

CONSERVATION STATUS, THREATS AND HABITAT REQUIREMENTS OF AUSTRALIAN TERRESTRIAL AND FRESHWATER MOLLUSCA

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Abstract

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World-wide, non-marine molluscs have the largest number of documented extinctions, and of IUCN — listed threatened species, of any major group. Despite this, as with other invertebrate groups, they attract little or no attention from organisations and government departments concerned with conservation.

Major impediments to the conservation of non-marine molluscs in Australia, and elsewhere, include the lack of appropriate legislation, lack of concordance with existing protected areas and little public and political interest. An Action Plan for Australian molluscs is being prepared as part of an Action Plan for non-marine molluscs world-wide being coordinated through the Mollusc Specialist Group of IUCN. The plan will bring otherwise inaccessible data to public attention and its recommendations will have application in the conservation of non-marine invertebrates in general.

Many Australian non-marine molluscs have very small ranges and are therefore vulnerable to a wide range of threatening processes. The Australian non-marine molluscan fauna currently comprises 1020 named species-group taxa, 80.2% of which are endemic to one State or Territory. 255 species-group taxa (25% of the total fauna) are currently listed by IUCN as threatened in Australia.

Introduction

Invertebrates comprise a large proportion of biodiversity but are very rarely considered in reserve selection and other conservation initiatives in Australia (e.g., Yen and Butcher, 1992; Ponder, 1992a; New, 1995). A major impediment in utilizing invertebrates is that many groups are poorly known both taxonomically and biologically and few people have the expertise to accurately identify them. In addition, unlike the situation with vertebrates and higher plants, funding has not generally been made available to place important collections on data bases. Some of the better known groups, including some insect groups (e.g. butterflies), are known to contain rare and threatened species. However many of these taxa, like many threatened vertebrates and higher plants, have considerable distributional ranges. By way of contrast, some invertebrates, including certain groups of insects and spiders show marked regional endemism. This is especially true in land and freshwater molluscs and some aquatic crustacean groups, many of which have very restricted ranges (often less than 2 km² — e.g., Solem, 1988). Areas which have a concentration of narrow range endemics ('hot-spots') should have a high priority for conservation once identified.

Such areas are easily missed in a strictly habitat-based approach to conservation.

Non-marine molluscs are one of the best known groups of non-marine invertebrates (see Smith, 1992, for a reasonably up to date listing of named taxa). Non-marine molluscs, as a group, comprise the largest number of recorded extinctions in the last 300 years [284, listed by IUCN (Groombridge, 1993)] — this being far more than combined world-wide bird and mammal extinctions in the same period. To date, mainland Australia has no absolutely confirmed non-marine mollusc extinctions but this will undoubtedly change, given increasing knowledge about the fauna, the large numbers of narrow range endemics and the rapid rate of habitat destruction that will undoubtedly affect a significant number of Australian non-marine molluscs. However, mollusc conservation continues to have a low profile, even in current discussions on invertebrate conservation. For example, in a recent issue of *Victorian Naturalist* (vol. 112, 1995) devoted to invertebrate conservation, molluscs hardly rated a mention.

An important aspect of IUCN conservation strategy is to produce 'action plans' for particular groups. To date (Nov 1995), there has been only one IUCN Action Plan developed for invertebrates, that being for one small group of

insects, Swallowtail Butterflies. The Mollusc Specialist Group (one of the IUCN specialist groups) is well advanced in its production of an Action Plan for all non-marine molluscs of the world. A draft Australian plan has been developed as part of this exercise and some of the findings are summarized below.

The Australian non-marine molluscan fauna

The non-marine fauna of Australia, Lord Howe and Norfolk Islands was catalogued by Smith (1992) who recognised 190 freshwater and 920 terrestrial species, including 52 introduced taxa. On the Australian mainland (including Tasmania), only 14 (1.4%) of the native land and freshwater taxa occur naturally outside Australia, thus the molluscan fauna has a very high endemism even by Australian standards (98.6% compared with mammals 82%; birds 45%; reptiles 89% and vascular plants 85%). The land and freshwater molluscan fauna of Lord Howe Island (69 terrestrial, 16 freshwater species-group taxa) and Norfolk Islands (68 terrestrial and 1 freshwater) is also almost entirely endemic to each island. Since Smith (1992) an additional 119 species-group taxa have been named (to Jun 1995) (Table 1). Smith (1992) estimated that 30–40% of the non-marine fauna remained to be described, but a more likely estimate is that the total non-marine fauna is around 2000 species.

There are 178 species of Australian (excluding Lord Howe and Norfolk Islands) freshwater molluscs recorded by Smith (1992) and 743 species of terrestrial molluscs. Since then (to late 1995) 119 additional species-group taxa [66 freshwater (representing a 37% increase) and 53 terrestrial (7% increase)] have been described bringing the totals to 244 and 796 respectively

and the overall total of named terrestrial and freshwater taxa 1170. Of these 72.1% of the named freshwater fauna (176 species-group taxa) and 69.3% of the named terrestrial fauna (642 species group taxa) are restricted to a single state or territory. Only 14 (1.5%) of these species also occur outside Australia.

For most groups, the work to date has only been descriptive. There are no substantive reviews of most families, and very few phylogenetic treatments. Only two cladistic analyses of non-marine groups have been published, both involving Hydrobiidae (Ponder and Clark, 1990; Ponder et al., 1993). Very little biological information is available, even for common taxa and few detailed distributions have been published.

Terrestrial molluscan fauna

Of the 23 families recognised in the described Australian terrestrial mollusc fauna, the medium to large-sized Camaenidae is by far the most speciose family, with 408 currently valid, named species-group taxa comprising 51.3% of the named terrestrial land snails. The small-sized Charopidae are next (129 named, valid species-group taxa) with 16.2% of the named native terrestrial fauna. Both of these groups, and some other families, contain a large number of unnamed taxa (e.g. Solem, 1991; Stanisic, 1994). In all, nearly half (48%) of the land molluscs of eastern Australia are unnamed (Stanisic, 1994). Other large families include Pupillidae (41 taxa), Bulimulidae (31 taxa), Punctidae (23 taxa), Pupinidae (19 taxa) and Helicarionidae (60 taxa).

Smith (1992) lists 69 native terrestrial molluscs in 10 families on Lord Howe Island. The most diverse are the Helicarionidae (18 species-group taxa), Charopidae (17 species-group taxa),

Table 1. Species-group taxa of Australian freshwater and terrestrial molluscs listed by Smith (1992) with the number of species-group taxa named since added to the totals in brackets. The number in square brackets is the number of species-group taxa restricted to the state or territory, those in the totals columns being the sum of these numbers.

	NSW	Qld	Vic.	SA	WA	NT	Tas.	Total Aus.
Freshwater	42 [11]	56(58) [24]	37(45) [16]	34 [11]	31 [20]	27 [8]	42(98) [86]	178(244) [176]
Terrestrial	140 [79]	234(236) [172]	50 [20]	72(99) [83]	226(230) [201]	71(94) [52]	44 [35]	743(796) [642]
Total	182 [90]	290(294) [196]	87(95) [36]	106(133) [94]	258(262) [221]	98(121) [60]	86(141) [121]	901(1020) [818]

Diplomatinae (14 species-group taxa) and Punctidae (11 species, with several undescribed, Climo, 1981). The last comprehensive review of the Lord Howe terrestrial molluscan fauna was by Iredale (1944 — see also Stanisc, 1981).

Freshwater molluscan fauna

Australia does not possess a spectacularly diverse freshwater molluscan fauna, having only 18 species of freshwater mussels (Unionoidea: Hyriidae) and very few large-sized gastropods. Apart from the hyriids, corbiculids (2 species) and small numbers of viviparids (6 species) and thiarids (9 species), most of the rest of the fauna (9 families) are of small size. Amongst these, the hydrobiids stand out as being particularly diverse (117 named species-group taxa), many with very restricted distributions (Ponder, 1994) and many remain undescribed. The next largest family, the Planorbidae, has about 40 species. Most families require major revision and more new taxa are known in Assimineidae, Bithyniidae and Glacidorbidae than are currently described. Although the Sphaeriidae was relatively recently revised (Kuiper, 1983), further work on this group is also needed.

For an oceanic island, Lord Howe Island has an exceptional freshwater molluscan fauna. Apart from one record of an ancylid (Ponder, 1981a), there is a remarkable hydrobiid fauna (Ponder, 1982) comprising 15 named species-group taxa in three genera. *Hemistomia minutissima* and another unnamed species live interstitially in sediments in stream beds.

Threatened taxa

Although 255 threatened Australian taxa are listed in the 1994 Red List (Groombridge, 1993) more will be added as details of their distributions and status become available. Other species belong in groups which require taxonomic revision but by far the largest group of unlisted taxa are species which await description. Many undescribed, narrow range camaenids are known, especially from Western Australia, the Northern Territory and Queensland. Charopids are speciose in eastern Australia and many undescribed species have very limited ranges, especially those on limestone outcrops. At present the following numbers of threatened taxa are listed by IUCN (Groombridge, 1993) for each state and territory (T=terrestrial, FW=freshwater) — NSW (mainland 18T, 1FW; Lord Howe Island 4T, 8FW), Queensland

(26T, 13FW), Victoria (13T, 5FW), South Australia (19T, 9FW), Western Australia (63T, 1FW), Northern Territory (21T), Tasmania (7T, 60FW) and Norfolk Island (2T, 1FW).

The current listing of only 6 terrestrial species from both Lord Howe and Norfolk islands does not reflect the true nature of the situation. For example *Placostylus bivaricosus* from Lord Howe is certainly threatened, being restricted to a few very small colonies which suffer high levels of rat predation. Data is urgently needed on the current distributions and status of terrestrial taxa on both islands.

Extinctions

Many of the recorded extinctions of terrestrial molluscs are those on oceanic islands. There have been some extinctions of large land snails on Lord Howe Island, probably mostly due to rats (Smithers et al., 1977) and, possibly, pigs, rather than habitat destruction. A large species, *Epiglypta howinsulae* (Cox), is almost certainly extinct, as is a 'form' (or 'subspecies') of *Placostylus bivaricosus* (Gaskoin), *P. bivaricosus etheridgei* (Hedley), both of which occurred on the well forested southern part of the island. Habitat destruction caused by introduced animals was probably responsible for the extinction of another 'form' of *Placostylus*, *P. cuniculinsulae*, from Rabbit Island (Smithers et al., 1977; Hutton, 1986), as well as other supposed endemic land snails from that island (see Iredale, 1944).

On Norfolk Island, the only recorded freshwater mollusc, the hydrobiid *Posticobia norfolkensis* (Sykes), is now presumed to be extinct (Ponder, 1981b). The environmental degradation of this island and the introduction of feral animals which has resulted in the extinction of several birds and plants has probably affected the terrestrial land snail fauna. Iredale (1945) records the extinction of the land snails of the nearby Phillip Island (3 species) which was completely stripped of vegetation by feral animals by the 1940s and at least 4 species of land snails are now presumed extinct on Norfolk Island itself (R.V.J. Varman, *in litt.*).

There are no published records of confirmed extinctions of non-marine molluscs on the Australian mainland to date. However, this is probably in part because there was a general lack of systematic and/or well documented early collecting of many of the areas now entirely rural and urban. It is probably also a reflection of the poor state of the taxonomy of many of the

groups, particularly the lack of modern comprehensive reviews and revisions resulting in poor information on the current status of many species.

Given the considerable localization and high vulnerability in permanent, mainly lowland streams, many hydrobiids have undoubtedly become extinct in the last 200+ years in areas where this family is known to be diverse (e.g. north coast of Tasmania). The detailed work of Ponder et al. (1993) enables the reporting of at least four suspected extinctions of Tasmanian hydrobiids. *Beddomeia tumida* from Great Lake has not been found since the flooding of that lake in the 1920s. An unnamed species of *Beddomeia* with a distinctive shell morphology from 'Table Cape' collected prior to 1900 was not located in a search of virtually all the streams in this heavily impacted area in 1989. An undescribed species of *Phrantela* was collected from the Serpentine River, SW Tasmania prior to the flooding of this area as part of the new Lake Pedder in 1972. This species has not been found in any of the extant streams and rivers in the area. A population attributed to *Beddomeia lodderae* by Petterd (1889) from Deep Creek, Duck River, but which probably represents a distinct species, cannot now be located (Ponder et al., 1993: 603), this area having been cleared for agriculture.

Drawdown from extraction of artesian water since the turn of the century has resulted in the extinction of many of the artesian (mound) springs associated with the Great Artesian Basin (Habermehl, 1982; Ponder, 1986). Given that the considerable endemic aquatic invertebrate faunas associated with these springs (Ponder, 1986) were not recorded until the 1980s, there have probably also been extinctions of significant undocumented faunas.

Near extinctions of viviparids have been reported in the Murray River, with the only surviving population of one species living in a few irrigation pipelines (Sheldon and Walker, 1993a,b). Another species, extinct in the Murray, is known from a few additional populations. At the time of writing the viviparid in the pipelines are in imminent danger of being exterminated because they pose a nuisance through clogging the spray nozzles (K. Walker, *pers. comm.*).

About two thirds of Australia's rainforests have been cleared in the last 200 years but the first detailed survey for molluscs in east coast rainforests was undertaken in 1975 in mid-east Queensland. Of the 92 species collected in only

10 sites, 42% were undescribed (Colman and Burch, 1977).

Limestone areas in particular, because of their often highly localised cave and surface faunas, are particularly vulnerable. In the main, these habitats have only begun to be systematically collected in the last 10 years by J. Stanisc. Clearing of trees from limestone areas for rural activities has probably had a serious impact in some areas, as have mining activities.

Forty-five introduced taxa (Smith, 1992) make up 5.1% of the Australian mainland fauna. There are 13 families of terrestrial molluscs and one freshwater family introduced to Australia, the majority of these taxa being found in rural and urban areas, mainly in the southern, south-eastern and south-western coastal areas and Tasmania (Smith, 1981, 1992; Kershaw, 1991). Some helicids (see Smith and Kershaw, 1981; Baker, 1989) and limacid slugs (see Altena and Smith, 1975) are economic pests. Nothing is known about the interactions between native and introduced taxa.

Habitat conservation

The belief that habitats conserved for other organisms (namely vertebrates and higher plants), or on a representative ecosystem basis, will provide effective conservation for invertebrates is well entrenched. Whereas this may be effective for many widely distributed species (which are typically at low risk) it is generally inappropriate for many of the taxa of high conservation significance such as narrow range endemics, including many relict taxa. However, there are some areas where general conservation interests and those of molluscan conservation coincide, either because of general concerns for important habitats such as rainforests, or because of happy accidents, where areas set aside for conservation include areas that are important for narrow range endemic invertebrate taxa, typically without this having been realised (e.g., limestone cave reserves).

The conservation of rainforests is critical for molluscan conservation. They occupy only about 4.5% of Australian forests but contain a large proportion of the molluscan taxa. Existing rainforests are essentially refugia, occupying only about 20,000 km², mainly along the east coast of Australia (Webb and Tracey, 1981) with a few small areas of monsoonal rainforest patches from Cape York Peninsula in the north east to the Kimberley in the north west. Much of the lowland rainforest has been cleared for

agriculture. Rainforest remnants are still being cleared and are sometimes considered of little or no conservation value if they are of insufficient size to maintain large vertebrates. However, such areas may be vital for the continuing existence of locally endemic invertebrates, small plants and even small vertebrates (e.g., Meave et al., 1991).

The tropical rainforests of NE Queensland are a very important habitat for land snails (Stanisic, 1994) some locations with in excess of 40 species of land molluscs. Dry rainforest (vine thickets) inland from the coast in Queensland have reduced diversity (averaging about 10 species) although inland areas of moist refugia or limestone have higher diversities (Stanisic, 1994). The subtropical rainforests of south east Queensland and New South Wales also contain diverse molluscan faunas (Colman and Burch, 1977; Stanisic, 1994). Although generally a lower diversity than those further north (Stanisic, 1994), areas associated with limestones in the Macleay Valley peak in diversity at 36 species but in most sites in northern NSW 10–20 species is usual (Stanisic, 1994). There are few locations in the world in which the land mollusc diversity exceeds 30 species (Solem, 1984b). Monsoonal rainforests occur in small patches across northern Australia and are mostly poorly documented for molluscs but the Kimberley rainforest patches have been surveyed in some detail (McKenzie et al., 1991). These contain a rich molluscan fauna (Solem, 1991; Solem and McKenzie, 1991) with 115 species, all but 22 being camaenids. There is an average 12.5 species (average 3.7 species of camaenids) per rainforest patch (size < 1 ha to > 20), the mean species range for camaenids was about 20 km in diameter and about 64% of camaenids were recorded from only one or two patches. Temperate rainforests, typically dominated by *Nothofagus*, are found in Victoria and Tasmania, although the great majority (456,000 ha) is in Tasmania. These forests also contain a distinctive fauna, but it is less diverse than that seen in northern rainforests.

The remaining 95.5% of Australian forests are mainly dry forests, much of this dominated by eucalypts (about 67.4%). Such forests are generally poor habitats for terrestrial molluscs, although wet sclerophyll (mixed eucalypt and rainforest species) can contain diverse faunas. Rainfall can be high in some areas with eucalypt forests but even in these areas molluscan faunas are typically sparse, probably because of generally low water retention in soils and regular fires.

However, dry forests can be important habitats when local topography or geology results in establishing suitable conditions for refugia.

Other terrestrial areas of high conservation value are largely circumscribed by geomorphological features resulting in their being very long-term suitable habitats. Of particular importance are limestone outcrops in which endemicity of terrestrial species is usually very high. This is especially true in eastern Queensland and New South Wales (Stanisic, 1994) and in north Western Australia (Solem, 1981a,b, 1984a, 1985, 1988, 1991). When limestone areas occur in rainforests diversity is particularly high (Stanisic, 1994). Limestone habitats are often protected, at least in part, if they are associated with caves. However, many other outcrops are not protected and are often cleared or mined.

Arid zone refugia, particularly deep gorges, can be very important, especially if associated with limestone. There is a rich camaenid fauna in the Kimberley (Solem, 1981a,b, 1984a, 1985, 1988, 1991), Flinders Ranges (Solem, 1992a,b), and the gorges of the Red Centre (Solem, 1993), and even the coastal areas along the Great Australian Bight have a few endemic species (Solem, 1992a,b). In an important review of arid zone refugia (Morton et al., 1995), published data on terrestrial and aquatic molluscs were taken into account. However, when assessing the relative conservation importance of particular habitats only threatened vertebrates (ANZECC listed species) were considered.

The conservation of Australian aquatic habitats is reviewed by Lake (1980) and McComb and Lake (1988). The only national review of the conservation of Australian inland aquatic fauna is that of Michaelis (1986), but few molluscs were noted. Most Australian lakes are very recent and do not contain endemic molluscan faunas. A few Tasmanian lakes, particularly Lake Sorell, Lake Crescent and Great Lake are older and contain a few endemics (Fulton, 1983), including some molluscan taxa. The few large rivers in Australia have a rather low diversity of freshwater molluscs when compared with some rivers in south east Asia and North America. The most conspicuous of the freshwater molluscs, the hyriids, are typically widely distributed, although *Hyridella glenelgensis* (south western Victoria) and *H. moretonicus* (Tasmania) are exceptions (McMichael and Hiscock, 1958).

Small streams and, to a lesser extent, local ground-water seepages and springs, are the major habitats of the majority of hydrobiid

there is virtually no information on the biology and ecology of most Australian non-marine molluscs. Such basic data gathering is vital to our understanding of how we might best facilitate the long term survival of many taxa. Coupled with this, work on the threats to native molluscs needs to be encouraged and facilitated. For example, there is virtually no data on the long term effects of fire, damming, salination and pollution on Australian molluscs.

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