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NEWSLETTER

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Surveying the Tasmanian sea-mounts for molluscs – some preliminary findings

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Last summer I was privileged to be invited to join a research voyage aboard the *RV Investigator* to the Tasmanian sea-mounts – the undersea mountains lying just beyond the continental shelf to the south and east of Tasmania, whose peaks are seldom closer to the surface than 600 m, and whose bases are at 1500-2000 m depth. This was CSIRO's third decadal survey of these sea-mounts, with the broad aim of monitoring recovery of deep-sea cold-water coral communities following the partial closure of the orange roughy fishery in the 1990s. The bulk of the research effort, and ship's time, was dedicated to obtaining video footage from remotely controlled camera-tows cleverly deployed so as to skim over the surface of a seamount from its summit to its base. Successive tows outwards from the summit were repeated along different bearings. The resultant video footage – hundreds of hours of it – was then digitally annotated and categorised by on-board **(cont'd on p.3)**

An assortment of deep-water molluscs trawled during the expedition. Image: Simon Grove.

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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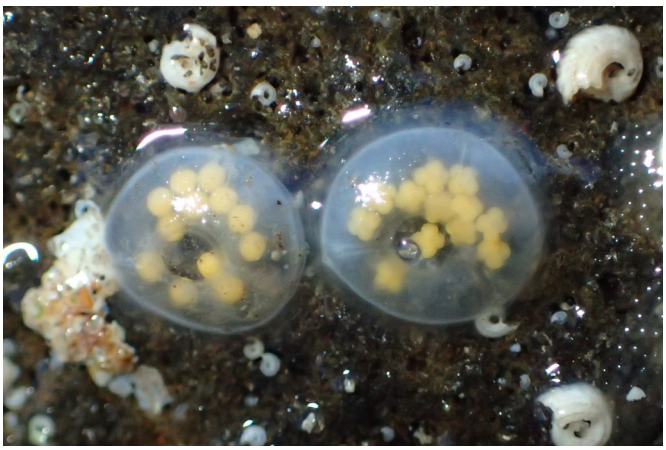


***Bedeva vinosa* egg capsules on the under-surface of a mid-littoral rock at Kitty Miller Bay, Phillip Island, Victoria, Saturday 21 April, 2018. Zygotes within the capsule on the right have begun to cleave. Capsule diameters are in the order of 4mm. (Photo: P. Vafiadis).**

Bedeva vinosa egg capsules

Bedeva vinosa (Lamarck, 1822) (Muricidae) is a common predatory snail in the Victorian littoral zone. Found along southern Australia from New South Wales to Fremantle, Western Australia (Wilson, 1994), its egg capsules were described by Synnot (1980). Some capsules of this species were seen at Kitty Miller Bay last year and, on closer inspection, zygotic cleavage had commenced in some. Synnot (1980) observed capsules to contain 6-9 light orange eggs (noting that some may serve as nurse eggs) and suspected that, pending food availability, spawning occurred year-round. The capsules shown at left each contained 12 yellow-orange eggs but otherwise match Synott's description accurately, with two sutures from the central fenestrum to the periphery dividing the uppermost surface unevenly.

Further reading: Synnot RN (1980). The egg capsules of *Lepsiella vinosa* (Lamarck, 1882—sic) (Muricidae: Thaidinae). *Journal of the Malacological Society of Australia* 4(4): 209-211.
Wilson B (1994). *Australian marine shells. Prosobranch gastropods, Part 2*. Odyssey Publishing, Kallaroo, Western Australia.

P. Vafiadis

interpreters trained on similar footage. These data will help to build up a picture, and ultimately models, of the spatial variation in sea-bed substrate as well as coral coverage, condition and composition. The data will also be compared with similar data collected on earlier voyages, and related to past or present fishing intensity as well as to other variables such as aspect, depth and exposure to currents.

Besides the camera-tows, the research programme also allowed for smaller numbers of benthic trawls, using a beam-trawl with a width of 4 m and a net mesh-size of 10-12 mm. These trawls had two main aims: to build up a picture of the macro-invertebrate fauna living on or around the various sea-mounts; and to obtain specimens of some of the distinctive soft-corals featuring in the videos so that the footage could be annotated with the coral species, where feasible. Since it was neither feasible nor ethical to trawl through structurally complex stands of corals, efforts were focused instead on flatter or smoother terrain – for instance at the foot of sea-mounts, where the trawl was less likely to get snagged and where damage to living corals would be limited.

I was part of a team of biological sample sorters, joining my colleague Dr Kirrily Moore (a deep-water soft-coral expert) from the Tasmanian Museum & Art Gallery (TMAG), plus others, with various areas of taxonomic expertise, from mainland Australian museums. Since many of these sea-mounts now lie within Australian Marine Parks, the team also included representatives from Parks Australia. Some of us were veterans of previous voyages, but I was one among several rookies, my seafaring abilities as-yet untested. We were guided in our sorting and identification work by CSIRO's zoology photographer Dr Karen Gowlett-Holmes, who maintains a photographic database comprising her own excellent on-board photos of nearly all the named and un-named taxa ever landed on voyages such as this over the past couple of decades.

My particular interest, of course, was in the molluscs. At TMAG I had already worked my way through live-caught material trawled in CSIRO's previous survey of the same sea-mounts conducted a decade earlier, and originally sent to Dr Richard Willan at the Museum & Art Gallery of the Northern Territory. By my reckoning, that survey turned up some 74 mollusc taxa (i.e. putative species). Nearly half of these represented seemingly undescribed species, to which I gave code-names, some adopted from Karen's schema, reflecting their taxonomic affiliations (e.g. *Cuspidaria* TAS sp 01). My hopes were high that there would be similarly rich and interesting pickings this time around. I was not the only scientist on board with an interest in the molluscs: Drs. Francesco Criscione, Ingo Burghardt and Alison Miller from the Australian Museum also participated.

Trawling proved to be a very hit-and-miss affair. It did not take much of an upset to the ship's tight schedule of operations (for instance, due to bad weather, bad currents or equipment failure) for a planned trawl to be postponed or pushed off the agenda. Nevertheless, over the course of four weeks, there were 14 successful trawls. All produced molluscs: some as few as 5 taxa, while one memorably productive trawl came up with 125 – including what are probably the world's southernmost cowries (very worn specimens of *Umbilia hesitata* and a *Notocypraea* species). Our usual procedure was to bring the entire contents of the trawl into the wet-lab in Nally-bins, where it would be tipped into smaller trays so that each of us could pick through the contents of a tray and pull out all the living macro-invertebrates, plus (at my instigation) a range of dead mollusc shells. The molluscs from the various trays would then be consolidated for closer examination and separation into distinct taxa for either immediate preservation in ethanol (for live-caught specimens) or drying out (for dead shells).

Upper photo: living *Sassia kampyla* (Ranellidae) and, below, an assortment of other trawled mollusca. (Photos: Simon Grove)

For the first leg of the voyage, when Francesco was on board, he would assign preliminary names to members of the superfamily Conoidea; otherwise, all on-board identifications were by me. These remain tentative, pending closer examination back at TMAG over the coming months. Not all shells proved identifiable, of course, since many were old and corroded; but I made an effort to identify even fragments if these seemed to belong to otherwise unrepresented taxa.

The most productive trawl was unusual in that the net was completely clogged with a couple of tonnes of fine 'biogenic' grit (essentially coral rubble and dead shells) – material that would usually pass straight through the mesh. So in this case, we picked over the net contents on deck, before 95% was shovelled, unsorted, back overboard. Nearly all those 125 mollusc species were extracted from the couple of Nally-bins of grit that we were able to sort through in the web-lab; indeed, most were micro-molluscs that I extracted, under a dissecting microscope in the dry-lab, from my own single tray's worth of grit. It's tantalising to think of how many shells and how many additional species must have been in the other trays of grit that I didn't sort under the microscope; and even more so in the grit shovelled back overboard!

Sorting material on deck.
(Photo courtesy of Simon Grove).

It would be premature to list all the collected species, and putative species, here, but Table 1 (on p. 5) gives a breakdown of the number of taxa by family. The profile is, of course, very different from those typical of shallower waters, including many families (such as Cetoconchidae, Pulvinitidae, Anatomidae, Cocculinidae and Ptychatractidae) that are seldom, if ever, encountered closer to shore.

Interestingly, of the 74 previously recorded (live-caught) taxa, I recorded fewer than half (33 taxa) in the current survey. However, I additionally recorded 203 taxa, bringing the total number of taxa recorded in the current survey to 236 and the total across the two surveys to 277. It's worth noting that in the current survey, just 65 taxa were collected live, while three times as many (213 taxa) were collected dead. Thus it appears to have been the change of sorting protocol to include dead shells that largely accounted for the big jump in taxa between the two surveys. This begs the question as to why dead shells aren't included in the standard sorting protocols for CSIRO's surveys. The answer, I think, is that it is not clear how long dead shells remain on the sea-floor before disintegrating or being buried, leaving open the possibility that a species might be erroneously recorded as locally extant when it is in fact extinct; furthermore, one cannot be certain that the dead shells originated from the area trawled: they may have been washed there by currents, perhaps from many kilometres away – for instance on the continental shelf. An example of the former issue is the clam *Tucetona laticostata* (Glycymerididae), a distinctive species considered endemic to New Zealand waters but which has nevertheless been found 'as empty worn shells off southern New South Wales' (Lamprell & Whitehead, 1992). I identified a single, worn valve of what appears to be this species; but I have no idea what it was doing down there, where it came from or how it got there. Further examples include the shells of several species of pelagic 'sea-butterfly' (Cavoliniidae, Creseidae, Peraclidae) and the shell of the pelagic violet-snail *Janthina janthina* (Epitoniidae). An example of the latter issue would be the large number of old, eroded *Tawera* (Veneridae) valves in some of the trawls. They were too worn to be identified to species, but to the best of my knowledge, neither of the Tasmanian species (*T. gallinula* and *T. lagopus*) lives at depths greater than about 100 m.

Above: Selected mollusca from the expedition: Gastropoda from left to right: *Ataxocerithium* sp., 21 mm; *Claviscala* sp., 26 mm; Bivalvia from top to bottom: *Cardiomya* sp., 12 mm; *Cuspidaria* sp., 20 mm. Photos: Simon Grove

Class	Family	No. of taxa
Aplacophora	(Unplaced)	1
Bivalvia	Anomiidae	1
	Arcidae	4
	Carditidae	3
	Cetoconchidae	1
	Condylocardiidae	2
	Cuspidariidae	8
	Cyclochlamydidae	1
	Glycymerididae	2
	Limidae	7
	Limopsidae	2
	Lucinidae	1
	Lyonsiellidae	1
	Mytilidae	1
	Neoleptonidae	1
	Pectinidae	5
	Philobryidae	2
	Propeamussiidae	1
	Pulvinitidae	1
	Veneridae	1
	Verticordiidae	3
	(Bivalvia unplaced)	1
Cephalopoda	(Teuthoidea unplaced)	1
Gastropoda	Acteonidae	1
	Anatomidae	2
	Belomitridae	2
	Borsoniidae	7
	Buccinidae	6
	Calliostomatidae	12
	Calyptraeidae	1
	Cancellariidae	2
	Capulidae	3
	Cassidae	3
	Cavoliniidae	5
	Cerithiidae	1
	Cerithiopsidae	1
	Chilodontidae	4
	Chromodorididae	1
	Cocculinidae	1
	Cochlespiridae	3
	Colloniidae	2
	Colubrariidae	3
	Columbellidae	4
	Costellariidae	2
	Creseidae	1
	Cypraeidae	2
	Cystiscidae	7
	Drilliidae	4

Class	Family	No. of taxa
	Epitoniidae	8
	Eucyclidae	3
	Fasciolariidae	1
	Fissurellidae	7
	Horaiclavidae	5
	Limacinidae	5
	Mangeliidae	3
	Margaritidae	7
	Marginellidae	13
	Mathildidae	1
	Mitridae	1
	Mitromorphidae	1
	Muricidae	11
	Nassariidae	2
	Naticidae	2
	Newtoniellidae	5
	Orbitestellidae	1
	Peraclidae	1
	Phenacolepadidae	1
	Pseudococculinidae	3
	Pseudomelatomidae	6
	Ptychatractidae	2
	Pyramidellidae	2
	Ranellidae	7
	Raphitomidae	8
	Retusidae	1
	Ringiculidae	1
	Rissoidae	2
	Scaphandridae	2
	Skeneidae	4
	Solariellidae	8
	Tornatinidae	1
	Triphoridae	1
	Tritoniidae	1
	Trochidae	2
	Turritellidae	3
	Umbraculidae	1
	Velutinidae	1
	Volutomitridae	1
	(Conoidea unplaced)	2
	(Heterobranchia unplaced)	4
	(Seguenzioidea unplaced)	1
Polyplacophora	Loricidae	1
Scaphopoda	Laevidentaliidae	3
	(Dentaliida unplaced)	1

Table 1. The number of mollusc taxa (putative species) recorded from the 14 trawls, by family (in alphabetical order)

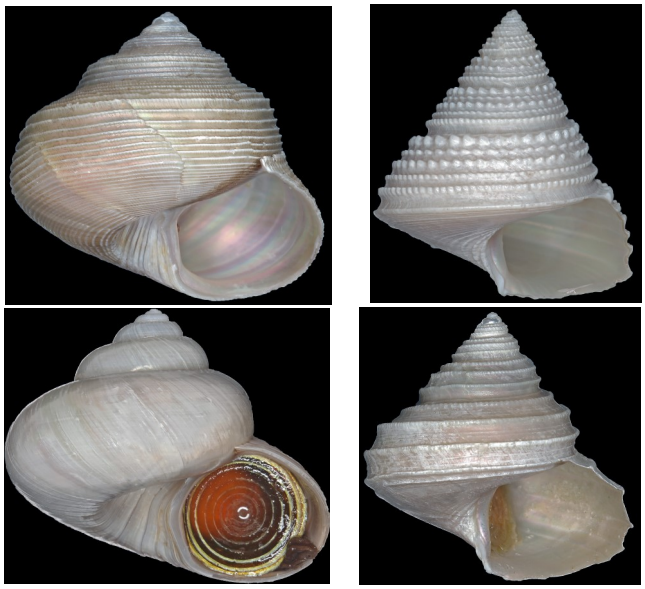
Meanwhile, the relative lack of overlap in live-caught taxa between the two surveys is likely to be a reflection of the fact that each survey is only sampling a tiny extent of sea-floor, and (by necessity) only the structurally rather simple and uniform parts of it at that; so the species returned to the surface are probably not much more than a random selection of a much more substantial regional species-pool.

While sorting and retaining dead shells greatly boosted the number of mollusc taxa detected, I have so far only been able to put species-names to a little over half of these. That leaves 106 putatively undescribed taxa comprising dead shells only – or even a single dead shell, or part thereof. To add to the challenge, most are micro-molluscs too. These days, best practice for describing new species requires describing not only shell morphology but also the morphology of the animal that made it, and preferably inclusion of molecular data too. So, it would be a challenge to formally describe most of these taxa. That said, I am open to working up descriptions for particular taxa if there is a view that doing so will prove adequate in the absence of these other elements – I would welcome feedback on this. This would seem most palatable for morphologically very distinctive taxa. One I have in mind is a small and very steeply conical shell that I have called *Conisepta* TAS sp 01 (Fissurellidae). But I only found a single example (in the grit from that memorably productive trawl), and it didn't travel well between the ship and museum (it's now in a couple of pieces!).

Another taxonomic avenue that I would like to explore is the identity of the various members of the family Naticidae. These were very numerous, as both live animals and dead shells, and came in a range of sizes. The largest would appear to be a species of *Falsilunatia*. As to the smaller animals, some look very like species of *Natica* that were originally described a century ago, on the basis of shells only; but then as the shells get larger there is a gradation in shape until they 'become' *Falsilunatia*! Perhaps a molecular approach would determine whether they are indeed all *Falsilunatia* (or at least all one taxon), or multiple taxa, possibly involving more than one genus. Any takers?

Having now had time to reflect on my on-board experiences, I have rather put to the back of my mind how I spent the first few days almost unable to stand up due to sea-sickness; how it took me two of my three weeks to really get my sea-legs; how even then every physical and mental task was that much harder to perform; how unnerving it was to be trying to sort micro-molluscs under the microscope when they kept rolling from one side of the petri-dish to the other (the microscope itself was bolted down to the bench-top). No, the learnings that are foremost in my mind are the professionalism of not only the scientists but the entire crew; the massive investment that goes into funding the design, construction and operation of a research vessel; and above all, the human ingenuity that goes into preparing for and successfully carrying out such a research-based voyage. As I know from my past life as a forest ecologist, surveying and sampling a 'land-mount' is no trivial exercise; but when your mount is up to two kilometres beneath the roiling surface of a cold ocean, a long way from shore, in pitch darkness, at monstrous pressures and buffeted by swirling currents, it adds multiple extra layers of complexity. It's often said that we know more about the surface of the moon than we do about our deep oceans. I now have a better understanding of why this is so.

With thanks to all those who facilitated my participation in this voyage and who helped make it the memorable experience that it was. Please contact me for further information on the molluscs recorded, or for exploring possibilities for new species descriptions.



Top row, left to right: *Antimargarita* sp., 14 mm; *Calliostoma* cf *cochlias*, 13 mm. Lower row, left to right: *Margarites* sp., 21 mm; *Maurea eltanini*, 23 mm. All images: Simon Grove.

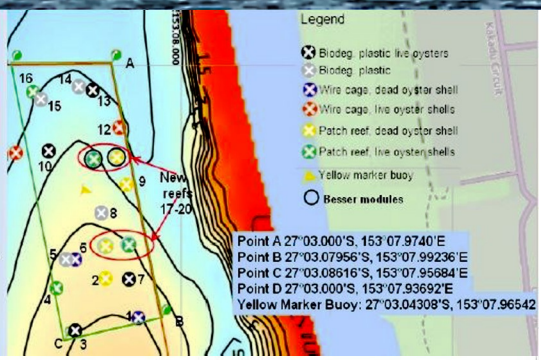
Malacological research grants

Applications for the 2019 MSA Malacological Research Grants are currently being accepted. The deadline for applications is 30th June, 2019. There are no restrictions on who may apply, but the committee granting the awards will generally give preference to candidates who are not employed as professional malacologists. Up to $2000 is available to assist with costs associated with field trips or research consumables. For further details go to http://www.malsocaus.org/?page_id=27

Queensland's PUMICESTONE PASSAGE
Oyster reef restoration

WHY IS IT IMPORTANT?

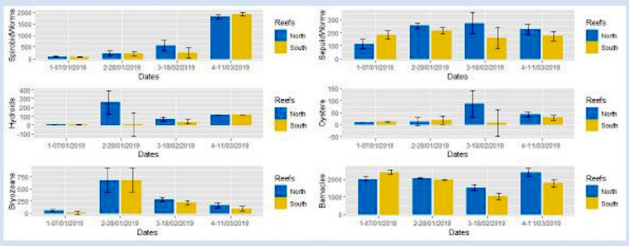
Historically, Pumicestone Passage contained extensive shellfish reefs. These reefs were an important food source for indigenous populations, and, later, for early colonists. However, overexploitation and increased sedimentation heavily impacted oyster populations, and almost no shellfish reefs exist in the passage today. The 'Restore Pumicestone Passage' project aims to restore some of these oyster reefs.



WHAT HAVE WE DONE?

Researchers from Griffith University and the University of Nottingham have joined forces with the 'Restore Pumicestone Passage' team to investigate what animals are settling on the artificial reefs. We evaluated invertebrate settlement on submerged besser bricks, and used genetic techniques to determine exactly which oyster species are being recruited.

SETTLEMENT TRENDS

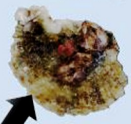


Settlement trends of various invertebrate groups were generally similar on the northern and southern reefs.

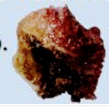
WHAT DID WE FIND?

We expected to find settlement of Sydney rock oysters on the reefs, however DNA analysis revealed that the oysters that were settling were from three previously unreported species, despite Sydney rock oysters existing intertidally nearby. No DNA records currently exist for these species, so they may not have been previously described.

Ostrea sp.



Crassostrea sp.



NEW OYSTERS FOUND

Dendostrea sp.

CONCLUSIONS AND FUTURE RESEARCH

- The detection of three oyster species that had not previously been sequenced or recognised as components of shellfish reefs highlights how little is known about the invertebrate biodiversity associated with these systems.
- Timing of peak settlement differs for different taxonomic groups.
- Extension of this analysis over a longer period of time and for more invertebrate groups will provide important information about settlement dynamics and the impact of shellfish reef restoration projects.
- Future assessments of shellfish reef biodiversity should include genetic analyses for more accurate species identification.

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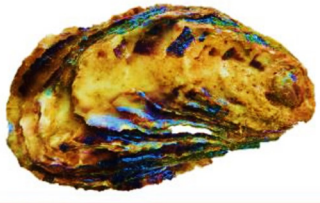

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Addenda to the J. H. Macpherson bibliography

Robert Burn, Malacological Society of Australasia

Three omissions have been discovered in the bibliography of the late J. Hope Macpherson published in this newsletter by Burn & Vafiadis (2018). To her publication list, the following must now also be added:

Macpherson, J.H. (1957). Pioneering in conchology. *Australian Museum Magazine* 12(6): 173-176.

Black, J.H. (1976). Spawning and development of *Bedeva paivae* (Crosse, 1864) (Gastropoda: Muricidae), compiled from notes and observations by Florence V. Murray and G. Prestedge. *Journal of the Malacological Society of Australia* 3: 215-221.

Black (Macpherson), J.H. (2005). The Kershaw dynasty. *Victorian Naturalist* 2005: 122(6): 351-357.

Reference: Burn R, Vafiadis P (2018). J. Hope Macpherson (Mrs. Ian K. Black) 7 February 1919—25 January 2018. *Newsletter of the Malacological Society of Australasia* 165: 5-9.

The Inverloch Shell Museum and Display

T. Joan Hales (email phasianella@dcsi.net.au) and Janet Davies, Honorary Curators

Inverloch is a coastal Victorian town situated on the north-western bank at the entrance to Anderson's Inlet, and is home to the Inverloch Shell Museum and Display. The history of this museum goes back to the 1960s when a local Inverloch resident, **Mr Jack Lewis**, began to encourage visitors to explore his shell collection at his home in Pier Road, Inverloch. Later, the display was relocated a number of times to allow better access to the public. After Jack Lewis' death in 1978, the collection remained on display in the Yacht Club rooms at Inverloch until 1980, when the Inverloch community raised money and purchased the collection from the family (this formed the base to which other collections, donations and specimens have been added, continuing to the present day).

Honorary Curators Joan Hales (at right) and Janet Davies at the Inverloch Shell Museum and Display, 20 March, 2019. (Photo courtesy of Joan Hales).

A Trust was also set up by the local community to oversee the enhancement and maintenance of the collection. Shortly after the purchase of the **Jack Lewis Collection**, the Trust purchased the **Norma Drysdale Collection** in 1989, almost doubling the number of specimens available for display. **Noel and Betty Hope**, Melbourne-based collectors for more than 50 years, donated their collection to the Trust in 1990 (a major portion of the Museum's cone shell collection came from the Hope donation).

In 1992, before disbanding, the Trust gave control of the collection to the Shire of Woorayl (now the Bass Coast Shire Council following local council amalgamations in 1994) and councillor **Rex Bowman** and his wife **Joy** took on the responsibility of caring for the collection**.** The Council agreed to help with building a home for the growing collection at Ramsey Boulevard & Esplanade, Inverloch. Funds were raised, with the South Gippsland Conservation Society agreeing to assist financially in return for use of part of the building (known as the Bunurong Environment Centre) for their activities. As the collection grew, an extension was added to the rear of the building.

When the Bowmans departed to live in Queensland, the Shire formally appointed **Mr Stan Sanders** to take over the responsibility of caring for the collection. Prior to his departure to Melbourne, Stan handed over responsibility to the present Honorary Curator, **Joan Hales** in early 2002. **Janet Davies** joined Joan as an Honorary Curator at around this time. The Council continues to own the collection under the auspices of the South Gippsland Conservation Society, who lease the building at a minimal rent in return for overseeing entry to the shell museum.

Some of the specimens at the Inverloch Shell Museum and Display. (Photo: Joan Hales).

The South Gippsland members of the Malacological Society of Australasia had been using the building for their monthly meetings with a Shire representative attending. **Jack Austin** acted as tutor, educating members with his talks (illustrated with shells from his excellent collection), answering any questions raised as well as assisting with identifications. Later he donated many specimens to the display collection. Other local members also took on the regular curating of the collection to assist Stan Sanders. They included the late **Cecile Carroll** (who undertook identifications and display work) and the late **Joe Griscti** (who was responsible for many of the renovations, being an excellent carpenter). **Eddie Beulke** also occasionally came over from Morwell to assist.

The Inverloch Shell Museum and Display (Photo: Joan Hales)

Besides working on curating the collection, the current curators survey localities in the area regularly, keeping records of the species seen. Originally, these lists were based on those of the Field Naturalists Club of Victoria, Marine Research Group. Over time, the lists have increased in both scope and species seen. Using these lists as a base, a booklet, *"Shells of the Bunurong"* was prepared in 2004, listing species along with a short description. Copies were sold by the South Gippsland Conservation Society with the small profit shared by the Society and the Museum.

Today, the collection is open six days per week for public viewing, as well as being used by the South Gippsland Conservation Society's Education Officer as a base for marine education programs. Entry is $2.00 per person (children under 5 are admitted free) with funds going to museum maintenance and improvement. The display includes about 8000 marine shells, land shells and freshwater shells, with many other non-molluscan marine specimens. Items are constantly being added. The museum houses a large collection of Victorian shells which the current curators are attempting to make as complete as possible, adding species as they are found. The collection includes a left-handed *Cymatiella verrucosa* collected by Jack Lewis at Waratah Bay and a tide-line specimen of the very uncommon *Vexillum*

pellucidum found at Harmers Haven, Victoria. Other comprehensive collections include both Australian and overseas specimens of Cypraeidae, Volutidae, Conidae (as previously defined) and a significant land snail collection (the latter is in need of a complete overhaul to bring it into line with modern taxonomy).

At the request of the South Gippsland Conservation Society, there was recently a small change to the title which they believed better reflected the nature of the display. It is now officially called 'The Inverloch Shell Museum and Marine Display'.

Editor's note:
The Inverloch Shell Museum and Display is a must-see for any visitor to the local area. An outstanding scientific collection and educational centre, it will no-doubt inspire a future generation of malacologists. The environmental bookshop, also housed within the building, is very good. Joan and Janet have also built up a formidable malacological library within the collection which guides their curatorial work. See also the South Gippsland Conservation Society's website at http://www.sgcs.org.au/index.php for further information and images.

Juvenile sea-hare images

Courtesy of Matt Nimbs, Southern Cross University, Coffs Harbour, NSW

Many sea-slug and nudibranch books illustrate adult examples of the species they cover. Below are some images of juvenile sea-hare specimens (Mollusca: Aplysiidae), which, from left to right, are:

***Dolabrifera brazieri* G. B. Sowerby II, 1870**, 11 mm, Woolgoolga, NSW (adult length to 150 mm);
***Aplysia juliana* (Quoy & Gaimard, 1832)**, 7 mm, Emerald Beach, NSW (adult length to 200mm); and
***Aplysia extraordinaria* (Allan, 1932)**, 22 mm, Nelson Bay, NSW (adult length up to 400 mm).

All photos are by Matt Nimbs, and thanks to him for sending them in.