Case studies in implementing the NSW *Threatened Species Conservation Act* 1995 for invertebrate conservation

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ABSTRACT

The difficulties in applying threatened species legislation, which has a general vertebrate and vascular plant focus, to invertebrates, have been widely recognised. Nevertheless, such legislation provides valuable opportunities to promote invertebrate conservation that were previously available only for high profile, charismatic vertebrate species. This paper presents three case studies, two land snails Lord Howe Placostylus *Placostylus bivaricosus* and Mitchell's Rainforest Snail *Thersites mitchellae,* and the lepidopteran Purple Copper Butterfly *Paralucia spinifera*, to demonstrate some of the achievements of the NSW *Threatened Species Conservation Act* 1995 in this regard, including significant increases in the known range of the species, reduction of threatening processes at key sites, improved understanding of the species' ecology, consideration of the species in land use planning decisions, involvement of local communities in recovery programs and an increase in community awareness of broader invertebrate conservation issues. The Act can be effective as one of a range of tools to positively promote and build support for invertebrate conservation in the public arena.

Key words: invertebrate; conservation; recovery; legislation; NSW *Threatened Species Conservation Act* 1995; biodiversity; land snail; *Placostylus bivaricosus; Thersites mitchellae;* lepidoptera; *Paralucia spinifera;* habitat; community.

Introduction

The New South Wales *Threatened Species Conservation Act* 1995 (TSC Act), including amendments introduced by the *Threatened Species Conservation Amendment Act* 2002, is the key legislation with respect to threatened terrestrial species in NSW. The objects of the TSC Act are to conserve biodiversity, prevent extinction and promote recovery, protect critical habitat, eliminate or manage threatening processes, ensure impacts of proposed actions are properly assessed, and encourage conservation through cooperative management. The Act allows for the recognition of threatened biodiversity at three different levels: that of the population, species and ecological community. Species and ecological communities can be listed as *endangered* (higher risk category) or *vulnerable* (lower risk category), while populations are eligible for listing only in the *endangered* category. Species may also be listed as *presumed extinct* in NSW. The TSC Act allows for the identification of *critical habitat* for endangered species and ecological communities. The Act also enables a strategic, direct approach to common threats to biodiversity through the listing of *key threatening processes*. The TSC Act aims to conserve threatened species, populations and ecological communities and their habitats through the preparation and implementation of recovery plans and threat abatement plans, the identification and protection of critical habitat, consideration of threatened taxa in environmental planning decision making, and through other provisions including licensing controls, stop work orders and joint management agreements.

In common with similar legislation around the world, the listing of fauna under the TSC Act is heavily weighted towards vertebrates, with approximately 95% of the fauna species listed coming from 1% of the actual fauna. This is partly a reflection of broader community values (the appeal of the 'cute and cuddly'), partly due to data availability and partly legal and historical precedence. Threatened species legislation has generally been established originally with vertebrates in mind, and the legislative criteria and thresholds developed for listing vertebrates do not apply equally as well to invertebrates (Hutchings and Ponder 1999; Kitching 1999; Mawson and Majer 1999).

The difficulties faced in applying legislation, such as the TSC Act, to invertebrate conservation include:

1. the sheer number of invertebrate species. (The number of terrestrial invertebrates in Australia could be 10 million or more species (Horwitz, Recher and Majer 1999), compared to approximately 2000 terrestrial vertebrate species);
2. the poor taxonomic understanding of many invertebrate groups, with a significant proportion of taxa undescribed or predicted to be awaiting discovery (New 1995; Stork 1999);
3. the even poorer understanding of the distribution, ecology and conservation status of species in many invertebrate groups (Yen *et al.* 1990; New 1995).

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(While the biology and ecology of some invertebrate groups such as butterflies are relatively well-known, others such as Australian land snails are very poorly known, with basic biological and ecological information lacking for all but a few taxa, and most species never studied as living animals (Bishop 1981; Smith 1992));

4. the limited funding support and specialist expertise to address this data deficit (Yen *et al*. 1990; Hutchings and Ponder 1999; New 1999);
5. the lack of knowledge amongst some sections of the invertebrate science community (professional and amateur) concerning the functioning of threatened species legislation and associated reservation concerning the potential value thereof (Gunning 1999; Greenslade 1999); and
6. the generally poor awareness and valuation by the broader community of invertebrate conservation.

Notwithstanding, the TSC Act enables the listing and protection of threatened species, populations and communities of terrestrial invertebrates, and is thus an advance on its predecessor, the NSW *Endangered Fauna (Interim Protection) Act* 1991, which was restricted to the consideration of four classes of vertebrates (birds, mammals, amphibians and reptiles). Sixteen invertebrate species or populations had been listed under the TSC Act by April 2004: 1 earthworm, 3 land snails and 12 insects (Table 1).

This paper discusses, by way of presenting three separate case studies (two land snails and one butterfly), some of the challenges and successes experienced by the authors in implementing the TSC Act for the conservation of invertebrates in NSW. The aim is to demonstrate that the listing of invertebrate species under the TSC Act can result in significant conservation benefits to individual species and, through their promotion as flagship species, make a valuable contribution to broader conservation goals. The approved recovery plans for all three species can be seen on the NSW Department of Environment and Conservation (DEC) website www.nationalparks.nsw.gov.au.

A brief background to land snail conservation

Land snails are currently undergoing a global mass extinction of which few people outside of malacological circles are aware. Molluscs as a group make up approximately 6% of known global fauna species diversity, yet they comprise 18% of threatened fauna species and 43% of recorded modern fauna extinctions (IUCN Species Survival Commission 2003). This is despite the fact that only about 3% of the world's mollusc species have been assessed for conservation status, compared to better known groups such as birds and mammals where virtually 100% have been assessed (IUCN Species Survival Commission 2003). Australia has the second highest number of IUCN-listed threatened mollusc species (after the USA), with up to 25% of mollusc species potentially at risk (Ponder 2000; IUCN Species Survival Commission 2003). The land snails and freshwater snails are the two mollusc groups under greatest threat (Ponder 2000; IUCN Species Survival Commission 2003). Major threats to land snails include loss of habitat, frequent fire, and predation and habitat degradation by feral species (Ponder 1997). Three land snail species are currently listed under the TSC Act (Table 1). Positive outcomes achieved through the recovery programs developed following the listing of two of these species are briefly described below.

Table 1. Invertebrates listed under the TSC Act (as at April 2004)

	Species	Date of listing under TSC Act	Status under TSC Act
butterfly	*Paralucia spinifera* Edwards & Common, 1978 (Purple Copper Butterfly)	Nov 1996	Endangered
moth	*Synemon plana* Walker, 1854 (Golden Sun Moth)	Nov 1996	Endangered
phasmid	*Dryococelus australis* Montrouzier, 1855 (Lord Howe Island Phasmid)	Dec 1996	Endangered
land snail	*Thersites mitchellae* (Cox, 1864) (Mitchell's Rainforest Snail)	March 1997	Endangered
land snail	*Placostylus bivaricosus* (Gaskoin, 1855) (Lord Howe Placostylus)	April 1997	Endangered
land snail	*Meridolum corneovirens* (Pfeiffer, 1851) (Cumberland Land Snail)	Aug 1997	Endangered
dragonfly	*Petalura gigantea* (Leach, 1815) (Giant Dragonfly)	Jan 1998	Endangered
beetle	*Menippus fugitivus* (Lea)	March 2000	Endangered Population (Sutherland Shire)
beetle	*Nurus atlas* Castelnau, 1867	March 2001	Endangered
beetle	*Nurus brevis* Motschulsky, 1865	March 2001	Endangered
earthworm	*Pericryptodrilus nanus* Jamieson 1977	March 2001	Endangered
beetle	*Hybomorphus melanosomus* (Saunders & Jekel, 1885) (Lord Howe Island Ground Weevil)	Dec 2002	Presumed Extinct
butterfly	*Argyreus hyperbius* (Linnaeus, 1763) (Australian Fritillary)	Dec 2002	Endangered
butterfly	*Ocybadistes knightorum* Lambkin & Donaldson, 1994 (Black Grass-dart Butterfly)	Dec 2002	Endangered
moth	*Phyllodes imperialis* Druce (ANIC 3333) (southern subspecies) (Pink Underwing Moth)	Dec 2003	Endangered
cockroach	*Panesthia lata* Walker, 1868 (Lord Howe Island wood-feeding Cockroach)	Feb 2004	Endangered

Case Study 1: Lord Howe Placostylus *Placostylus bivaricosus*

The *Placostylus* (Family Bulimulidae) is a genus of large, ground-dwelling land snails found in the south-west Pacific from the Solomon Islands, Vanuatu, Fiji and New Caledonia to Lord Howe Island and the northern extremity of New Zealand (Abbott 1989; Parrish *et al*. 1995; Ponder *et al*. 2003). It has been suggested that this distribution reflects an ancestral distribution on a once extensive but now largely submerged Gondwanan continental fragment on the eastern side of the Tasman rift (Hedley 1893). Many *Placostylus* species are considered to be at risk of extinction (IUCN Species Survival Commission 2003). Threats include clearing of habitat, predation by introduced vertebrate species such as rodents, pigs and Eurasian thrushes (Parrish *et al*. 1995; Sherley *et al*. 1998) and, in some areas, over-harvesting of wild snails for human consumption (Salas *et al*. 1997). New Caledonian *Placostylus* species were recently described in the popular print media as rare but much-loved when simmered in white wine and garlic (Guy 2004).

Placostylus bivaricosus (Gaskoin, 1855) (Fig. 1) is endemic to Lord Howe Island, and is most closely related to the New Zealand species *Placostylus ambagiosus* and *Placostylus hongii* (Ponder *et al*. 2003). It has a conical shell up to 80 mm long, medium to dark brown in colour (weathering to white in older animals) and with a thickened lip in mature adults. The body colour is black. *Placostylus bivaricosus* was previously abundant on sandy and calcarenite-derived soils of the central lowlands of Lord Howe Island, and also occurred more sparingly on the volcanic soils of the northern hills and southern mountains (Brazier 1889). Three Recent subspecies are currently recognised on the basis of shell morphology: *P. bivaricosus bivaricosus* (Gaskoin, 1855) from the central lowlands and northern hills, *P. bivaricosus cuniculinsulae* (Cox, 1872) from a small island (Blackburn Island) in the Lord Howe lagoon, and *P. bivaricosus etheridgei* (Hedley, 1891) from the southern mountains. Ponder *et al*. (2003) proposed that the population from the summit of Mount Gower (in the southern mountains) may also have been distinct. One fossil taxon, *P. bivaricosus solidus* (Brazier, 1889), is known from Pleistocene calcarenite deposits of the central lowlands of Lord Howe Island.

Historical accounts and fossil evidence indicate that *P. bivaricosus* was formerly widespread and common on Lord Howe Island (Brazier 1889; Hedley 1891; Smithers *et al*. 1977; Sutherland and Ritchie 1977). The decline of the species was first noted in the 1940s (Iredale 1944), and it is now recognised internationally as critically endangered through listing on the *2003 IUCN Red List of Threatened Species* (IUCN Species Survival Commission 2003), in the category CR B1+2abcde. *Placostylus bivaricosus cuniculinsulae* is presumed to be extinct. The original forest cover on Blackburn Island has been largely cleared and no specimens have been collected there for over a century (Ponder and Chapman 1999). *Placostylus bivaricosus etheridgei* has declined in range and abundance and was considered likely to be extinct (NSW Scientific Committee 1997a), but it may survive as a number of small, isolated local populations (Ponder and Chapman 1999). *Placostylus bivaricosus bivaricosus* remains extant but is endangered and has declined in range and abundance (NPWS 2001a).

Figure 1: Lord Howe Placostylus *Placostylus bivaricosus*. This large, ground-dwelling land snail is endemic to Lord Howe Island, where it is threatened by loss of habitat and predation by introduced species, particularly the Black Rat *Rattus rattus*. Preparation of the recovery plan for the species involved assessment of current status through field survey, identification of past and current threats, review of scientific literature detailing research into related *Placostylus* species and consultation with the Lord Howe Island community. Photograph by Michael Murphy.

Little information is available on the ecology of *P. bivaricosus*, and behavioural and life history studies are a priority for future research to assist conservation efforts (NPWS 2001a). Live animals are found under well-developed, moisture-retaining leaf litter in evergreen closed forest, often, but not exclusively, in the vicinity of Banyan Figs *Ficus macrophylla columnaris* (NPWS 2001a; Murphy pers. obs.). Recent records of *P. bivaricosus* are from *Drypetes australasica-Cryptocarya triplinervis* evergreen closed forest or *Howea fosteriana* evergreen closed forest, or in ecotones between these two associations, using the vegetation associations described and mapped by Pickard (1983). Ponder and Chapman (1999) noted that *P. bivaricosus* was generally sparse or absent in areas developed as palm plantations, but that mixed palm and broad-leaf forest provided good habitat. *Placostylus bivaricosus* is generally active at night. Nocturnal behaviour in the related New Caledonian species *Placostylus fibratus* was found to be related to a preference for lower temperatures and higher humidity levels (Salas *et al*. 1997). *Placostylus* species are unable to seal the shell aperture during dry conditions and are therefore prone to desiccation (Sherley 1994).

In areas of suitable habitat, *P. bivaricosus* occurs at an average density of 0.24 live adults and 0.33 live juveniles per square metre (Ponder and Chapman 1999), with localised densities of up to two live animals per square metre in appropriate microhabitat patches within these areas. These densities are comparable to those observed in New Zealand *Placostylus* species (Parrish *et al*. 1995). Accumulated shells of dead *P. bivaricosus* can remain in the soil and leaf litter for many years and, in some places, can occur at densities of up to 30 shells per square metre (Ponder and Chapman 1999; NPWS 2001a).

The diet of *P. bivaricosus* is thought to be the fallen dead leaves of broadleaf trees (Ponder and Chapman 1999). New Zealand *Placostylus* species feed on the fallen leaves of

a range of native broadleaf tree and shrub species (Parrish *et al.* 1995; Sherley *et al.* 1998). *Placostylus bivaricosus* lays small clutches of eggs in the soil beneath leaf litter, probably during the warmer months, and the eggs hatch into small-shelled snails about 6.7 mm in length and 5 mm in width (Ponder and Chapman 1999). Hatchling and juvenile mortality is high (Ponder and Chapman 1999). Growth rate and lifespan of *P. bivaricosus* are unknown, but related *Placostylus* species in New Zealand reach maturity at 3 to 5 years and may live for 20 years or more (Parrish *et al.* 1995).

Recovery Program for *Placostylus bivaricosus*

Placostylus bivaricosus was listed as an endangered species under the TSC Act in April 1997 (NSW Scientific Committee 1997a). A recovery plan for the species was developed by the NSW National Parks and Wildlife Service (NPWS) (now part of the DEC) between 1998 and 2001. A draft recovery plan, prepared in accordance with the TSC Act, was publicly exhibited in December 1998 (the first recovery plan for a fauna species in NSW) and a final recovery plan was approved in October 2001 (NPWS 2001a). The recovery plan identifies habitat clearing and modification for development, and predation and habitat disturbance by exotic vertebrate fauna (predominantly the Black Rat *Rattus rattus* and possibly the Common Blackbird *Turdus merula* and Song Thrush *Turdus philomelos*), as the major causes of the species' decline. Herbicide and pesticide use, invasion of habitat by exotic weeds, trampling and habitat disturbance by domestic stock, and predation and habitat disturbance by domestic poultry are listed as additional current threats. Predation and habitat disturbance by feral pigs *Sus scrofa* and habitat disturbance by feral goats *Capra hircus* are listed as previous threats, with pigs successfully eradicated from the island and eradication of feral goats almost completed. The objectives of the recovery plan are to identify and protect remaining habitat and extant populations of the species (with a priority given to conserving maximum surviving genetic diversity), identify and ameliorate current threats, support and coordinate relevant research and encourage community involvement in the conservation and recovery of the species (NPWS 2001a). Some of the outcomes achieved through the recovery program are outlined below.

Increased knowledge of extant distribution

At the time of listing under the TSC Act in 1997, the only recent records of live *P. bivaricosus* were three site records from a general invertebrate survey on Lord Howe Island by the Australian Museum in 1971 (at Windy Point, the east end of North Bay and the east end of Neds Beach) (Smithers *et al.* 1977; NSW Scientific Committee 1997a). One of these sites (Windy Point) had since been destroyed through development of the Lord Howe Island airfield in the mid 1970s. Later identification of hatchling *P. bivaricosus* from leaf litter samples collected from Big Slope and Little Slope in the 1970s indicated that populations may also have been extant in these remote coastline localities in the southern mountains area at that time (Ponder and Chapman 1999).

The Australian Museum was engaged by the NPWS in 1999 to undertake a targeted survey for *P. bivaricosus* as part of the development of the recovery plan. The survey recorded live or freshly dead *P. bivaricosus* at 24 sites out of a total of 59 sites examined (Ponder and Chapman 1999). Additional records have also been obtained through increased community awareness. *P. bivaricosus* is now known from approximately 5 localities comprising 26 sites in the central lowlands and northern hills (Ponder and Chapman 1999; NPWS 2001a). Investigation of the Big Slope and Little Slope localities in the south of Lord Howe Island is a priority for proposed future surveys (NPWS 2001a).

Statistical modelling of predicted habitat for *P. bivaricosus* was completed by the NPWS in 2002 (NPWS 2002). Maps of predicted habitat were derived for pre-settlement (pre-1833) and the present time (Fig. 2) through a process of overlaying and statistical analysis of environmental variable spatial data and *P. bivaricosus* site data using an ArcView Geographic Information System and S-plus statistical software. Environmental variables which proved to be significant in driving the statistical model were calcium availability and elevation. Correlation with calcium-rich soils reflects the requirement of land snails for calcium for shell production (Stanisic 1994, 1997). Correlation with elevation probably in part also reflects differences in calcium availability between the calcareous sands and calcarenite of the central lowlands and the volcanic geology of the northern hills and southern mountains, and is consistent with early descriptions of the species' distribution (Brazier 1889).

The resulting maps showed three classes of habitat quality: category A and category B for high quality habitat (78-100% and 55-77% likelihood of occurrence respectively); a single category of lower quality habitat (17-54% likelihood of occurrence); with the remaining areas (0-16% likelihood of occurrence) classified as unsuitable habitat (NPWS 2002). These maps provide the best guide to the historical and current distribution of *P. bivaricosus* on Lord Howe Island. Analysis of this mapping indicated significant spatial overlap between human settlement of Lord Howe Island and high quality snail habitat, with 50% of the highest quality snail habitat (category A) cleared since 1833, compared to only 3% of the lower quality snail habitat (NPWS 2002), supporting the contention that loss of habitat has been a major factor in the decline of the species.

Development control and land use planning

Listing under the TSC Act triggers an obligation for approval authorities under the *NSW Environmental Planning and Assessment Act* 1979 (EP&A Act) to consider the impacts of proposed developments and activities on a threatened species, population or

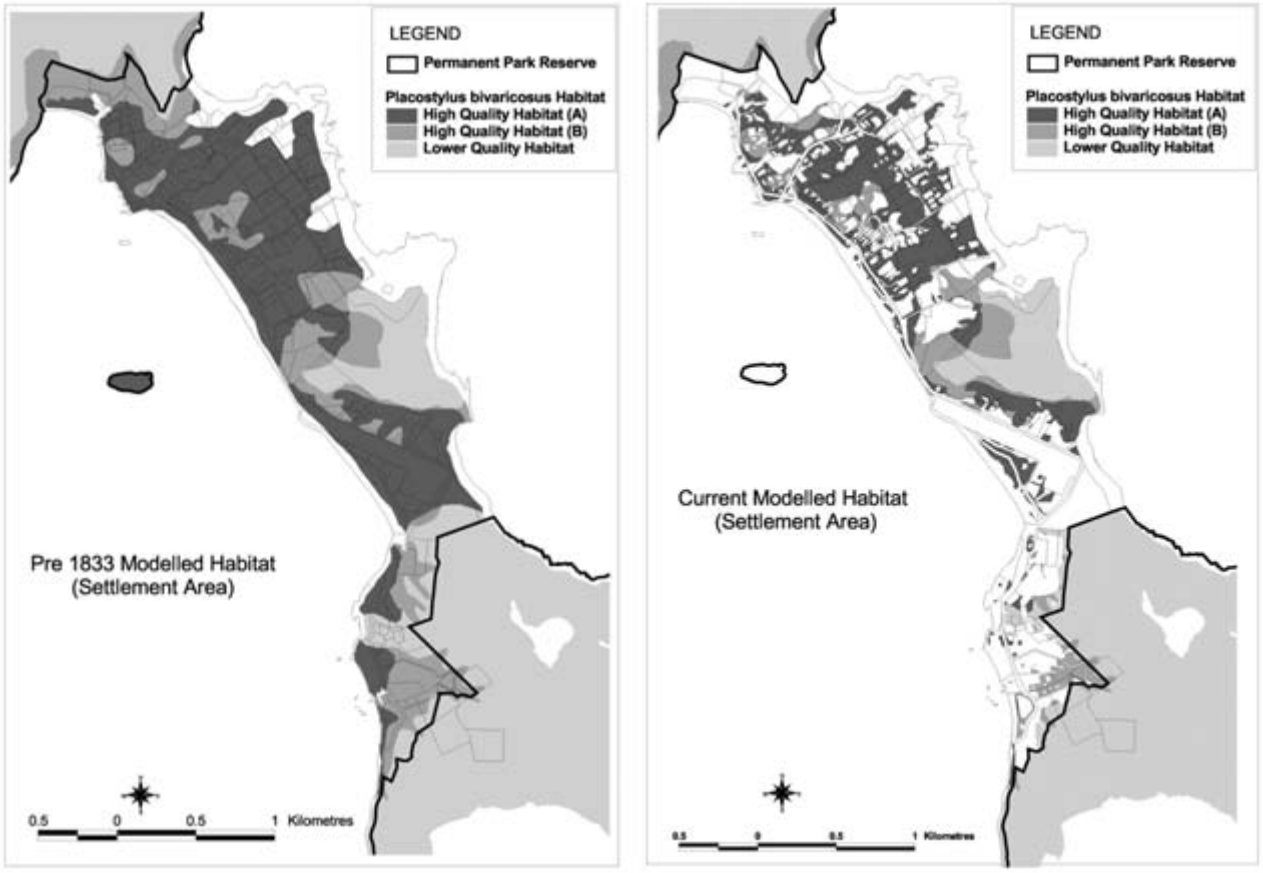


Figure 2: Modelled habitat of *Placostylus bivaricosus* in the Lord Howe Island Settlement area. Left: pre-1833 modelled habitat; Right: current modelled habitat (From NPWS 2002). Statistical modelling of habitat extended recognition and consideration of the species' habitat beyond simple point locality records. Past land clearing on Lord Howe Island has been most extensive in the highest quality habitat areas.

endangered ecological community. Where a significant effect on threatened species cannot be avoided, or where critical habitat will be affected, the approval authority must seek the concurrence of the Director-General of DEC (or, where a Minister is the approval authority, must consult with the Minister for the Environment). The recovery plan for *P. bivaricosus* includes, as an appendix, guidelines for environmental impact assessment to assist those required to prepare or review such assessments in relation to *P. bivaricosus*. These guidelines include information concerning field survey methods, habitat assessment and significance of likely impacts on the species (per section 5A of the EP&A Act), and were designed to ensure that consideration of the species in environmental impact assessment and land use planning is robust, with a precautionary approach taken where necessary information is lacking.

The main approval authority on Lord Howe Island is the Lord Howe Island Board (LHIB) under the *Lord Howe Island Act* 1953. The map of current predicted snail habitat (NPWS 2002) is being used by the LHIB as a tool to assess the likely effect of individual development proposals on *P. bivaricosus* (T. Wilson LHIB pers. comm), thereby extending recognition and consideration of the species' habitat beyond simple point locality records. On a strategic level, this mapping has also been included as a data layer in the development of a revised *Regional Environmental Plan* for Lord Howe Island under the EP&A Act, which is currently in preparation by the NSW Department of Infrastructure Planning and Natural Resources in consultation with the LHIB and DEC. The mapping will be used in identifying significant areas to be protected from development.

Rodent control

The Black Rat *Rattus rattus* was accidentally introduced to Lord Howe Island in June 1918 following the grounding of the ship *Makambo* (Hutton 1990), and was in prolific numbers across the Island by 1930 (Billing 1999). Within 25 years of their arrival, *P. bivaricosus* was in noticeable decline (Iredale 1944). Rats prey extensively on *P. bivaricosus*, particularly on juvenile snails, and are considered to be a major predator of this species and a significant threat to its survival (Ponder and Chapman 1999; NPWS 2001a). Evidence of rat predation on *P. bivaricosus* is readily observable in the form of distinctively damaged empty shells (Fig. 3) which can be easily found on the forest floor (Murphy pers. obs.). Predation by the Black Rat on Lord Howe Island was listed as a key threatening process under the TSC Act in May 2000, partly on the basis of their impact on *P. bivaricosus* and other endemic land snail species including *Epiglypta howinsulae* and *Gudeoconcha sophiae* (NSW Scientific Committee 2000).

Figure 3: Shells of *Placostylus bivaricosus* showing spiral pattern of shell damage typical of rat predation (compare with Fig. 2 of Sherley *et al.* 1998). Photograph by Michael Murphy.

Rat predation has similarly been identified as a significant threat to *P. ambagiosus* populations in New Zealand, restricting the recruitment of adult snails by removing medium to large-sized juveniles and resulting in progressively ageing snail populations which could ultimately die out (Sherley *et al.* 1998). At one site studied, 73% of empty *P. ambagiosus* shells collected prior to commencement of rodent control were the result of rodent predation, and there was a significant increase in snail numbers following the commencement of rodent baiting, due mostly to a relative increase in the number of juvenile snails (Sherley *et al.* 1998).

The LHIB has been running a regular, warfarin-based rodent control program on Lord Howe Island since 1986. The program has a primary focus on the protection of the palm seed industry, but it also includes a number of significant sites for the conservation of *P. bivaricosus* (NPWS 2001a). The LHIB is currently considering the feasibility of a proposal for the total eradication of introduced rodents on Lord Howe Island.

Genetics research

Conservation of the maximum surviving genetic diversity within *P. bivaricosus* is identified as an objective in the recovery plan (NPWS 2001a). A preliminary assessment of the genetics of extant populations of *P. bivaricosus bivaricosus* was undertaken in 2001 with joint funding provided by the NPWS and Australian Museum (Colgan and Ponder 2001). The results suggested two genetic clades with distinctive shell morphology within the extant populations, with a more elongated-shelled form found predominantly in the northern part of the Island (and north-eastern part of the Settlement area) and a broader-shelled form from the central and western parts of the Island (Colgan and Ponder 2001). The results of this study were included in the identification of priority sites for protection in the rodent control program and further genetics research is proposed (NPWS 2001a).

Habitat restoration

The original evergreen closed forest on Blackburn Island (in the Lord Howe lagoon) has been predominantly cleared since European settlement (Pickard 1983), with only a few individuals of the original tree species remaining, and the forest has been replaced by a grassland of Rhodes Grass *Chloris gayana*. *Placostylus bivaricosus* formerly occurred on the island but has not been recorded there for over a century (Ponder and Chapman 1999). Rats are currently not present on offshore islands in the Lord Howe Island group, including Blackburn Island. An action proposed in the recovery plan for *P. bivaricosus* is the restoration of an area of evergreen closed forest habitat on Blackburn Island to create a rat-free area of habitat to be used as a release site in the event that the translocation of *P. bivaricosus* is considered necessary at a future date (NPWS 2001a). Establishment of translocated populations on offshore islands or in areas of regenerated habitat has been employed as an *ex situ* conservation measure for *P. ambagiosus* and *P. hongii* in New Zealand (Sherley 1994). The LHIB has recently commenced the initial work on a habitat restoration project on Blackburn Island (T. Wilson LHIB pers. comm.). A broader outcome of this work will be the provision of a rat-free, closed forest habitat for a range of additional threatened and significant species, including the endangered cockroach *Panesthia lata* (NSW Scientific Committee 2004).

Future actions

High to medium priority actions in the recovery plan for *P. bivaricosus* which remain to be implemented include scientific survey of areas of high potential habitat for *P. bivaricosus etheridgei* in the southern mountains area (including Big Slope and Little Slope), establishment of long-term monitoring sites in both rodent baiting and non-rodent baiting areas, establishment of a captive breeding program, research into the impact of the Common Blackbird and Song Thrush, research into the ecology of *P. bivaricosus*, preparation of community awareness material and nomination of the species for listing under the Commonwealth EPBC Act. At the time of writing this paper, planning was underway for a pilot captive breeding project for *P. bivaricosus* on Lord Howe Island which will incorporate an ecological research component and local community involvement. *Placostylus bivaricosus* has also been included in a series of six bookmark-style brochures currently being produced by the DEC for distribution to Lord Howe Island residents and visitors to highlight threatened species and the actions which can be taken to assist their conservation and recovery.

Case Study 2: Mitchell's Rainforest Snail *Thersites mitchellae*

The *Thersites* (Family Camaenidae) is a genus of large land snails found in the coastal lowlands and adjacent ranges of north-east New South Wales and south-east Queensland (Abbott 1989; Bishop 1978; Smith 1992). *Thersites mitchellae* (Cox, 1864) (Fig. 4) has a shell up to 55 mm wide and 50 mm high with a strongly elevated spire, deep reddish chestnut to black in colour with two prominent yellow bands. The body colour is dark grey to black with a thin lighter line on the dorsal midline. The species was formerly common in lowland rainforest and paperbark *Melaleuca quinquenervia* swamp forest on the coastal plain of north-east NSW between the Richmond and Tweed rivers, typically on basaltic alluvium (Bishop 1978; Smith 1992; NPWS 2001b). Coastal north-east NSW has experienced major development over the last century, initially for agriculture and now increasingly for urban development, and the coastal lowland habitat for *T. mitchellae* has been reduced in area by at least 90%, with the remaining habitat remnants generally small and fragmented (NSW Scientific Committee 1997b; NPWS 2001b). The largest known surviving population and largest single area of remaining coastal lowland habitat is on Stotts Island, in the Tweed River near Murwillumbah (NPWS 2001b; NPWS 2001c). *Thersites mitchellae* is recognised internationally as endangered through listing on the *2003 IUCN Red List of Threatened Species* (IUCN Species Survival Commission 2003), in the category EN C2a. Available ecological information was summarised by Murphy (2002a). Most of the sites where the species is known to survive are located on slightly elevated ground on the margins of coastal wetlands. Live animals have been recorded from within and under leaf litter on the ground and under bark on Fig (*Ficus* spp.) trees. The species is considered to be herbivorous, feeding on leaf litter, fungi and lichen, and lays eggs beneath leaf litter.

Figure 4: Mitchell's Rainforest Snail *Thersites mitchellae*. This large land snail is endemic to the far north coast of NSW. It is threatened by loss of habitat, with over 90% of its coastal lowland habitat already cleared, and many of the remaining habitat remnants at risk of clearing. Recovery efforts have included increasing protection of key habitat areas, ensuring the species is appropriately considered in land use planning and encouraging local community support and involvement. Photograph by Michael Murphy.

Recovery Program for *Thersites mitchellae*

Thersites mitchellae was listed as an endangered species under the TSC Act in March 1997 (NSW Scientific Committee 1997b). A draft recovery plan was publicly exhibited in July 2000 and the final recovery plan was approved in June 2001 (NPWS 2001b). The recovery plan identifies loss of habitat as the major threat to *T. mitchellae*, with fire, weeds and feral predators listed as additional threats. The objectives of the plan are to identify and protect remaining habitat and extant populations of the species, maximise the protection of the population on Stotts Island, improve the protection and management of other populations and encourage community involvement in the conservation and recovery of the species (NPWS 2001b). The recovery program was summarised by Murphy (2002a) and the following is an update on some of the outcomes.

Critical Habitat declaration and listing under Commonwealth legislation

Stotts Island in the Tweed River has approximately 120 ha of habitat for *T. mitchellae* and an estimated population of several hundred snails, and the Island is considered pivotal to the continued survival of the species (Stanisic 2000). The entire Island was declared to be *critical habitat* under the TSC Act in November 2001 (NPWS 2001c), the first such declaration for any species in NSW, affording it the highest level of protection under the Act. *Thersites mitchellae* was listed as *critically endangered* under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) in July 2002, being the first land snail species to be listed and one of only two land snails currently listed (April 2004). Both the critical habitat declaration and EPBC Act listing have increased the public profile of *T. mitchellae*, and land snails in general, as well as increasing the level of legislative protection afforded to the species. The NSW recovery plan for *T. mitchellae* (NPWS 2001b) was adopted as the Commonwealth recovery plan under the EPBC Act in February 2004.

Increased knowledge of extant distribution

Only two site records of *T. mitchellae* were known in the 70 years prior to listing under the TSC Act: from Stotts Island near Murwillumbah and Cumbebin Wetland near Byron Bay (NSW Scientific Committee 1997b). It is now known from eight localities in the coastal lowlands comprising approximately 30 sites (Fig. 5). The increase in sites since listing is due to a combination of targeted surveys undertaken by the Queensland Museum with funding from the NPWS (Stanisic 1998; 2000), records from the public as a result of increased community awareness, and inclusion of the species in standard development-related environmental impact assessment surveys. The known current range of *T. mitchellae*, from Banora Point near Tweed Heads south to Lennox Head, now approximates its historical distribution on the coastal lowlands, although the actual area of occupancy within this range has been substantially reduced (Murphy 2002a).

A 1980 record of *T. mitchellae* by a local resident (supported with voucher specimens), from a site (elevation 230 m AHD) at Wilsons River near Mullumbimby (Fig. 5) suggested that, contrary to accepted wisdom, the species' distribution might extend beyond the coastal lowlands into adjacent upland areas. The specific location of the Wilsons River site was only determined in 1999, and a targeted search of the site at that time found no sign of *T. mitchellae* (Stanisic 1999). Noting that the snail fauna there comprised upland species (including *Ngairea corticicola*, *Pedinogyra rotabilis* and *Thersites richmondiana*) not usually associated with *T. mitchellae*, it was suggested that the 1980 record might have been the result of accidental and unsuccessful translocation (Stanisic 1999). Nevertheless, further investigation of the Wilsons River area and other upland areas was recommended (Stanisic 1999; NPWS 2001b). At the time of writing this paper, additional upland records of *T. mitchellae* (from sites at elevations between 400 and 515 m AHD near Mount Chowan in Mount Jerusalem National Park) (Fig. 5) were received from a local resident. The identification was based on a brochure prepared by the NPWS for that purpose. These records (supported with voucher specimens) indicate that *T. mitchellae* may also occur in some upland areas adjacent to the coastal lowlands, and that the distribution and habitat preference parameters of the species may need to be reconsidered, with implications for recovery efforts.

Figure 5: Recent records of *Thersites mitchellae*. The only known records in the 70 years prior to listing under the TSC Act in 1997 were from Stotts Island and Byron Bay. Open stars represent coastal lowland localities where the species has been recorded since 1997. Closed stars represent upland localities where the species has been found by local residents (the lower one represents Wilsons River and the upper represents Mount Chowan – see text). Shaded area represents land over 100 m elevation.

Development control and land use planning

Loss of habitat for development continues to be a major threat to *T. mitchellae*, with many of the remaining areas of coastal lowland habitat under threat of development (Murphy 2002a). Prior to listing as a threatened species, *T. mitchellae* received no consideration in environmental impact assessment and land use planning decisions. The recovery plan for *T. mitchellae* includes, as an appendix, environmental impact assessment guidelines. They are similar to those prepared for *P. bivaricosus*, and were designed to ensure that consideration of the species in environmental impact assessment and land use planning was robust and precautionary. *Thersites mitchellae* has been a significant consideration in a number of major development proposals on the NSW far north coast since listing under the TSC Act, requiring habitat protection measures to be negotiated. The listing of the species under the EPBC Act affords an additional safeguard, in that the Commonwealth Government now also an approval role in relation to development proposals likely to result in a significant impact on *T. mitchellae*.

Community awareness

The DEC (and previously the NPWS) has raised the public profile of *T. mitchellae* as a threatened species and as a flagship for land snail conservation since TSC Act listing through numerous local, regional, state and national media stories, including radio, television, newspaper and popular magazines (Murphy 2002a). The NPWS produced and distributed a brochure detailing how *T. mitchellae* can be identified, describing its habitat, outlining the threats to the species and listing actions members of the community can undertake to assist its conservation and recovery. The NPWS has also supported community-based educational and awareness efforts, including the funding of interpretive display material prepared by the Byron Environment Centre to highlight a significant area of habitat in Cumbebin Wetland, Byron Bay.

School education can be a powerful strategy for invertebrate conservation through the promotion of flagship taxa (New 1995; Sands 1999). A Teacher Resource Book titled *Mitch the Rainforest Snail* (NPWS 2003) (Fig. 6) was recently prepared and released by the DEC, with funding provided by the Foundation for National Parks and Wildlife. The book provides a range of classroom resource material suitable for school students in stages 2 and 3 (Year 3 to year 6), promoting *T. mitchellae* as a flagship for student awareness of molluscan diversity and land snail conservation issues on the NSW north coast, and has been positively received. Over 350 published copies have been distributed to primary school teachers, predominantly within the Tweed/Byron/Ballina target area where the species occurs, but also more widely in NSW. An electronic version of the book can be seen online on the DEC website www.nationalparks.nsw.gov.au.

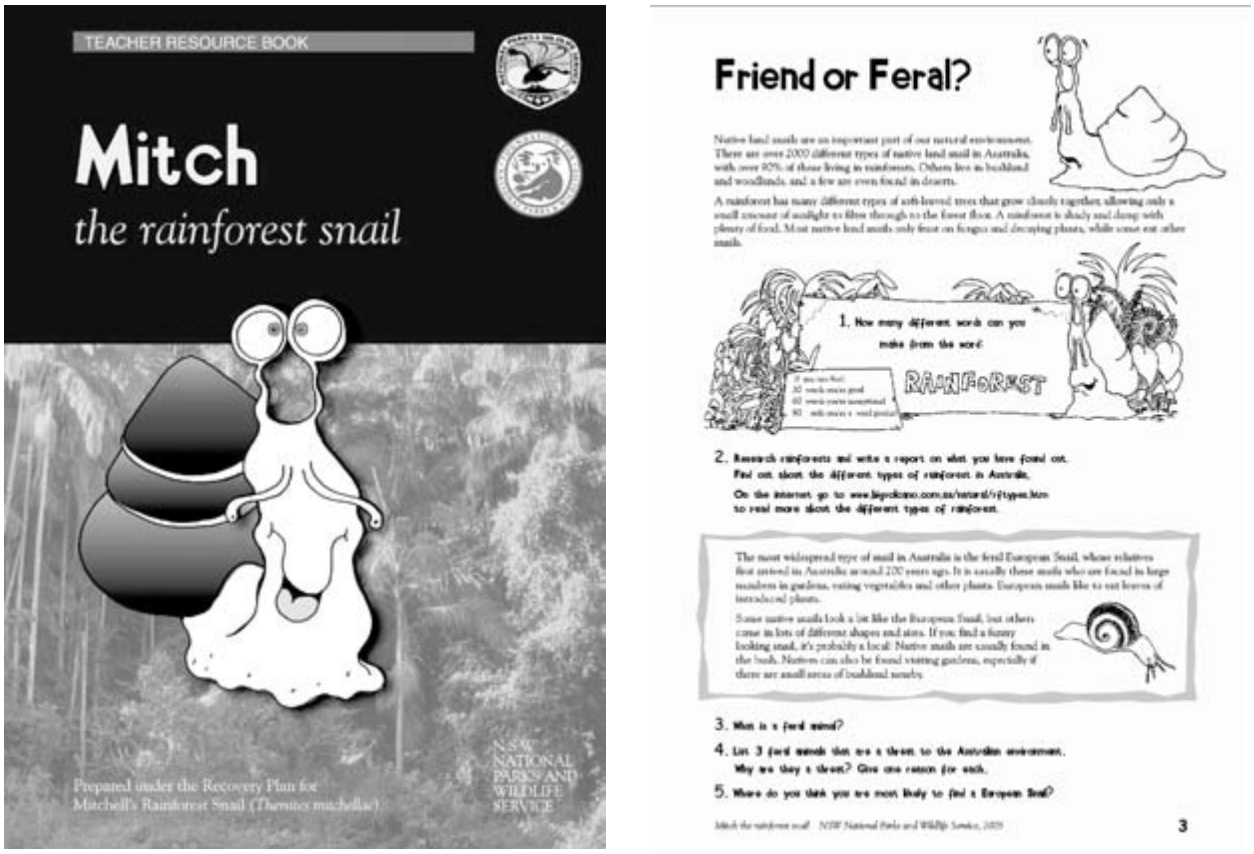


Figure 6: Cover and sample page from *Mitch the Rainforest Snail Teacher Resource Book* (NPWS 2003). This book uses the endangered *Thersites mitchellae* to promote awareness of mollusc diversity and land snail conservation in primary schools. The book received a Whitley Award from the Royal Zoological Society of New South Wales in 2004, judged by the Society to be the best book in the teachers' resource category.

Future actions

High to medium priority actions in the recovery plan for *T. mitchellae* which remain to be implemented include scientific survey of areas of high potential habitat on the coastal plain and adjacent foothills (including the Wilsons River area), statistical modelling of predicted habitat, research into the ecology of *T. mitchellae*, establishment of long-term monitoring sites and assessment of additional areas for identification as critical habitat. At the time of writing, records of *T. mitchellae* from sources including development-related environmental impact assessment surveys, community reports and opportunistic field surveys were being collated and validated in preparation for a habitat modelling project.

A brief background to Lepidoptera conservation

Despite their prominence in community-based conservation actions internationally, Lepidoptera in Australia remain poorly known, with only 10 500 of the estimated 21 870 species having been described (Yen and Butcher 1997). Sands and New (2001) assessed the conservation status of 624 Australian Lepidoptera taxa, and recommended that 15 taxa were threatened according to criteria modified from those used in the 1994 IUCN Red List. Such a small proportion may result from the combination of the lack of data available for most species, and that many entomologists prefer that species are not included on statutory lists as this often triggers the requirement to obtain permission to collect or undertake research on the listed species (Greenslade 1999; Gunning 1999). Conversely, the broader community has embraced the opportunity to participate in many species-based management programs, such as those for the Eltham Copper Butterfly *Paralucia pyrodiscus*, the Purple Copper Butterfly *Paralucia spinifera*, and the Richmond Birdwing Butterfly *Ornithoptera richmondia* (Sands and New 2001). Five Lepidopteran species (three butterflies and two moths) are listed under the TSC Act (as at April 2004, Table 1). The recovery program of one of these species is detailed below.

Case Study 3: Purple Copper Butterfly *Paralucia spinifera*

The Purple Copper Butterfly *Paralucia spinifera* (Edwards and Common 1978) (Family: Lycaenidae) (Fig. 7) has been described as one of Australia's rarest butterflies (Dunn *et al.* 1994). It is known from about seven localities comprising 37 sites on the NSW Central Tablelands, all above 900 metres elevation and generally bounded by Bathurst, Lithgow and Oberon. The larvae of *P. spinifera* graze on native Blackthorn *Bursaria spinosa* ssp. *lasiophylla* (Braby 2000; NPWS 2001d). *Paralucia spinifera* is generally found within, or on the edges of, eucalypt woodland with a grassy understorey and patches of the larval food plant, where the aspect and local vegetation structure allow direct sunlight to reach the food plants for a proportion of the day (NPWS 2001d).

Figure 7: Purple Copper Butterfly *Paralucia spinifera* adult. This species was only described in 1978 and is known only from a small area on the NSW Central Tablelands. Photograph by Simon Nally.

The larvae of *P. spinifera* have a mutualistic association with the ant species *Anonychomyrma itinerans* that attends its larvae and pupae (Braby 2000; NPWS 2001d) (Fig. 8). Although relatively common amongst Lepidoptera, the larvae – ant association engenders fascination both within researchers and the general community. After an apparent autumn and winter absence, the *A. itinerans* return to patrol the *B. spinosa* subsp. *lasiophylla* during the spring larval emergence of *P. spinifera*. Although attentive to the early larval instars and defensive of the *B. spinosa* subsp. *lasiophylla*, *A. itinerans* do not alter the behaviour of the early instar larvae. However, the activation of the larvae's 'honeydew' glands at the third or fourth instar is coincident with a marked change in larval behaviour. Whilst previously remaining on *the B. spinosa* subsp. *lasiophylla* both day and night, the larvae become nocturnal, being shepherded by *A. itinerans* to and from chambers within the subterranean *A. itinerans*' nest. *Anonychomyrma itinerans* constantly check the availability of 'honeydew' from the larvae's glands, and activity that stimulates the retraction of the glands. *Anonychomyrma itinerans* continue their behaviours of attacking potential predators that come into contact with the *B. spinosa* subsp. *lasiophylla*, and of causing the larvae to retreat underground when such a threat is detected.

Recovery Program for *Paralucia spinifera*

Paralucia spinifera was listed as endangered under the TSC Act in November 1996, on the basis that; there were three known sites, it was threatened by habitat disturbance (grazing of the host plant by sheep, goats and cattle, clearing for the establishment of pine plantations, invasion of exotic weeds and activities of feral pigs) and overcollecting, and only one site was secured within a conservation reserve (NSW Scientific Committee 1996). The recovery program, developed between 1997 and 2001, included surveys to identify unrecorded locations and the preparation of a recovery plan. A draft recovery plan, prepared both in accordance with the TSC Act and Commonwealth EPBC Act, was publicly exhibited in 2000. A final recovery plan was approved in June 2001 (NPWS 2001d). Since 1997, the DEC (and previously the NPWS) has implemented a program to acquire an understanding of the ecology of the species, and to prevent the operation of processes that threaten its survival. The recovery plan identified a range of habitat modification and disturbance factors as the key processes threatening the species. Accordingly, the recovery plan proposed habitat identification and survey, site management and protection, research, and community involvement as key program areas (NPWS 2001d). Some of the successes are outlined below.

Figure 8: *Anonychomyrma itinerans* ants attending larva of Purple Copper Butterfly *Paralucia spinifera.* The larvae of *P. spinifera* have a mutualistic association with *A. itinerans,* with the ants protecting them from potential predators and feeding on 'honeydew' exuded by the larvae. Photograph by Simon Nally.

Potential habitat identification and survey

At the time of listing under the TSC Act, *P. spinifera* was known from three locations (NSW Scientific Committee 1996). Further sites had been recorded, but these details were not made available to the Scientific Committee. It was expected to be found at further sites. In 1997, the NPWS and volunteers undertook helicopter-based aerial surveys to find potential habit. Topographic maps in the Bathurst-Lithgow-Oberon areas were used to record areas of *B. spinosa* ssp. *lasiophylla*, the larval host plant, at sites with minimal canopy cover. Due to time and land tenure constraints, ground-truthing of potential habitat sites was generally confined to accessible areas of public land. By the end of the flying season in the spring of 1998, further sites of *P. spinifera* had been recorded at Lithgow, and at new sites in the Lidsdale and Cheetham's Flat areas.

Surveys for flying adults of this butterfly are made difficult due to a range of factors:

- peak flying activity occurs over only a three-week period;
- preliminary data suggest that flying activity is related primarily to incident solar radiation, even at temperatures as low as 5°C. Accordingly survey work can be confounded by localised or unpredicted cloud conditions;
- time of flying varies between sites because aspect and tree canopy cover affect solar radiation reaching the *B. spinosa* ssp. *lasiophylla* patch;
- within a patch of *B. spinosa* ssp *lasiophylla*, apparent numbers of flying adults may be consistently recorded over a number of years, fluctuate over several years (Sands and New 2001, Nally pers. obs.), or annually decline to a level where adults are unrecordable (Nally 2003), possibly indicating an underlying metapopulation structure;
- there are both extensive stands and numerous small and discrete areas of potential habitat in this locality.

In response to these difficulties, the DEC has encouraged amateur entomologists and the broader community to be involved in the survey to identify new sites. All these activities have resulted in records of 37 sites where flying adults have been observed, and a doubling of the range (Fig. 9). Notably, this range increase was recorded by a seven year-old Oberon resident, Heather Wilson, (Fig. 10), who had identified the butterfly from a brochure prepared for this purpose.

In response to the helpful advice of numerous amateur and professional entomologists, combined with the results of the potential habitat modelling, DEC plans to facilitate further community-based survey in predicted potential localities in NSW and the ACT.

Management of threatening processes at recorded sites

Seven sites in the vicinity of Lithgow have been the subject of community-based weed control programs coordinated by Lithgow Tidy Towns, Lithgow-Oberon Landcare Association, Conservation Volunteers Australia and the DEC. This has involved herbicide treatment to large stands of Broom *Cytisus scoparius*, and intensive hand weed control of Hawthorn *Crataegus monogyna*, Radiata Pine *Pinus radiata*, Blackberry *Rubus fructicosus* and Cotoneaster *Cotoneaster* sp.. This has reduced the weed load over about three hectares of habitat. Four sites have been the subject of weed control by the landholder

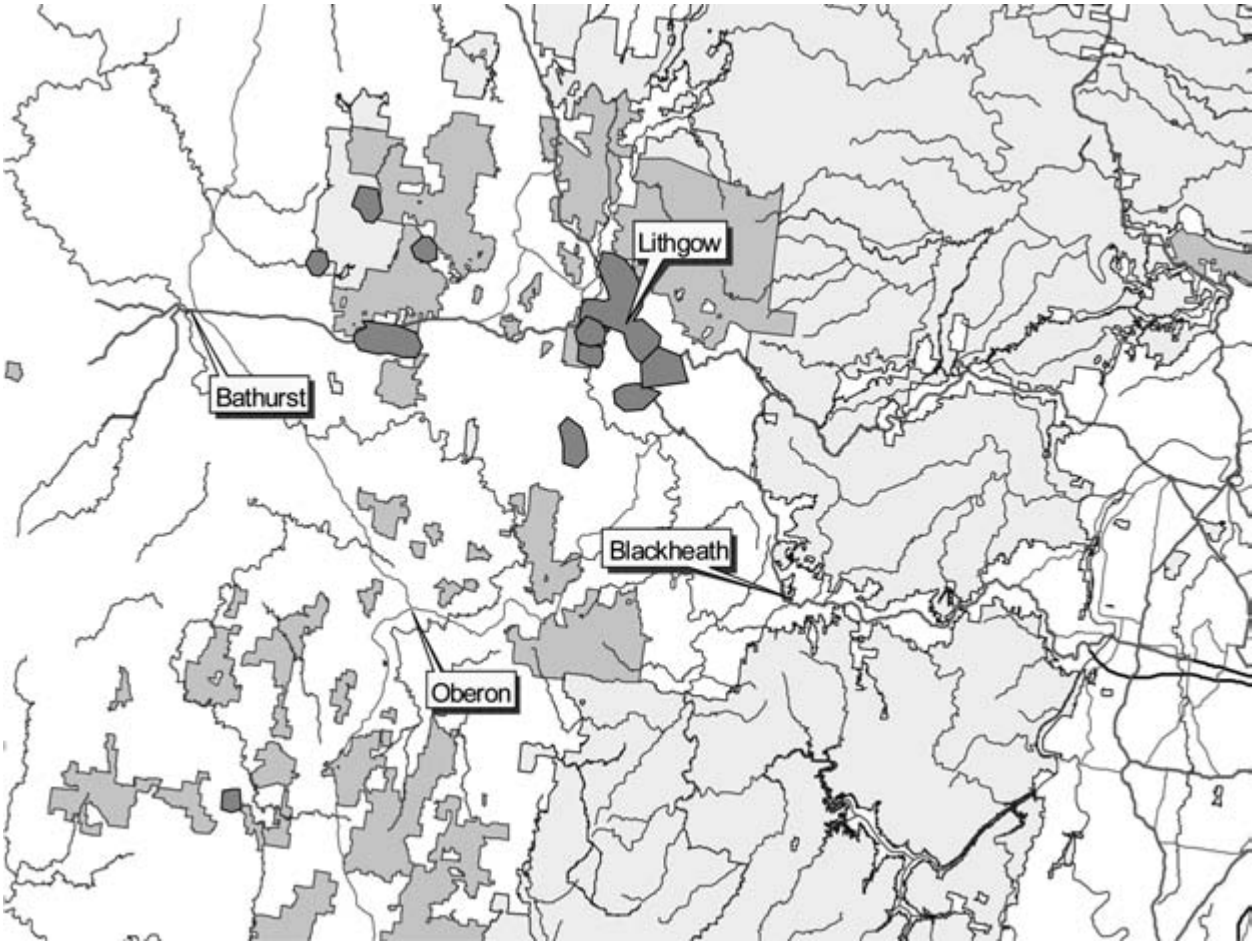


Figure 9: *Paralucia spinifera* distribution and range extension (bright green areas represent a one kilometre buffer around each site, pink hatched areas are State Forest, green hatched areas is the Winburndale Nature Reserve, red lines represent main roads, and blue lines represent drainage lines).

Girl finds rare butterflies

Nature lover: Heather Willson

By DESIREE D'COSTA

A SEVEN-YEAR-OLD girl with a love of insects has discovered a new population of one of Australia's most endangered butterflies.

Heather Willson's discovery of a colony of purple coppers at her grandparents' NSW property had increased their known habitat by 50km, Simon Nally of the National Parks and Wildlife Service said.

"We're very happy with the find," Mr Nally said.

"At the moment, there are 35 sites located in two main areas east of Bathurst, at Yetholme and Lithgow, covering 48km. The site Heather found last year is south of Oberon."

Last year, the NPWS told Heather's grandparents a colony of the butterflies might be on their property, sparking Heather's investigation.

"I'm not surprised that Heather found them, because a butterfly flies at eye height for a child and children are very good at focusing on small things," Mr Nally said.

"These butterflies aren't found anywhere else in the country, so we're very pleased with Heather's efforts.

"The CSIRO has established that the population Heather found is genetically distinct from all other populations, making the find even more valuable."

Heather's mother, Kate, says she has always been interested in nature.

"Her room is like a compost heap," Ms Willson said.

"She's always collecting colourful leaves and bark; she's very intrigued with the outdoors.

"I'm amazed that she found the butterfly, and really proud of her."

Found: The endangered butterfly

Figure 10: Extract from the *Sunday Telegraph* 12 October 2003 in response to DEC media release (Courtesy, News Limited, 12 October 2003, Desiree D'Costa)

with assistance from the DEC in the Lithgow and Yetholme areas. A further five sites on public land have been subject to similar weed control activities undertaken by their respective management agencies.

Augmentation and habitat linkage plantings have commenced on three sites, achieved through a combination of community-based and management agency activities. Both NSW State Forests and Commonwealth Department of Defence have installed fences around recorded habitat to prevent its loss through vehicular damage. The DEC is implementing feral animal and weed control programs at two sites within Winburndale Nature Reserve, and Evans Shire Council has commenced the process to close an unsealed road, where traffic-generated dust is settling on habitat.

All the above activities are ongoing, with a recovery team monitoring progress and priorities. Further discussion of community participation in these recovery actions is in Nally (2003).

Research

In order to identify potential habitat areas within the broad distribution of *B. spinosa* ssp. *lasiophylla*, predictive habitat modelling was undertaken. Due to inconsistent availability of vegetation data layers, and the recent review of *Bursaria* by Cayzer *et al.* (1999), vegetation could not be included as a variable in the predictive modelling. Accordingly, the modelling analysed the statistical relationship between the known locations and climate, terrain and substrate variables. The modelling showed the taxon has a strong relationship with temperature range and rainfall seasonality combined with elevation, which served as another climatic surrogate, with these factors delineating a 'climatic envelope' in which this species may occur (Eco Logical Australia Pty Ltd 2003). The model predicts that the following general areas represent areas offering similar conditions to those of the known habitat: western edge of Tweed Caldera rim; Barrington Tops; between Mudgee to Goulburn; south-east ACT to Bombala along the eastern slopes of the Great Dividing Range; Tumut to Mt Kosciusko along the western slopes of the Great Dividing Range; and small areas east of Mittagong and Moss Vale, and south east of Braidwood. The initial survey effort will focus on the area between Oberon and Goulburn.

In 2003 the CSIRO, in collaboration with the DEC and the Natural Heritage Trust Endangered Species Program, completed a genetic analysis of *P. spinifera*. The results showed a minor genetic differentiation between the main site clusters at Lithgow and Yetholme, with increased differentiation for the disjunct population located at Mount David south west of Oberon, and that there were generally high levels of genetic diversity within populations. Clarke and Grosse (2002) concluded:

…that there are few, if any, genetic concerns for the species at this stage. If habitat loss and fragmentation are impacting this species, the effects are not reflected in the genetic architecture of the species at this point in time, suggesting that population sizes and/or levels of gene flow, are sufficiently large to maintain genetic diversity and variation.

The genetic analysis indicates that the management effort should be directed to as many representative populations from the two groups centred on Yetholme and Lithgow as feasible in order to conserve genetic diversity within the species, and to specific sites that display unique genetic variation (Clarke and Grosse 2002).

Increased knowledge of the mutualistic relationship between *P. spinifera* and attendant ants has the potential to guide effective management of known sites, as well as provide insights into the creation of effective habitat linkages between sites. During 2003, the University of Wollongong established a partnership with the DEC to study the ant species assemblages in areas of *B. spinosa* ssp *lasiophylla* occupied and unoccupied by *P. spinifera*. Preliminary results show that top-dominant ant species assemblages varied between occupied and unoccupied habitat (Sam Luccitti University of Wollongong, pers. comm.). The significance of this finding is that ant surveys may be an effective tool in identifying potential or occupied habitat within the extensive areas of *B. spinosa* subsp. *lasiophylla*. The study has also provided indications of both seasonal and cyclical variation in ant assemblages that may reflect the temporary nature of habitat suitability.

Reservation of habitat

The DEC has commenced processes, pursuant to the provisions of the *National Parks and Wildlife Act* 1974, to dedicate a Nature Reserve west of Lithgow to conserve potential habitat for *P. spinifera*. A survey undertaken by 20 volunteers from the NSW Society for Insect Studies recorded two sites occupied by *P. spinifera* within the proposed Nature Reserve. Notably, one of these sites appears to be unaffected by human activities, possibly due to its remote location. All other sites, except for one within Winburndale Nature Reserve, have been highly disturbed by direct human intervention. This survey has effectively increased the number of sites within conservation reserves from two to four.

Future actions

High to medium priority actions in the recovery plan for *P. spinifera* which remain to be implemented include; ground-truthing and refining the habitat modelling, identification and survey of areas of potential habitat, research into the ecology of *P. spinifera* and *A. itinerans*, and extending community involvement activities. At the time of writing, the ground-truthing of modelled habitat was being planned for the coming spring emergence of adult butterflies.

Conclusions and future directions

We do not intend to delve into the issue of the relevance or applicability to invertebrates of state, national, or international criteria and processes for the assessment of conservation status. Hutchings and Ponder (1999), Sands and New (2002) and others have adequately canvassed these matters. The point we do make is that, as imperfect as these criteria and processes may be to invertebrates, it is better to apply and utilise threatened species legislation as best as able as one tool for invertebrate conservation than to ignore the opportunities it presents.

Several authors have questioned the value of utilising the provisions of the TSC Act towards invertebrate conservation (e.g. Gunning 1999; Hutchings 2004). The three case studies demonstrate that the TSC Act can make a valuable contribution to the conservation of individual threatened invertebrate species. The recovery programs for *Placostylus bivaricosus*, *Thersites mitchellae* and *Paralucia spinifera* have resulted in both the reduction of threatening processes at key sites for these species and significant increases in the known range of the species over the period of the recovery program. The combination of targeted research and fieldwork, and the involvement of amateurs and community groups, has improved the understanding of the ecology of these species, which is essential if they are to be properly considered in conservation and land use planning decisions (Murphy 2002b). There has also been an increase in the level of awareness in the broader community concerning these species and a commensurate increase in the involvement of local communities in their conservation and recovery. It is important that all tiers of Government maintain their commitment to the implementation of recovery plans to sustain this momentum.

A common theme in the three invertebrate recovery programs has been the promotion of these species as flagships for greater community awareness of broader invertebrate issues, including the unique nature of many native Australian invertebrates, the pivotal role of invertebrates in ecosystems, the critical conservation status of many taxa and the need for protection of habitats. With the scant handful of invertebrate species listed under the TSC Act (16 as at April 2004, Table 1) to represent 99% of the state's fauna, this is an important component of recovery programs for all listed invertebrates. Numerous authors have identified the critical role of flagship taxa in stimulating wider community awareness of, and support for, invertebrate conservation (e.g. Yen *et al*. 1990; New 1995; Van Praagh 1997; Horwitz *et al*. 1999; Kitching 1999; Lunney 1999; Mawson and Majer 1999; Sands 1999). It is imperative that the promotion of broader community awareness of the serious issues facing invertebrate conservation be continued. The media profile established by threatened species legislation, such as the TSC Act, can be used as an effective avenue for promoting invertebrates. Cassis (1999) noted with optimism that the popular media and the general public were becoming more responsive to positive messages about the relevance of invertebrates. The media coverage regarding the proposed listing of the native cockroach *Panesthia lata* under the TSC Act (Fig. 11) further demonstrates the value of the TSC Act in promoting invertebrate conservation issues. It is unlikely that such a story would have featured as prominently (or at all) in the absence of the proposed listing under the TSC Act.

The provisions of the TSC Act for multi-species conservation initiatives, such as the listing of endangered ecological communities and key threatening processes, have not yet been fully utilised for invertebrate conservation (Murphy 2002a). No invertebrate assemblages have yet been listed as endangered ecological communities under the TSC Act (April 2004). Invertebrate assemblages with high endemism, restricted distributions and which are under threat, for example some land snail assemblages occurring on restricted limestone outcrops threatened by land clearing or mining, would be worth considering for listing under the TSC Act. A number of key threatening processes which have been listed under the TSC Act are of relevance to invertebrate conservation. These include predation by the Ship Rat on Lord Howe Island (NSW Scientific Committee 2000), clearing of native vegetation (NSW Scientific Committee 2001a) and loss or degradation of sites used for hill-topping (i.e. congregation for mating) by butterflies (NSW Scientific Committee 2001b).

Kitching (1999) stressed the need for members of the invertebrate science community to work together to positively promote invertebrate conservation and build sympathy and support in the public arena. We suggest that the lack of sufficient collaboration and mutual support within some sections of the invertebrate science community is a significant factor in limiting the broader acceptance of the need to actively conserve invertebrates and reducing the efficacy of extant conservation programs.

Salvation at hand for cockroach that's more than a pretty face

Stephanie Peatling
Environment Reporter

Not all creatures worth saving are cute like koalas, or awe-inspiring like whales. Others that you would rather stomp on or hit with a newspaper can need a hand too. Even cockroaches.

The native-wood feeding cockroach, now found only on two tiny islands off Lord Howe Island, is about to have an image overhaul in a last-ditch attempt to save it from extinction.

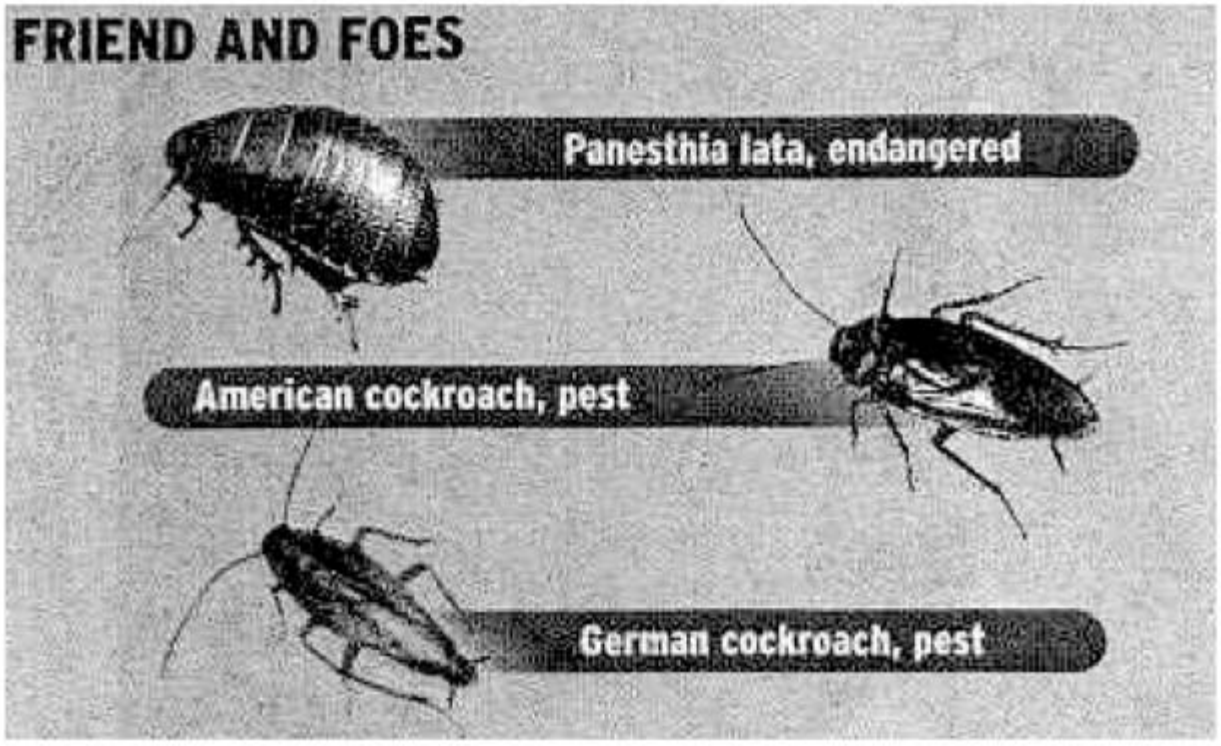
The NSW Scientific Committee will today recommend the listing of the cockroach, *Panesthia lata*, as an endangered species.

Michael Murphy, threatened species officer with the NSW National Parks and Wildlife Service, said many people did not appreciate the need to protect the less telegenic members of the foodchain.

"Biodiversity is not just made up of lovely birds and mammals," Mr Murphy said.

"Ninety-nine per cent of creatures out there are the forgotten invertebrates that keep the wheels turning on the whole ecosystem."

And, he notes, this particular endangered roach is not as ugly as some. "I tend to raise my foot from the floor when I see a cockroach in the kitchen but this is really a nice-looking sort of cockroach."



Lord Howe Island is a rich source of study for scientists. The wood feeding cockroach is one of 23 threatened species including several species of plants, a woodhen, worm and snail.

Mr Murphy can see new avenues for promoting the island's biodiversity make-up: "Lord Howe Island – leading the way in invertebrate conservation."

First documented in 1868, the cockroach was all but wiped out after the black rat was introduced to Lord Howe in 1918. An introduced grass has also contributed to the plummeting numbers.

The cockroach's preferred habitat of decayed logs is also increasingly under threat, although there are plans to regenerate areas of the island in order to boost numbers.

Two colonies of the creature remain on two smaller islands away from Lord Howe but exactly which two is being kept secret for fear of looting. "There could be international smugglers out there who will come and take them," Mr Murphy said.

Figure 11: Extract from the *Sydney Morning Herald* 24 October 2003 (p. 3) (Courtesy, Stephanie Peatling and the *Sydney Morning Herald)*. This article from the popular media demonstrate how the TSC Act can be used to encourage community support for invertebrate conservation issues.

While there are difficulties in applying threatened species legislation to invertebrates, the invertebrate science community has yet to recognise that this legislation can make a valuable contribution as one of a number of useful tools for invertebrate conservation efforts, through promoting community support and involvement, incorporating consideration of invertebrates into land use planning decisions, encouraging scientific research, identifying critical areas for protection, and controlling threatening processes.

At the Royal Zoological Society Forum in October 2003, of which this book is a record, several participants asked whether the effort spent on single species conservation through threatened species legislation had been a failure and should be diverted instead to broader landscape protection measures. It is our belief that success in biodiversity conservation will rely on the continued application of a range of approaches at different scales, including targeted species-specific conservation measures, as well as strategic threat abatement actions and broader landscape protection and management. Concentrating on broad landscape planning initiatives, to the detriment of maintaining active programs to address threatened taxa with special requirements, will not optimise biodiversity conservation. Heywood and Iriondo (2003) made this point strongly, arguing that a purely landscape-level approach to biodiversity conservation was as flawed as a purely single-species approach, while Hnatiuk (2003) warned that relying on the simplified modelling of real world complexity that is an essential part of landscape-level planning would, in conjunction with other shortcomings in environmental management, result in unwanted outcomes including species loss, environmental degradation and declining agricultural production. The issue of broad landscape-level planning as a surrogate for biodiversity conservation is particularly relevant to invertebrate conservation. Protecting a vegetation-based community through broad landscape planning will, by default, probably also conserve some invertebrate species, but not in any strategic, comprehensive or dependable way. The spatial distribution of invertebrate species and assemblages often has little or no relation to the distribution of broad vegetation communities, so that relying on a landscape conservation framework based on vegetation communities as a surrogate for invertebrate conservation is highly unreliable (Hutchings and Ponder 1999). Many invertebrate species have very precise environmental requirements and occur at spatial and temporal scales that cannot be reliably addressed from a broad landscape approach (Yen *et al*. 1990; New 1995). *Paralucia spinifera* is a case in point, with habitat suitability linked to the temporal occurrence of both the species' food plant and ant associate and decided at the spatial scale of sunlit patches in eucalypt woodland (NPWS 2001d). The plight of *Thersites mitchellae* further demonstrates this point. The species survives today in tiny remnants of its previously extensive habitat, the majority of which are simply too small to be reliably identified at the resolution of landscape-level planning (NPWS 2001b).

Yen *et al*. (1990) considered the introduction of threatened species legislation in Victoria (the *Flora and Fauna Guarantee Act* 1988) to be 'an exciting phase of invertebrate conservation' in that state, seeing it as a transition from invertebrates being merely fortuitous passengers in conservation efforts undertaken for other reasons to being the prime object of targeted conservation programs. Threatened species legislation provides opportunities for invertebrate conservation that were previously available only for high profile, charismatic vertebrate species, and as such is of significant value in efforts to redress the continuing imbalance between invertebrates and vertebrates in the conservation priorities of both government and the community. The potential disappearance of a couple of snails and a small butterfly may not seem important to many, but they are a warning that many invertebrate communities are under threat, whose functional loss may indicate the commencement of ecosystem collapse.

We close with a local newspaper quote from a local government Shire Councillor which highlights both how listing under the TSC Act has significantly raised the profile of an invertebrate species (*Thersites mitchellae*) in land use planning decisions on the NSW far north coast, and the low value still placed on this critically endangered species by some sections of the community:

Councillor X "urged her colleagues not to be influenced by the presence of 'one wretched thing that crawls along the ground' during debate about the location of a future district town centre" (*Tweed Sun* Wednesday 16 April 2003 p. 5).

….and, with apologies to Coleridge and Shelley, our own poetic view of the voice in land use planning that listing under the TSC Act has given this hitherto unregarded species:

Ode to the Snail

Long live the snail
May its viability never fail
May its significance never pale
May it make consultants quail
So that all developments entail
Robust ameliorative measures

MJ Murphy

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