia to date: *Pila ampullacea*, *Pila gracilis*, *Pila polita* and *Pila scutata* (Maassen, 2001). However, the taxonomy of *Pila* is complicated, and some of these species may be variants of others (Keawjam, 1990). Also, some of the Malaysian records are centuries old, and even the most recent records were from the mid 1990s (see Maassen, 2001). Many ampullariid habitats have likely been modified or disappeared since. In Singapore, *Pila scutata* is the only indigenous Southeast Asian ampullariid species present and appears to be declining, possibly because of competition from the confamilial golden apple snail *Pomacea canaliculata* (Tan *et al*., 2013). Unfortunately, there have yet to be empirical studies done to confirm the decline or the ecological impacts of the introduced *Pomacea* in this region. Urgent assessment of the status of *Pila* in Malaysia is needed as *Pomacea* is already well established in the peninsula (Yahaya *et al*., 2006).

Pila scutata. Photo Ting Hui Ng.

In addition, the status of *Pila* in Singapore is uncertain. Although the Apple Snail *Pila scutata* is assumed to be native to Singapore, it was never collected from undisturbed habitats in Peninsular Malaysia and Singapore (Johnson, 1973). The snails were widely eaten in the past (Lim *et al*., 1978), and thus its present distribution may be the result of human-mediated rather than natural dispersal. Population genetics research has been used to determine whether a particular mollusc is native to an area, or if it had been translocated by humans (Hayes *et al*., 2008; Grindon & Davison, 2013). In addition to determining the distribution of Ampullariidae in Malaysia, an effort to collect the snails would provide material for genetic analysis, and contribute to resolving the natural distribution and taxonomic issues relevant to *Pila* in this region (Keawjam, 1986; Low *et al*., 2013).

Ampullariids will be recollected from sites known from historical data in nine states in Peninsular Malaysia (Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore; Sykes, 1902; Annandale, 1921; van Benthem Jutting, 1960; Ismail, 1994; Chan, 1997; Chan, 1998). Other suitable habitats in the vicinity will also be sampled, such as water bodies around limestone outcrops, ditches, reservoirs, riceland, and ponds (Johnson, 1973). Other mollusc species encountered will also be recorded. A piece of foot tissue will be taken from ampullariids at each site, and stored for genetic comparison of populations in Malaysia and Singapore to be conducted at a later date.

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President's report, AGM 2013

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We had a very successful conference in Melbourne in December 2012 with a great student presence, dynamic discussions, and a small but dedicated organising committee. During the 2012 AGM at the conference, the current MSA council was elected.

Over the past year Council has worked to improve and update aspects relating to publications and communication, including:

Change of *Molluscan Research* publisher to Taylor and Francis. This has resulted in small financial savings, increased online capability, stronger support services, and a more professional-looking publication. Many thanks to Winston for making this happen;

Reformatting of the MSA Newsletter, including member options for digital-only subscriptions. Many thanks to co-editors Mandy Reid and Jonathan Parkyn for sourcing interesting and relevant content and ensuring the newsletter's professional appearance;

Appointment of a new council position (Public Relations Officer) and the segregation of two previous positions (Membership Secretary and Treasurer) that had previously been held by a dedicated and hardworking individual (Don Colgan);

Effort to improve communication with the Victorian branch, including the appointment of an MSA councillor who is active in the branch (Platon Vafiadis);

Effort to develop and strengthen ties with Affiliates and other like-minded organisations including assisting former branches with their transition to independent organisations (e.g. Qld branch to the Brisbane Shell Club);

Development of social networking presence via an MSA Facebook group, set up by Caitlin Woods. The group is open to non-members but requires approval from an administrator (Caitlin, Carmel, Rachel) prior to participating. As of November 2013, the Facebook group had 116 participants, with a range of posts including molluscan photographs, media links, MSA news, and introductions and questions from participants;

Migration of the MSA website (www.malsocaus.org) to a content management system which has resulted in a more professional appearance that can be more readily updated, including by those with minimal IT experience. Many thanks to Shane Penny for working behind the scenes to make this happen.

In addition, we received 10 applications for the annual molluscan research grants, and the quality was again extremely high this year. Kirsten Benkendorff yet again led the grant committee, and we're very grateful to her, Simon Massey and Jonathan Parkyn who also assessed grant applications in 2013.

The applicants were based across nine different intuitions across three countries. The projects encompassed a diverse range of molluscan research, including responses to climate change and pollution, behavioural ecology, biogeography, taxonomy, immunology and bioengineering. The quality of applications was very high making it a tough decision for the selection committee. Two projects were ranked equal top and awarded $1000 each and a runner up was awarded $680 as a contribution towards their research projects:

- Sue-Anne Watson, James Cook University 'Giant clams and global change: the potential for light to ameliorate the negative effects of ocean acidification and warming on giant clams'.
- Ng Ting Hui, National University of Singapore 'Investigating the diversity and distribution of apple snails (Ampullariidae) of the Malay Peninsula'. (See project summary on previous page).
- Clarissa Fraser, University of Sydney 'Does desiccation stress explain patterns of limpet orientation?'

I'd also like to thank our Secretary Carmel McDougall whose good record keeping and helpful reminders ensure we all remember upcoming meetings and meet our obligations.

All our council members and office bearers are to be commended in volunteering their time to help maintain and improve the MSA. The dedication and effort expended is much appreciated!

The upcoming year will see the MSA begin planning for the 2015 conference, finalise the website and online journal content issues, and continue to strengthen relationships with our members, branch, and partner organisations.

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