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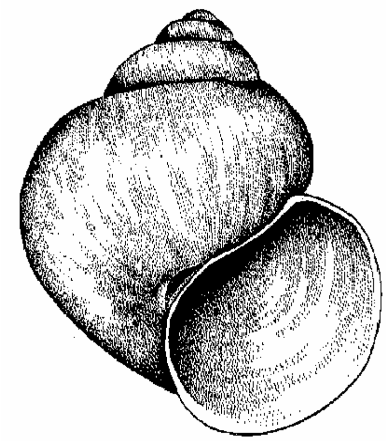

The River Snail *Notopala hanleyi*: An Endangered Pest

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Most of us are inclined to dismiss "animals without backbones" as a minor cause in conservation—rather, we focus on animals with which we feel more empathy. Yet more than 95% of all animals are invertebrates, and they are a vital part of the ecosystems that, as conservationists, we try to protect. This article tells the story of a lowly snail with portents for the entire River Murray ecosystem in South Australia.

You may have seen many scattered snail shells along the banks of the River Murray. The most common are about the size of a garden snail, some bleached and crumbling but others seemingly fresh, still with an intact olive-green sheath ("periostracum"). In 1935 Bernard Cotton, Conchologist at the SA Museum, observed that these "river snails", named *Notopala hanleyi*, lived in the deep littoral zone of the Murray where they could be found gliding across the bottom sediments (Cotton 1935a). He noticed that the same shells were scattered through the middens left by Aboriginal Australians, confirming them as long-time residents of the Murray. They cannot have been an important part of the Aboriginal diet, like the larger freshwater mussels, and probably were scooped up by accident from the same river-edge habitat.

In the years since little has been written of *N. hanleyi*, other than to echo Cotton's words. Many commonplace things of the Murray have received scant attention in the past, and as a result we know little of the river as it was before regulation by dams and weirs. When studies of the river began at the University of Adelaide, over 20 years ago, river snails were exceedingly rare. The last-reported specimen was from the river at Wood's Point in the early 1980s (Bennison et al. 1989), although this might have been an empty shell rather than a live snail. There are older, unequivocal reports from researchers concerned with snails as hosts for trematode parasites—they collected nearly 5000 specimens of river snails in 1937-47 (e.g. Johnston & Beckwith 1947).

What little evidence there is suggests that the river snail embarked on a sharp downward path toward extinction after about 1950, when flow regulation intensified dramatically. The species had virtually disappeared 25 years later, and in our laboratory during the 1980s we were inclined to pronounce it extinct. Its only known range had been the lower Murray and Darling rivers, and we never could find live snails.

Re-Discovery

You can imagine our delight when in 1992 Geoff Parish, an engineer from the Engineering & Water Supply Department at Barmera, brought in a sample of snails that were causing major problems in the Loveday irrigation pipeline. Fran Sheldon, then a postgraduate student studying the Murray, was confronted by a bucketful of “extinct” snails—*Notopala hanleyi*. Fran learned that the snails occurred in such numbers that they blocked pipes, pumps and sprinklers and also fouled the water, as they would die for want of oxygen when the pumps were still. The irrigators were forced to attend their machinery continually, unblocking sprinkler heads and pipes and in some cases accumulating trailerloads of shells. The snails since have been found in two other pipelines in the same area (Sheldon & Walker 1993a). They continue to cause distress to the irrigators, and to their families dependent on the pipelines as a source of domestic water. Some seasons, it should be said, are much worse than others.

We were not surprised that snails should cause problems of this kind, as they have been troublesome for irrigators at Renmark and elsewhere. This time, however, the culprit was a virtual ghost. Could an endangered species also be a pest? The paradox was taken up by the print media (“Revenge of the Gastropods”), and Fran also related the story on the ABC-TV science magazine, *Quantum*.

Survivors and Refugees

The re-discovery of *Notopala* is all the more remarkable because it is merely one of about 18 species of native snails known to have disappeared from the Lower Murray in the past 30 years or so. *N. hanleyi* is confined to this region but, so far as we are aware, the other species still remain in New South Wales and Victoria. These “regional extinctions” are still significant, as species on a path to absolute extinction are likely first to contract their range, leaving fragmented sub-populations in isolated areas. They are significant too because the disappearance of virtually an entire complement of animals surely is a sign of profound changes in the River Murray ecosystem.

One of the regional native species remains reasonably common. The freshwater limpet *Ferrissia* is a cryptic snail with a tiny (1–2 mm), cap-like shell, scarcely bigger than the letter “O” on a typed page. The limpets have an affinity for the strap-like leaves of water ribbons, *Vallisneria spiralis*, and occur in sheltered pockets at many places along the main river channel.

A few other native species remain as refugees in irrigation systems, like the one at Renmark. These are prosobranch snails which, like *N. hanleyi*, have gills (“ctenidia”) and an operculum that closes the shell aperture. Pulmonate snails, like *Ferrissia*, respire through an air-filled “lung” and lack an operculum. Prosobranchs prefer flowing, well-oxygenated water, whereas pulmonates are typical of floodplain wetlands where oxygen levels and other conditions can vary widely.

These native species, if not completely absent from the river, are exceedingly rare. It would not be surprising to discover small, localised populations, or to witness a minor recovery in the aftermath of strong river flows. Sporadic, short-lived resurgences are typical of other declining species like the Murray crayfish, and even the Murray cod. But this would not disguise a persistent downward trend. The environment is no longer favourable for snails most of the time. Extinctions are on the horizon.

One other snail is reasonably common along the margins of the Lower Murray, but it is a pretender. The aquarium snail *Physa acuta* is of European origin, but is widespread in eastern Australia and sporadically abundant along the margins of the Murray. *Physa* is an air-breathing (pulmonate) snail with a fragile, amber-coloured shell 6-8 mm long. It is an animal "weed", pre-disposed to life in disturbed environments. It tolerates even polluted environments like the Torrens River in Adelaide.

A Changed Food Supply?

It is not clear why *Physa* and *Ferrissia* are able to live where other snails cannot, although the latter may owe its survival to its small size. Freshwater limpets feed upon tiny particles of organic material, perhaps including bacteria, trapped within the "biofilms" (coatings of algae, bacteria and fungi) that grow on submerged rocks and wood. Those small food particles remain, but the composition of the biofilms may have changed to the disadvantage of other snail species.

In the unregulated Murray biofilms probably had a higher bacterial content than they do now, and as a result they would have contained more protein and provided more nutritious food for snails (Sheldon & Walker 1993a). With the advent of regulation, including changes in the patterns of water-level fluctuations and the underwater light regime, the composition of the biofilms may have shifted toward dominance by algae and so declined in nutritional value. Filamentous algae may also be difficult for a snail to manipulate. Thus food, or lack of food, may explain why some snails have disappeared from the river.

But why should some snails take to life in pipelines? The feeding organ ("radula") of *N. hanleyi* is rake-like, with few rasping teeth and supporting muscles. This implies a diet of soft organic material, including bacteria and non-filamentous algae, and not the tougher tissues of aquatic plants or the tangled, mucilaginous masses of filamentous algae. It happens that biofilms on the innermost walls of the pipes contain no algae (there is no light for photosynthesis), and are dominated by bacteria and fungi. The pipeline biofilm has a high nutritive value, and it obviously is an adequate food for the refugee snails. Another reason is that the river snails are able to tolerate low oxygen levels for some days, and may tolerate exposure to air for a similar period, provided the humidity remains high.

Incidentally, the presence of snails in the pipelines tends to discount the possibility that pollution by agricultural chemicals, or salinity, is implicated in the decline. The pipes contain water that is pumped directly from the river.

Is there Scope for Repatriation?

What prospects are there for re-introducing snails to the river? If these ideas about a change in the food supply are right, it seems that the base of the riverine food chain could no longer support snails. The likelihood of successful translocations is prejudiced also by the isolation and degradation of the remaining floodplain wetlands along the river, and by the depredations of bottom-feeding fish like the introduced carp. Both of these factors, as well as changes in the biofilms, are likely to have played an important role in the decline.

The irrigation pipelines are a haven only in the short-term, and snail populations there are by no means secure. For some years the pipeline authorities have made repeated attempts to eliminate them, generally by extravagant dosing with chlorine. There are limits to chemical use because the pipeline water is often used as a secondary domestic supply, although that is not to say that chlorination is entirely safe for humans. Other measures, like back-flushing the pipes, have had some effect in the Renmark system, but they still fall short of adequate control in bad seasons. The pipeline managers see their first responsibility as their consumers, and there is no operational provision for conservation of endangered species. To the contrary, the snails are confirmed pests.

Relationship to other River Snails

As a member of the prosobranch family Viviparidae, *N. hanleyi* is somewhat unusual in being viviparous (the young are born alive and not hatched from eggs). The family has many species around the world but perhaps only six in Australia, including four species of *Notopala* (Sheldon and Walker 1993b). *N. waterhousii* inhabits ephemeral waters in northern Australia, and *N. essingtonensis* is found in more persistent water bodies in the same region. *N. sublineata* is of special interest because its reported range overlaps that of *N. hanleyi*, and because its range too appears to have contracted in recent decades. It formerly occurred in both the Murray-Darling and Lake Eyre drainages, but may now remain only in Cooper Creek, in the Lake Eyre Basin. The distinctions between these two species are subtle and related to the relative size of the aperture and the length of the shell. Shell measurements, however, are a notoriously unreliable way to distinguish molluscan species, and a clearer picture of the relationships of *Notopala* species, and their conservation status, awaits new work by Dr Winston Ponder of the Australian Museum, Sydney.

A Fossil Relative

An interesting footnote is that related fossil shells with a distinctive ridge around the basal whorl have been described from Pleistocene sediments 90 metres above the present-day river level, near Murray Bridge. Bernard Cotton named them *Notopala wanjakalda*, honouring the local Aboriginal people (Cotton 1935b). The fossils apparently were not from an Aboriginal campsite, but from the banks of a creek stranded long ago as the Murray cut its way down through marine sediments to form its present gorge.

Conclusion

What is to be the fate of *Notopala hanleyi*? Like most invertebrates it has a lowly status in most people's perception of conservation issues, but it deserves to be an icon, representing the need for us to widen our horizons. As with many species whose range has declined dramatically following river regulation, the situation forewarns of changes that ultimately could prejudice our own relationship with the River Murray. Whilst the plight of the snails has not been entirely ignored by the authorities, efforts to protect and translocate them so far have received no tangible support. For the present the snails could not have chosen a better refuge; their best insurance for survival is that they share their water supply with humans.

Acknowledgments

The articles cited below are limited to formal publications, but the story of the Murray's disappearing snails is drawn also from theses, including Honours research by Sue Botting (1995), Daryl Evans (1981), Sue Farnham (1988), Robin Galbreath (1995), Michelle Jenkins (1991), Steve Parker (1989), Marcus Wishart (1993) and Tony Woolford (1984), and especially PhD research by Fran Sheldon (1994). Work continues through Adrienne Burns (PhD, 1996) and Sue Graham (Hons, 1996).

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