

3. The recovery plans

In this section a short account of each threatened *Powelliphanta* taxon is given, using the standard format prescribed for all Department of Conservation recovery plans (Brown & Molloy 1999). Because so many species require conservation attention, the taxa in each Department of Conservation Area are prioritised according to threat and a summary of recommended recovery actions given in Appendix 5.

For most taxa, little is known of the current rate of decline. As this is essential information, used to determine the urgency of recovery actions, the establishment of monitoring plots and several years of annual or biennial re-measurement is suggested for most taxa. While monitoring alone does not effect any recovery, and in fact consumes substantial recovery resources, the examination of fresh empty shells in monitoring plots provides valuable quantifiable information on the causes as well as the rates of snail decline.

In many instances the options for recovery actions are limited until the causes of decline are better understood. Research into the nature of and solutions to the decline of *Powelliphanta* is best done centrally, as most problems are common to many taxa. For this reason, general research topics are listed in Section 5.0 rather than within individual taxon accounts.

Various target densities for populations have been recommended as long-term goals within the plans, the target densities differing largely with species, but also with situation. Those species living sympatrically with other *Powelliphanta* species are presumed to occur naturally at lower densities than otherwise.

The average densities achieved by populations of *P. gilliesi subfusca* and *P. gilliesi kaburangica* where pests were absent or controlled were used as target densities for other coastal small *P. gilliesi* snails. Likewise, the average densities in populations of *P. hochstetteri hochstetteri* and *P. marchanti* when exotic predators were scarce were used as a guide to the former densities of large snails in montane beech forest. A few relatively pest-free populations of *P. lignaria lignaria*, *P. l. lusca* and *P. l. unicolorata* provided a guide for the target densities for all subspecies of *P. lignaria*.

Included in each recovery plan is a photograph illustrating the range of morphological variation within the taxon, as well as a map showing the taxon's distribution. On the maps, red stippling represents the known or reliably presumed range of the taxon, while solid red dots represent sites from where shells have recently been collected. Details of these collection sites are listed in the *Powelliphanta* database at the Department of Conservation, Nelson, where most of the shell collections are stored.

3.1 *POWELLIPHANTA MARCHANTI*

Description

At the type locality near the Mokai Patea Trig on the Ruahine Ranges, *Powelliphanta marchanti* is a medium-sized snail (maximum diameter 54 mm; height 30 mm) with a yellowish brown to old-gold coloured shell. The dorsal surface and periphery are very sparsely lined with spirals of darker brown (Powell 1979).

Several other large *Powelliphanta* found in the ranges north and west of the Ruahines in the 1960s and 1970s were described by Powell as *P. marchanti* in his 1979 publication, on the basis of rather cursory examination of single specimens from each locality. More information on the snails on Mt Egmont, on Mt Manuoha in the Urewera National Park and on the Maungaharuru Range in Hawkes Bay, was gathered in the 1980s and 1990s, including a genetic profile of each. It became clear that these more recently discovered snails were distinctive taxa which should not be included in *P. marchanti*.

Powelliphanta from the southern Kaimanawa Ranges are similar in appearance to typical *P. marchanti*, but are always smaller (maximum diameter 52 mm). Snails from the Kaweka Ranges are small (maximum diameter 50 mm; height 22 mm) and plain gold in colour with no banding and may be better considered a subspecies of *P. marchanti*. However, the genetic make-up of the Kaweka and Kaimanawa snails have yet to be examined, and in the meantime they are considered within this Recovery Plan as important populations within *P. marchanti*.

Habitat

An upland species (1000–1470 m a.s.l.), found under bush rice grass and litter in red beech/mountain cedar forest at Ruahine Corner, under leatherwood/inaka scrub in the southern Ruahine Ranges and under the skirts of tall tussock in montane grasslands. Particularly common on limestone scarps and plateaux.

Found under litter in manuka and mountain beech forest in the Kaimanawa and Kaweka Ranges.

Distribution

In the western Ruahine Ranges, particularly in the northwest Ruahines on the Mangaohane limestone plateau and its surrounding limestone scarps (Potae – Makirikiri Ridge, Ohutu Ridge, Aorangi) and on the Mokai Patea and Otupae Ranges. However, also found in apparently localised populations in scrub and tussock above 1000 m a.s.l. on the Hikurangi, Whanahuia and Ngamoko Ranges to the west of the main Ruahines, and very patchily on the main Ruahine Ranges ridge line as far south as Takapari.

In the southern Kaimanawa Ranges, close beside the Rangitikei River from its junction with the Mangamaire River to its junction with Otamateanui Stream, and in the Otamateanui catchment.

In the Kaweka Ranges, in the headwaters of Kiwi Creek and Rocks Ahead Stream.

Cause Of Decline And Threats

1. Intense predation by possums from at least the mid-1970s until the early 1990s in the Ruahine Ranges population, and since the 1980s in most of the Kaimanawa Ranges populations (in 2000 there was still 120 ha with no possum-damaged shells and high snail numbers).
2. Deterioration of the snail's micro-habitat through: fire and stock grazing prior to 1960 in the Mangaohane Plateau; fires, stocking and consequent erosion on the Mokai - Patea Range; and deer browse in the Kaweka, Kaimanawa and Ruahine Ranges.

Past Conservation Efforts

1. Possum control (aerially delivered 1080) over a wide area in the northwest Ruahine Corner - Lake Colensoi area in 1994 to protect both the special vegetation and the snail population. The possum population has recovered gradually since then (5.3% RTC in May 1999; 13% RTC in 2002). Since 1995 possum numbers along the Potae ridge line have been controlled through regular (bimonthly) re-stocking of bait stations along the Potae Track with the poison Pest-off.
2. Snail density was monitored in three 500 m² plots near Ruahine Corner in 1994 and one of these was re-measured each year between 1997 and 1999.
3. A 500 m² plot established in the Kaimanawa population in 1994 was re-measured in 1997 and a second plot set up in 1998.
4. A survey of the distribution and density of the Kaimanawa Ranges snail population was undertaken in 1997/98 (Husheer 1998).
5. In 2000 thirty-nine 10 m² plots were set up at 100 m intervals on transects through 250 ha on the true left of the Rangitikei River, Kaimanawa Ranges. A further thirty-two 50 m² plots were established in a non-treatment block on the true right of the river.
6. In 1999/2000 several ground-based possum-control operations reduced densities from about 20% RTC to less than 1% RTC in the 250 ha treatment area in the southern Kaimanawa Ranges.

Current Conservation Status

In the northwest Ruahine Ranges *Powelliphanta marchanti* is in moderate to high numbers (9.8 snails/100 m²) and has a comparatively large range, but is dependent on on-going possum control and the maintenance of snail habitat in the privately-owned tussocklands. The status of the widely scattered snail populations of the southern Ruahines is unknown, but many of the shells had been damaged by possums, and snail density away from the calcium-rich soils of Ruahine Corner appear to be lower.

Probably due to the reduced and degraded nature of the Kaweka Forest, the population of *P. marchanti* there is now very limited in extent. However, there is no sign of predation on the snails by possums, and snail densities are apparently moderate (4 live snails/person hour in 2000; C. Ward, pers. comm.).

Powelliphanta marchanti is restricted to only a small part of the southern Kaimanawa Ranges and predation by possums has brought the numbers very low (0.6 snails/100 m²) over at least 85% of its range. However, in the remaining area unaffected by possums, snail densities are still moderate (5.6 snails/100 m²).

Powelliphanta marchanti is ranked in 'serious decline' by Hitchmough (2002).

Long-term Recovery Goal

Dense (> 12 snails/100 m²) snail populations that are stable or increasing and representative of the full range of genetic and morphological diversity in *Powelliphanta marchanti*.

Objectives For The Next 10 Years

Objective One

Increase the size of the snail populations in the Ruahine and Kaimanawa Ranges by sustained predator control.

Explanation

Possums are the main cause of mortality for snails in both the Kaimanawa and Ruahine populations, but there is no sign of predation by possums in the Kaweka population.

Possum damage on northwest Ruahine snail shells was obvious in the mid-1970s, but it may have started much earlier: the possum-induced collapse of rata/ kamahi forest in the southern Ruahines began as early as 1947. On the other hand, the northern forests are much less favourable to possums than the southern Ruahine forest so possum numbers were probably always lower further north. By the mid-1980s, 88% of shells found at Ruahine Corner, and 90% of shells found on the Whanahua Range, were from snails killed by possums. However, in 1994, the first live snail monitoring at Ruahine Corner found moderate to high snail densities (6-12 snails/100 m²), presumably because *Powelliphanta* numbers in the wet forests on calcium-rich soils had been particularly high to begin with. Unfortunately, despite possum control, snail density steadily declined through the 1990s to only 3.1 snails/100 m² in 2002.

By contrast, the density of *Powelliphanta marchanti* on the greywacke soils of the Kaimanawa Ranges may never have been particularly high. A few possum-damaged snail shells were first noted in a 1981/82 New Zealand Forest Service survey (Whiteford 1983), and then through the 1990s hundreds and hundreds of possum-eaten shells were obvious. Live snail density when first measured at one site in 1994 was extremely low (0.8 snails/100 m²). However, extensive and intensive snail-density monitoring around the Rangitikei - Otamateanui River junction in 2000 found a few areas still unaffected by possums. For example, although all 16 snail plots on the left bank of the Rangitikei had abundant possum-damaged snail shells and few live snails (113 broken shells, 9 live snails, a density of 0.6 snails/100 m²), away from the Otamateanui Stream and on the right bank of the Rangitikei River, no possum-damaged shells and 67 live snails were found in only 12 plots (5.6 snails/100 m²).

Although the vegetation is uniform beech forest throughout, and possums reached an eruptive peak in the Kaimanawa Ranges some time in the 1960s (C. Speedy, pers. comm.), snail-eating behaviour has taken more than 20 years to spread through the possum population. The physical barrier of the Rangitikei River may have slowed the spread, as the very large Karamea River did in a similar landscape at Karamea Bend, North West Nelson, thereby providing protection for a population of *P. lignaria oconnori*.

Once snail densities are very low, recovery of the population is extremely difficult, so it is vital that possums are controlled in the small remaining stronghold of *Powelliphanta* in the Kaimanawa Ranges.

Though possums are not eating Kaweka *Powelliphanta*, they have the potential to do so. Given this, it is a sensible precaution to keep possum numbers so low that those present do not face food shortages (and learn to eat snails), or cause deleterious changes to the forest itself.

Actions Required

1. In the southern Kaimanawa possum-control area (for *P. marchanti*), reduce possum abundance to under 1% RTC on all trap lines for the next 5 years. Monitor RTC annually, using at least five trap lines in snail areas affected and unaffected by possums. Aim to retain snail densities of 5.6 snails/100 m² in the northern treatment area and to reach this snail density in the southern block by 2012. Releaser snail plots at five-yearly intervals to determine the success of the management regime.
2. Review the possum control regime in the Potae - Makiriri snail colonies. Aim to keep possum numbers steadily below 3% RTC, preferably less than 1% RTC. Extend the snail-monitoring programme to include six to ten more 100 m² plots, scattered more widely over the snail area. Ensure that all snail monitoring teams have an experienced leader to avoid compromising results through confusion between *Wainuia* and *Powelliphanta* in the plots.

Objective Two

Determine population trends and conservation status of the Kaweka and southern Ruahine Ranges populations of *P. marchanti*.

Actions Required

1. Survey the extent of snail colonies in the southern and central Ruahines, on Mokai Patea Ridge, Otupae Ridge and in the Mangaohane tussocklands; and also in the Kaweka Ranges.
2. Establish five to ten 100 m² snail-density plots in each representative area across the snail's range and monitor snail numbers regularly to determine population size and trends and major causes of mortality.

Objective Three

Improve quality of snail habitat.

Explanation

Deer (mostly red) reach high numbers around the fertile, free-draining, limestone scarps at Ruahine Corner, and deer (mostly sika) are also in high numbers in both the Kaimanawa and the Kaweka Ranges. The dry and open understorey created by deer reduces the ground moisture essential for snail survival and recruitment, and makes it easier for thrushes to prey on the snails.

Actions Required

Keep deer populations throughout the range of *P. marchanti* at low levels.

Objective Four

Determine the variability within *P. marchanti*.

Explanation

In setting priorities and determining the urgency of actions to recover populations of *P. marchanti*, we must know the intraspecific variation that we are seeking to protect. On morphological characteristics the Kaweka snails are distinctive, and to a lesser extent, so are the Kaimanawa snails. The poorly known southern Ruahine Range snails are distant from the main population at Ruahine Corner, and their taxonomic status also needs examination.

Actions Required

1. Seek funds to compare the genetic profile of snails from the southern Ruahines to that of snails from the central Ruahines, and of snails from the Kaimanawa and Kaweka Ranges to that of *Powelliphanta* snails from Ruahine Corner and elsewhere.
2. The current taxonomy of *P. marchanti* includes genetically and morphologically distinctive snails from Mt Taranaki and Urewera. If appropriate, revise the taxonomy of *P. marchanti*.

Responsibilities

Ruahine Ranges: Palmerston North Area Office; Wanganui Conservancy.

Kaimanawa Ranges: Turangi/Taupo Area Office; Tongariro Conservancy.

Kaweka Ranges: Hawkes Bay Area Office; East Coast/Hawkes Bay Conservancy.

3.2 *POWELLIPHANTA* “MAUNGAHARURU”

Description

A small to medium-sized snail (maximum diameter 47 mm; height 23 mm) with burnished brown and tan spiral bands, of variable shade and width, covering the dorsal surface, and irregular brown axial stripes over the ventral surface. The background colour of the shell is olive to old gold, and the parietal callus is smooth and grey.

Habitat

Lives under the dense matt of fronds of prickly shield fern in high-altitude (1100 m a.s.l.) mist forest of mountain holly and kapuka. The trees are festooned with moss, and there is a tangled shrub understorey of weeping matipo, mountain wineberry and *Coprosma parviflora*.

The snails also occur under litter in damp gullies of red beech forest at slightly lower elevations (800–1000 m a.s.l.). The snail habitat lies on the calcium-rich talus slope of a great limestone scarp.

Distribution

Apparently only extant on the east-northeast slopes of Taraponui, which is the highest point on the limestone scarp of the Maungaharuru Range, in inland Hawkes Bay. Subfossil remains of *Powelliphanta* found in limestone caves near Patoka (Dell 1955), about 25 km from Taraponui, may be evidence of a much wider former distribution. However, the cave shell fragments are too small and weathered to identify to species.

The snails on Taraponui were discovered relatively recently (1961) and it is possible that other colonies still remain to be found elsewhere in the high country of northern Hawkes Bay. However, as apparently suitable forests immediately adjacent to Taraponui seem to be without *Powelliphanta* snails, the chances of finding colonies further afield seem somewhat remote.

The total known forest area now occupied by *Powelliphanta* “Maungaharuru” is about 80 ha, with about 8 ha within the privately-owned Taraponui holly forest remnants, and the remaining 72 ha in Cashes Bush, a Department of Conservation-administered Scenic Reserve.

Cause of Decline, and Threats

1. Loss of most of the forest clothing the Maungaharuru Range to fires, logging and then pasture creation.
2. On-going degradation and desiccation of the remaining forest habitat by the trampling and browsing of feral goats and deer and, in the holly forest remnants until the mid-1990s, by domestic stock. Feral pigs are damaging the lower parts of Cashes Bush.
3. Predation by rats, thrushes, hedgehogs and pigs in the lower, drier parts of the snail's range.

Past Conservation Efforts

1. A 500 m² snail-monitoring plot was established in one of the high-altitude remnants of holly forest in 1995 and re-measured in 1998 and 2000. A second 500 m² plot was established in Cashes Bush in 2000.

2. A 1-day survey for snails in the main bush remnants near Taraponui was carried out by six people in 1995.
3. About 1994, two of the holly forest remnants were protected through a covenant with the private landowner, and domestic stock fenced out of these remnants in 1995.

Current Conservation Status

Powelliphanta “Maungaharuru” is affected by rats, thrushes, pigs and probably hedgehogs, but compared to many other *Powelliphanta*, has a moderate density (6 snails/100 m²). However, the total snail population is small and the habitat fragmented and degraded, with the taxon very vulnerable to normal stochastic events such as droughts and fires. *Powelliphanta* “Maungaharuru” is ranked as ‘nationally endangered’ by Hitchmough (2002).

Long-term Recovery Goal

A healthy self-sustaining population (> 12 snails/100 m²) in at least 300 ha over most of its presumed former range, and with most of the forest patches that support snails linked to each other.

Objectives For The Next 10 Years

Objective One

Increase the size of the *Powelliphanta* “Maungaharuru” population by increasing the quality and amount of snail habitat.

Explanation

The major cause of the vulnerable status of *Powelliphanta* “Maungaharuru” is the loss of habitat and the fragmented and degraded nature of some of the remnant forest.

The fertile Maungaharuru Range has only limited cover for feral goats and deer so, despite the stock fences, the remnant patches of snail bush are used as shelter by goats and deer far more frequently than would usually be the case. Deer control is difficult around Taraponui as the land is privately owned and deer are not seen as important pests by the owners. However, goat control on private land since 1990 over much of the Maungaharuru Range has brought goat numbers generally much lower now than they were previously.

At present, deer and pigs are not controlled in the publicly-owned Cashes Bush Scenic Reserve, although possums and occasionally goats are—the Reserve has not been a high conservation priority and it is acting as an important ‘partial-treatment’ area for the Boundary Stream Mainland Island.

Though probably difficult to achieve, Crown purchase of the three forest remnants known to have snails, in addition to the land between these sites and the land between Cashes Bush and the remnants, is highly desirable. A revegetation programme could be implemented to link the fragmented populations, and Crown ownership would allow for adequate wild animal control to improve the quality of the habitat for snails and for the natural vegetation.

Actions Required

1. Negotiate with the private owners of the Taraponui holly forest remnants for permission for the Department of Conservation to keep goat and deer numbers low in the immediate vicinity of the Taraponui snail colonies.
2. Bid for funds within the Department of Conservation to regularly control pigs, goats, deer and possums in Cashes Bush and, if allowed, in the snail colonies on adjacent private land.
3. Discuss with landowners strategies to enlarge, link and protect currently fragmented snail habitat, including Crown purchase and revegetation of habitat south of Cashes Bush.

Objective Two

Accurately determine the distribution of *Powelliphanta* “Maungaharuru”, and the total population size.

Explanation

It is important to know whether other *Powelliphanta* “Maungaharuru” colonies exist, because a larger total population spread throughout different physical environments could alter recovery priorities significantly.

Our knowledge of the distribution of *Powelliphanta* “Maungaharuru” comes entirely from botanists systematically searching amidst native vegetation fragments on calcareous rock for rare plants. The first record came from A.P. Druce, who deposited a snail shell at the National Museum where it remained unremarked and labeled ‘*Powelliphanta marchanti*’ for 28 years until two more botanists (Geoff Rogers and Geoff Walls) ‘rediscovered’ the colony on 12/4/89.

There was a focused 1-day search for snails in 1995 in the immediate vicinity of Taraponui, but the search area needs to be expanded. The characteristics of the known snail habitat need to be taken into account when selecting further areas to search. The micro-habitat on Taraponui is quite rare in Hawkes Bay, being a combination of great height and geology — the former causing Taraponui to catch and retain cloud and the latter providing a limestone substrate (*Powelliphanta* distribution is significantly correlated with that of limestone).

Highly localised colonies of *Powelliphanta* occur to the south on the Kaweka Ranges and to the north on Mt Manuoha, in Urewera National Park (the snails are similar to, but distinctive from *Powelliphanta* “Maungahaururu”), so any further colonies of *Powelliphanta* ‘Maungaharuru’ can exist only in the Mohaka River catchment.

Actions Required

1. Check the forest below the known colony on Taraponui (V19/320-225) and at Ahuateatua (V19/323-218 and V19/324-208) for snails.
2. Select possible snail habitat on high forest country west of the Mohaka River and gradually carry out systematic searches of the areas most likely to harbour snails.

Objective Three

Determine population trends and the impact of introduced predators.

Explanation

Too little information is currently available to determine whether the population of *Powelliphanta* “Maungaharuru” is stable or is declining through the impact of introduced predators and competitors. This knowledge is essential in forming and prioritising any snail recovery actions.

Regular re-measurement of live snails in the permanently marked plots, and collection and examination of empty shells from them, will provide data for population density, population trends and the identification of predators.

Actions Required

1. Establish five more 100 m² plots randomly within the snail habitat in Cashes Bush.
2. Releaser all the snail plots two-yearly for the next 5 years.

Objective Four

Determine the taxonomic status of *Powelliphanta* “Maungaharuru”.

Actions Required

Facilitate mtDNA study of *Powelliphanta* “Maungaharuru” and its relationship with other *Powelliphanta* in the *marcbanti* - *traversi* series. If appropriate, name and describe the Maungaharuru snail.

Responsibility

Hawkes Bay Area Office, East Coast/Hawkes Bay Conservancy.

3.3 *POWELLIPHANTA TRAVERSI TRAVERSI*

Description

A medium-sized snail (maximum diameter of shell 54 mm; height 27 mm) with a smooth, purplish grey parietal callus. The ground colour of the shell is a warm, yellowish brown, and narrow spiral bands of darker brown line the base.

Habitat

Under leaf litter in swampy lowland forests dominated by pukatea, kahikatea and maire tawaki, and on drier soils under tawa, kohekohe, karaka and totara.

Distribution

The original distribution of this snail was naturally small, probably occurring over less than 4000 ha on the narrow strip of deep moist soils on the Horowhenua Plains. To the west are dunes, too sandy and free-draining for snails, and separated by raupo and flax swamps which were too wet for snails; in the east the Tararua Ranges rise steeply and the habitat is unsuitable for snails.

Unfortunately, the best snail habitat was also the best soil for cultivation, and *Powelliphanta traversi traversi* is today restricted to the northeastern shores of Lake Papaitonga, the Waiopahu Scenic Reserve and a few fragments of trees in and around Levin city (a total area of about 40 ha).

Cause of Decline, and Threats

1. Loss of most of the snail's forest habitat is the major cause of decline. The magnificent lowland forests of the Horowhenua remained intact for a much longer period after European arrival than did most forests. However, though felling of the forest did not begin until 1887, clearance was extremely rapid and comprehensive, leaving virtually no trees by 1900.
2. Most of the fragments of original forest are now protected in reserves, but clearing is still a threat to the unprotected trees; about 1997, tiny Parks Bush in Levin was sold and turned into a restaurant carpark. Less dramatically, the snail habitat at other sites is continuing to degrade because the litter layer is drying out and forest regeneration is prevented through intensive human use, stock trampling and drainage ditches on neighbouring land.
3. Predation by introduced pests, particularly rats, but also hedgehogs and thrushes, remains a threat.

Past Conservation Efforts

1. At Papaitonga, possum numbers have been kept low since 1994 through bi-monthly poisoning with Talon in bait stations on trees around the perimeter of the forest and in fifty 50 m transects across the area. The bait stations were lowered in 1997 to make sure rats could easily access them.

A 500 m² snail density-monitoring plot established at Papaitonga by DOC in 1994 found 29 live snails (5.8 snails/100 m²). A MSc study was carried out at Papaitonga between 1995 and 1996 on aspects of the biology of *Powelliphanta traversi*, which included further density measurements. Seventeen 100 m² plots representing the full range of snail habitat were searched, and a mean live snail

density of 2.8 snails/100 m² was found (Devine 1997). The population of *P. t. traversi* at Papaitonga (which has about 95% of the remaining good habitat) was estimated to be about 10,000 individuals (Devine 1997).

2. At Waiopahu Scenic Reserve Conservation Corp workers trapped rats quarterly on a transect along the Reserve's southern perimeter, from 1991 to 1993, to protect the land snails. One 500 m² plot and two 25 m² plots established in 2001 contained 2.4 snails/100 m².

Current Conservation Status

Powelliphanta traversi traversi is ranked as 'nationally endangered' by Hitchmough (2002). The main colony at Papaitonga has only moderate snail densities (2-8 snails/100 m²) partly because rats were found to be taking up to 25% of live adult snails annually (Devine 1997). Much of the remaining habitat of this snail is threatened: the Waiopahu Scenic Reserve and Prouses Reserve are, or are becoming, surrounded by houses—which bring land drainage and intense foot traffic. Even Papaitonga may be drying out through excessive ground water take (Park 1995).

Long-term Recovery Goal

A dense (> 12 snails/100 m²) population of *Powelliphanta traversi traversi* that is stable or increasing, in at least two secure sites.

Objectives For The Next 10 Years

Objective One

Protect and restore quality of the habitat of *Powelliphanta traversi traversi*.

Actions Required

1. Encourage local councils to make definite foot tracks in both Waiopahu and Prouses Reserves and to discourage human use outside those tracks by construction of bicycle-detering bars and by planting thick protective swathes of appropriate native species (seeds sourced from inside each Reserve) adjacent to the tracks.
2. Seek listings (Statement of Wildlife Values) of each Reserve in the District Scheme; contest further ground water take from around the Reserves and from between the Reserves and the Tararua Ranges, any new drainage ditches below the Reserves, and further subdivision around Waiopahu Scenic Reserve.
3. Remove the weed wandering willy from Prouses Reserve (taking care to find and relocate any snails sheltering among it) to allow forest regeneration. Attempt eradication of wandering willy from the margins of Papaitonga Scenic Reserve.
4. Seek funds to purchase, exclude stock by fencing and reforest the land on the west and south side of Lake Papaitonga and immediately adjacent to the existing forest.

Objective Two

Improve snail survival by sustained predator control at Papaitonga Scenic Reserve.

Explanation

Though possums at Papaitonga are not killing snails, they have the potential to do so. Given this, it is a sensible precaution to keep possum numbers so low that those present do not face food shortages (and learn to eat snails), or cause deleterious changes to the forest itself.

It would be desirable in the long term to fence rats, possums and hedgehogs out of Papaitonga rather than use poisons in perpetuity at this sacred and valuable site, but this is probably viable only if the whole lake is fenced and therefore depends on the now pastured south and west shore-line being turned into a reserve.

Actions Required

1. Keep rat and possum numbers steadily low (< 1% RTC for rats and < 5% RTC for possums). Rotate control methods, generally avoiding the use of accumulative anticoagulant poisons, such as Talon, and the use of the same acute poison on consecutive occasions. Use traps instead of poisons at regular intervals. When possible, use poisons and bait-station designs which kill both species equally well (1080, Feracol). Monitor rat and possum densities annually (before control operations).
2. Permanently mark at least ten new 100 m² plots throughout the range of habitat of *P. t. traversi* at Papaitonga. Measure live snail density in these and the existing 500 m² plot annually in winter for 2 or 3 years until a good understanding of the impact of the possum control on rat numbers, and of the rat control itself, is obtained; thereafter monitor less frequently.

Objective Three

Maintain diversity of *P. t. traversi*.

Explanation

It is important to have at least two populations of any taxon to make it less vulnerable to catastrophic events such as fire. Waiopēhu Scenic Reserve has the only other colony of this snail with any hope of long-term survival, so conservation attention here, as well as Papaitonga, would be desirable. However, pest management at this site is complicated by the high public use, increasing residential use of the land nearby and the fact that it is under Horowhenua District Council, rather than Department of Conservation, control. In addition, the site may never have been prime habitat, and its relative dryness has been greatly increased over the last century as the headwaters of the Koputaroa Stream, which flows through the Reserve, has been progressively channeled and has had water extracted from it. Before investing too much into this site, the status of its snail population should be assessed.

Actions Required

1. Survey the distribution of snails and the impact of snail predators within Waiopēhu Reserve.
2. In winter, measure snail density in six to eight 100 m² permanent plots placed randomly within the best snail habitat at Waiopēhu.

3. If recovery and long-term survival of the snail population at Waiopahu looks feasible, discuss with the council administering Waiopahu the possibility of the Department of Conservation assuming management responsibility.
4. Investigate the option of erecting a possum-, rat- and hedgehog-proof fence around the Reserve for long-term predator control that does not rely on poisoning and trapping in this built-up area.
5. If a predator-proof fence is not possible even in the medium term, undertake a regime of regular pest control and monitoring of snail density, as outlined for Papaitonga.

Responsibility

Kapiti Area Office, Wellington Conservancy.

3.4 *POWELLIPHANTA TRAVERSI FLORIDA*

Description

A medium-sized snail (maximum diameter 54 mm; height 27 mm). The top surface of the dark reddish-brown shell is closely spirally lined and banded in darker brown, with the base almost completely dark brown (Powell 1979).

Habitat

Under litter in podocarp/hardwood forest.

Distribution

Probably once covered an area of less than 4000 ha beside the Ohau River on the Horowhenua Plains, just south of Levin. Because of forest clearance, this snail is confined to less than 100 ha in three small remnants of forest at: Forest Reserve (immediately adjacent to the Tararua Ranges forest), in Kimberly Scenic Reserve and in the southeast corner of Lake Papaitonga, where it is contiguous with a population of *Powelliphanta traversi traversi*.

Cause of Decline, and Threats

1. The main causes of decline were destruction of probably 90% of the snail's forest habitat, and predation by rats, thrushes and hedgehogs.
2. The main threat is now low survival because of predation by introduced pests.

Past Conservation Efforts

1. About 1991 the Department of Conservation fenced the western boundary of Forest Reserve to keep stock from trampling the understorey.
2. Intermittent possum control in Forest Reserve by Horowhenua District Council (for TB control) and the Department of Conservation (as part of a measure to protect the vegetation of the Tararua Ranges).
3. At Papaitonga Reserve, possum and rat control by the Department of Conservation, as described in the *Powelliphanta traversi traversi* plan. A 500 m² plot was set up in 1997 to measure snail density.

Current Conservation Status

Because of the small total area it now occupies (probably about 100 ha), low snail density (0.8 snails/100 m²) and on-going uncertainty of the snail's ability to survive in the long term in the presence of exotic pests, *Powelliphanta traversi florida* was ranked 'nationally endangered' by Hitchmough (2002).

Long-term Recovery Goal

A dense (> 12 snails/100 m²) population of *Powelliphanta traversi florida* that is stable or increasing, in at least two secure sites.

Objectives For The Next 10 Years

Objective One

Determine population trends.

Actions Required

1. Survey the distribution of *Powelliphanta traversi florida* in Forest Reserve.
2. Measure snail density through establishment of ten to fifteen 100 m² permanent plots randomly located within the snail's range in Forest Reserve, and at least five more plots in Kimberly Scenic Reserve. Releaser live snail density and mortality annually each winter for at least 4 years to assess population trends, and to obtain quantitative data on the impact of pests on the population.

Objective Two

Increase population size by sustained pest control.

Actions Required

1. Continue the work started in 1994 at Papaitonga to control rats and possums and to monitor snail and pest densities, as described in the plan for *P. t. traversi*.
2. If population monitoring of the Forest Reserve snail population indicates a continuing decline due to rats, instigate an annual rodent-control programme on the same lines as that at Papaitonga.

It is important to maintain a good snail population at Forest Reserve as it is the largest remaining colony of *P. t. florida*, and its ecosystem has the best chance of long-term survival. The site is closer to the wet Tararua Ranges, and the soils are less prone to drying out, than are the free-draining river terraces of Kimberly Reserve. In addition, the geographic position of Forest Reserve makes it less vulnerable than other colonies to close residential settlement (which exacerbates pest and weed problems and reduces conservation management options).

3. Ensure possum numbers are kept below 5% RTC at both Forest Reserve and Kimberly Scenic Reserve.

Responsibility

Kapiti Area Office, Wellington Conservancy.

3.5 *POWELLIPHANTA TRAVERSI LATIZONA*

Description

A small to medium-sized snail (maximum diameter 44 mm; height 26 mm) with a dull, purplish grey smooth callus (Powell 1949). The background colour of the shell is yellowish-olive to old-gold, distantly but rather strongly spirally banded and lined in dark reddish-brown (Powell 1979).

As with all *Powelliphanta* in the Horowhenua area, the taxonomy of this snail has had a chequered history. It was first described as a subspecies of *P. traversi* (Powell 1949), then as a 'form' of *P. t. traversi* (Powell 1979). However, recent genetic examination has shown it to be more closely aligned to the upland *Powelliphanta* of the Tararua and Ruahine Ranges than to the lowland snails around Levin, and to be distinctive enough for at least subspecific status.

Habitat

Under fern fronds and litter in tawa/kamahi forest, and under the tree fern wheki on the margins of lowland rain forest.

Distribution

Powelliphanta traversi florida is endemic to the eastern flanks of the mid Arapaepae Range, on the foothills of the Tararua Ranges behind Levin. The snail is now confined to three forest remnants covering less than 45 ha on the Arapaepae Range. The largest area, traditionally known in its totality as Greenaways Bush is partly privately owned (the western end), with the remainder being in the Makahika Scientific Reserve. Two much smaller areas of snail habitat, Bentons Bush and Kohitere Covenant, are native forest remnants within the Kohitere Pine Plantation, just south of Greenaways Bush.

Cause of Decline, and Threats

1. Most of this snail's forest habitat was logged and burnt about 1900, and converted to pasture or exotic pine plantations.
2. In the remaining forest, introduced rats are a major threat and account for 50–80% of all adult snail deaths. Hedgehogs and thrushes prey on juvenile snails and, until recently, cattle trampling was a threat to snails on the edge of Greenaways Bush.

Past Conservation Efforts

1. The type locality at Greenaways Bush was purchased by the Department of Conservation in the 1990s and is now the Makahika Scientific Reserve. As a result of the land exchange agreement by which Makahika was purchased, the previous owner fenced the eastern boundary of the new Reserve to exclude stock.
2. The native forest remnants in Kohitere Pine Plantation were protected by conservation covenants in the 1990s.

3. Two 400 m² plots to monitor snail population trends were established by the Department of Conservation in 1996 (one in Makahika Reserve and one in Kohitere Covenant) and in 1997 a third 400 m² plot was established in Bentons Bush. In addition, in 1996 a student sampled five 100 m² plots in Makahika Reserve to determine snail density and the impact of predators on *Powelliphanta traversi latizona* (Devine 1997).
4. Since about 1997 the Department of Conservation has kept possum numbers low at Makahika Reserve through placement of poison (Talon) in bait stations along transects 500 m apart, every two months to begin with (as possum density was high—about 20% RTC), and latterly every 4 months.
5. Rats in Makahika Reserve have been targeted for control since 1998, when possum bait stations were lowered to ensure that rats could access them.

Current Conservation Status

Population density is low to moderate (3 snails/100 m²) with an estimated total population of 10 000 individuals (Devine 1997). Most of the habitat is now legally protected, and pest control is regularly undertaken in the best habitat. However, the range of the snail is very small, and population trends are unknown: it remains a vulnerable subspecies. *Powelliphanta traversi florida* was ranked as 'nationally endangered' by Hitchmough (2002).

Long-term Recovery Goal

A dense (12 snails/100 m²) population that is stable or increasing, in at least 100 ha of protected habitat.

Objectives For The Next 10 Years

Objective One

Determine population trends.

Actions Required

Establish at least five new 100 m² plots within the snail habitat at Makahika Reserve, and measure these and the existing three 400 m² plots every winter until population trends are clear.

Objective Two

Increase population size through enhanced survival by sustained pest control.

Explanation

Though possums are not killing *Powelliphanta traversi latizona* snails, they have the potential to do so. Given this, it is a sensible precaution to keep possum numbers so low that they do not suffer food shortages (and learn to eat snails), or cause deleterious changes to the forest.

Actions Required

1. Keep rat and possum numbers low (< 1% tracking rate for rats and < 5% RTC for possums). Rotate control methods, generally avoiding the use of accumulative anticoagulant poisons, such as brodifacoum, and the use of the same acute poison on consecutive occasions. Use traps instead of poisons at regular intervals. When possible, use poisons and bait stations which kill both species equally well (1080 and Feracol).
2. Use standard tracking and trapping methods to monitor rat and possum numbers annually, prior to control operations. Regularly monitor snail numbers within the permanent plots to assess the impact of the pest control regime.

Objective Three

Determine the taxonomic status of *P. t. latizona*.

Actions Required

1. Facilitate research into the genetic distinctiveness of *P. t. latizona* using DNA techniques.
2. If appropriate, revise taxonomy.

Objective Four

Increase area of snail habitat.

Actions Required

1. Negotiate with the private owner of the western end of Greenaways Bush to obtain legal protection of the snail habitat (either through purchase by the Crown or establishment of a covenant). Alternatively, seek a management agreement to enable the Department of Conservation to undertake pest control.
2. Begin negotiations to purchase and restore native forest on the pine plantation land around the bush remnants of Kohitere Covenant and Bensons Bush, and between them and Greenaways Bush. The aim is not just to increase the available habitat, but also to allow gene flow between the isolated subpopulations.

Responsibility

Kapiti Area Office, Wellington Conservancy.

3.6 *POWELLIPHANTA TRAVERSI TARARUAENSIS*

Description

A medium-sized snail (maximum diameter 53 mm; height 25 mm) with an olive-green coloured shell, tinged with russet brown on the top, with fine pale brown spiral lines and a few more distinct lines about the periphery. The parietal callus is smooth and grey.

Habitat

A mid-altitude snail found at 460–610 m a.s.l., particularly on flat areas where seepages are common and fertile alluvial soils and litter have accumulated. *Powelliphanta traversi tararuaensis* lives under litter and bush rice grass in rimu/miro forest with tawa, rewarewa and pigeonwood, and under low scrubby vegetation of the tree fern wheki where the forest has been logged.

Distribution

Powelliphanta traversi tararuaensis formerly occupied most of the basin in the headwaters of Kahuterawa Stream on the northern and northeastern slopes of Kaihinu, a low, western outlier of the northern Tararua Ranges.

There is a second, rather distinctive population further south in another perched basin informally known as ‘Shannon Heights’, on the saddle between the north-flowing Mangaore Stream and the south-flowing Makahika Stream (on the same outlier range of the Tararua Ranges).

The distribution of *P. t. tararuaensis* within the two basins is now small and fragmentary because most of the snail’s forest habitat has been cleared and transformed into pasture or pine plantation.

Cause of Decline, and Threats

1. The major cause of decline is the loss of probably 80% of the forest habitat of *P. t. tararuaensis* to pasture and pine plantations.
2. Predation by rats, pigs, thrushes and probably hedgehogs, and trampling by domestic cattle, are contributing to an on-going decline.
3. The main threat today is the continuing fragmentation, degradation by stock and loss of the tiny remnants of remaining snail habitat.

Past Conservation Efforts

No efforts have yet been made towards conservation of this snail.

Current Conservation Status

Almost none of this snail’s small remaining area of habitat is legally protected and, through gradual development of fields and forestry plantations, and road widening, the area is certain to shrink further. Population density and trends in the face of exotic predators are unknown: *Powelliphanta traversi tararuaensis* was ranked ‘nationally endangered’ by Hitchmough (2002).

Long-term Recovery Goal

Dense (> 12 snails/100 m²) snail populations that are stable or increasing, in at least 100 ha of secure habitat at both Shannon Heights and Kaihinu.

Objectives For The Next 10 Years

Objective One

Determine distribution and population size and trends.

Actions Required

1. Use timed shell searches and collections on transects to more accurately define the boundaries of the distribution of *Powelliphanta traversi tararuaensis* at both Shannon Heights and Kaihinu.
2. Establish ten to fifteen 100 m² snail-monitoring plots across the range of the snail at both Kaihinu and Shannon Heights. Measure live snail density in these plots annually until population trends and the main causes of mortality are clear.

Objective Two

Obtain long-term legal and physical protection for the habitat of *P. t. tararuaensis*.

Actions Required

1. Urgently seek Crown purchase or establish conservation covenants over all unprotected snail habitat, including transfer of road reserves to conservation-focused reserves, and protection of adequate buffer zones beside pine plantations to prevent further losses during logging.
2. Where practicable, purchase corridors of former snail habitat and encourage forest regeneration or start a revegetation programme to link the remaining fragmented snail populations.
3. Exclude stock from the snail reserves by erecting fences, and keep pig and deer numbers low enough to improve humidity, cover and food resources on the forest floor.

Objective Three

Increase population size by sustained predator control.

Actions Required

1. Depending on the outcome of the snail monitoring of Objective One, undertake a predator-control programme in at least one population of *P. t. tararuaensis*.
2. Continue monitoring snail density in the permanent plots in both the predator-controlled and uncontrolled areas to measure the impact of these conservation measures.

Objective Four

Determine the taxonomic status of *P. t. tararuaensis*.

Actions Required

1. Facilitate research into the genetic distinctiveness of *P. t. tararuaensis* using DNA techniques.
2. If appropriate, revise taxonomy.

Responsibility

Kapiti Area Office, Wellington Conservancy.

Palmerston North Area Office, Wanganui Conservancy.

3.7 *POWELLIPHANTA TRAVERSI KOPUTAROA*

Description

A medium-sized snail (maximum diameter 53 mm; height 27 mm) of rather flattened appearance. The shell is an almost plain, yellowish olive with a few dark bands around the periphery. Though described as a subspecies of *Powelliphanta traversi* in 1946, A.W.B. Powell later relegated it to a 'form' of *P. t. traversi* (1979). Because of its critically low numbers in the 1980s, the genetic make-up of this taxon has not been examined.

Habitat

Under the skirts of *Gabnia xanthocarpa* in swampy kahikatea forest on rich, alluvial lowland plains.

Distribution

The original distribution of this snail was naturally small, probably only covering about 6 km² of slightly elevated land just south of the Manawatu River near Koputaroa.

The distribution of *Powelliphanta traversi koputaroa* today is tiny, the snail being found in only two sites, Blakes Bush (< 1 ha) and Koputaroa Reserve (< 3 ha). The largest site was discovered in 1945 by A.W.B. Powell and 'the Prouse cousins'. Powell described the known range of *P. t. koputaroa* in 1946 as follows:

'An important discovery was a small colony of a low country form still persisting under adverse conditions in a small area of second growth native bush fringing a raupo swamp. The colony is situated on the Horowhenua Plain at approximately 1½ miles NNE of Koputaroa Railway Station. The Plain between Levin and the Manawatu River is now almost completely denuded of forest, the few small areas remaining being mostly low level Kahikatea remnants subject to flooding, and therefore without snails ...'

Cause of Decline, and Threats

1. Clearance of almost the entire forest habitat for farmland.
2. Predation by introduced rats, thrushes and hedgehogs, and crushing by cattle.
3. Degradation of the remaining habitat through the farming practices on nearby land, i.e. digging of drainage ditches which lower water tables within the remnant bush, and trampling of the litter layer and browsing of the understorey by cattle. The resultant unnaturally dry forest floor meant an increased rate of snail mortality, particularly of eggs and young snails.
4. Collection of live snails for original taxonomic description (*'Three specimens taken by the Prouse cousins in September, 1945, are probably the last of [the] colony-doomed to destruction'*; A.W.B. Powell 1946) and for shell displays.

Past Conservation Efforts

1. The largest remaining area of snail habitat, a stand of young kahikatea adjacent to a raupo swamp, was purchased by the New Zealand Wildlife Service in 1985 and subsequently fenced to exclude stock. Rat and possum poison stations in this forest (Koputaroa Reserve) have been filled with the anticoagulant Talon at irregular intervals since about 1990.
2. The only other colony, comprising about five mature kahikatea trees, was fenced about 1983 by the landowner, Mr Blake. This bush (Blakes Bush) is not legally protected. It is surrounded by deep drainage ditches, and has become overgrown with blackberry.
3. Systematic searches for other colonies in the small forest remnants in the area were made in 1984 by R. Parrish and K.J. Walker as part of a fauna survey by the New Zealand Wildlife Service of the Horowhenua.

Current Conservation Status

Powelliphanta traversi koputaroa was considered critically endangered in 1984, but numbers probably stabilised following habitat protection and some limited conservation management. It is now ranked as 'nationally endangered' by Hitchmough (2002).

Long-term Recovery Goal

A thriving population (density: > 12 snails/100 m²) in two separate legally-protected colonies; and a total area of available snail habitat of more than 8 ha.

Objectives For The Next 10 Years

Objective One

Obtain legal protection for Blakes Bush.

Explanation

With only one small legally protected area of habitat, *P. t. koputaroa* is in danger of extinction through natural stochastic events (high flooding, droughts, etc.). Although Blakes Bush is very small and modified, it supports the only other known natural population of *P. t. koputaroa*, and it is highly desirable that its future as snail habitat be made more secure.

Actions Required

1. Examine forest protection options with landowner.
2. Seek funds to support chosen course of protection.

Objective Two

Increase the area of snail habitat available at Koputaroa Reserve.

Explanation

Although there are about 5 ha of land within the Koputaroa Reserve, only about 2 ha are forested and suitable as snail habitat, the balance being covered by exotic pasture grasses and gorse on slightly better drained areas, and raupo, flax and toitoi on very wet swampy sites.

The existing forest comprises two patches of secondary kahikatea separated by a large area of grass and several ditches. It would be highly desirable to revegetate the grassed area to allow gene flow between the two snail populations and to increase the total area of snail habitat available.

This would require some modification of the drainage ditches, dug around 1983, just before the snail colony was purchased and made a reserve. However, the impacts of the likely change of the water tables on the Reserve's fauna and flora (including a population of brown mudfish) would need to be considered carefully.

Natural regeneration beyond the present forest canopy is limited by the dense grass sward which grew after grazing ceased in 1986.

Unfortunately, some particularly troublesome weeds (barberry, blackberry, honeysuckle, gorse and willow) were not tackled when grazing was first excluded from the Reserve, and are now causing a real threat to natural revegetation.

Actions Required

1. Compile a revegetation plan for Koputaroa Reserve, drawing on the expertise of botanists, hydrological engineers, freshwater fisheries scientists and land snail experts. If appropriate, fill in ditches.
2. Seek funds for the production of 5000–10 000 plants from Koputaroa Reserve seed sources (kahikatea, pukatea, white and black maire, matai, tawa, hinau, pokaka, mapou, lemonwood, mahoe, narrow-leaved lacebark, karamu, putaputaweta, toro, small-leaved milk tree, kohuhu, pate and cabbage tree).
3. Eradicate woody weeds from the Reserve by a sustained cutting and poisoning programme. Keep the ground bare on the fringes of the existing forest to allow natural regeneration of kahikatea.
4. Densely plant the grassed area with native species; mulch and maintain grass control around native trees until they are well established.

Objective Three

Improve snail survival rates by more effectively controlling predators.

Explanation

Even for a second-generation anticoagulant such as brodifacoum, resistance in the rat population can develop after prolonged use. After almost a decade of Talon use at Koputaroa Reserve, it would be wise to stop using it for a while. At present there are no indications that brodifacoum detrimentally affects snails or their prey, earthworms, but there is little information on the effect of its use long term. The ideal is to establish a programme in which effective rat-control techniques (snap trapping, and 1080 and brodifacoum poisoning) are rotated on a regular basis.

At present there is no sign of predation by possums on the snail population and, as both snail colonies are small, isolated, and surrounded by plentiful alternative possum food (pasture grasses), it is perhaps unlikely that possums will learn (or be driven) to eat the snails here. However, keeping possum numbers low is a sensible precaution and good for the snail's forest habitat. As with rodent control, methods used (trapping and poisoning with cyanide, choliciferol or 1080) should be regularly alternated to avoid shyness in possums.

Brodifacoum should not be used against possums at Koputaroa as many equally effective possum control methods exist. The use of accumulative poisons such as brodifacoum should be limited, especially at small sites such as Koputaroa where pest control will be necessary for many years. Brodifacoum is better saved for occasional use against rats, as it is the best tool available for rodent control.

Rates of snail recruitment are almost certainly reduced at Koputaroa through predation by thrushes and hedgehogs, but the scale of the impact on *P. t. koputaroa* is unclear. The introduced snail, *Helix aspersa*, is very common at Koputaroa, and large numbers of their shells, broken by thrushes or hedgehogs, are obvious.

Restoration of a dense understorey and deep, wet litter layer may limit the impact of both thrushes and hedgehogs, but hedgehog numbers should be directly addressed through Fenn trapping.

Actions Required:

1. Place rat snap-traps and possum traps at 50 m intervals throughout Koputaroa Reserve and regularly trap rats and possums for 1 year.
2. In year two, carry out a poison operation against rats, hedgehogs, thrushes and possums using hand-distributed 1080.
3. In year three, poison rats with brodifacoum in pegged-down (i.e. possum-proof) tunnels, and trap and poison possums with cyanide. Repeat the 3-year control cycle in subsequent years.
4. Place No. 6 Fenn traps in possum-proof boxes at 100 m intervals around Koputaroa Reserve. Bait regularly with eggs to control hedgehog numbers.
5. Investigate the cost effectiveness of replacing the pest-control regime (Actions 1-4) with rat- and hedgehog-proof fences around Koputaroa Reserve and Blakes Bush.
6. Establish five 100 m² snail-monitoring plots at Koputaroa to measure snail density and the effectiveness of the predator-control programme.

Objective Four

Determine the genetic distinctiveness of the Koputaroa snails, and if appropriate, formally restore to subspecific status.

Explanation

Snails from Koputaroa were not included in a genetic review of *Powelliphanta* in the mid-1980s because live snail collection was not feasible on the then very small snail population. Considerable genetic difference was found among the three forms of *P. traversi* which have been examined and, given the distinctive morphology of the Koputaroa snails, it is likely that the taxon should be re-instated as a subspecies.

Actions Required

1. Collect a small sample of live snails for genetic comparison with other *P. traversi* snails.
2. If appropriate, revise taxonomy.

Responsibility

Kapiti Area Office, Wellington Conservancy.

3.8 *POWELLIPHANTA TRAVERSI OTAKIA*

Description

A small to medium-sized snail (maximum diameter 50 mm; height 26 mm). The shell coloration is distinctive, the top being closely spirally lined in dark brown on an olive-brown to old gold ground, many of the lines being wavy or discontinuous, giving a speckled appearance. The base is uniformly dark brown, broken up only near the periphery into several broad bands. The parietal callus is pale blue-grey.

Habitat

Under litter in lowland broadleaf forest dominated by tawa, hinau and kohekohe, on swampy peat and alluvial soils.

Distribution

This snail was probably once common in the Otaki - Te Horo area but, because the land was rich and fertile, virtually all the original forests were destroyed after European settlement. *Powelliphanta traversi otakia* only just survived this era; only a few tiny populations remain, all in the immediate vicinity of Otaki.

Subfossil shell remains found in peat near Raumati and in the Wallaceville Swamp, Mungaroa Valley, east of Hutt Valley, may also have been of *P. t. otakia*.

Cause of Decline, and Threats

1. Clearance of almost the entire forest habitat for farmland.
2. Predation by rats, thrushes and hedgehogs.
3. Collection of live animals from the best remaining snail population for original taxonomic description—*‘the ... chance of survival of this subspecies appears slender ... the type locality yielded a small series only, but a few were left, including all juveniles and half-grown examples’* (Powell 1946)—and for shell displays.

Past Conservation Efforts

1. A rat-poisoning programme was set up in 1980 at the Rahui Road colony, though at the time, one freshly dead snail was the only sign live snails were possibly still present.
2. Since then, fresh Talon 50 WB pellets have been left in 14 bait stations at this colony every two months (occasionally at much longer intervals).
3. A permanent 125 m² plot in the Rahui Road colony was searched for live snails in 1987, 1990, 1997 and in 2000. Snail numbers originally increased after the rat-poisoning programme, but there have been no clear trends in recent years.
4. In the late 1980s QEII covenants were placed over the Rahui Road and Manakau forest remnants. Stock were fenced from the Manakau colony and an active replanting programme of kahikatea forest was undertaken by the landowner.
5. Stock were excluded from the Te Horo colony in 1996, and one 500 m² and four 25 m² snail-monitoring plots were established in 2000.

Current Conservation Status

With fewer than 250 adults alive today, *Powelliphanta traversi otakia* was ranked as 'nationally critical' by Hitchmough (2002).

Long-term Recovery Goal

Population size of more than 1000 individuals in at least two separate, secure colonies.

Objectives For The Next 10 Years

Objective One

Improve and enlarge the habitat for all remaining colonies.

Explanation

The best remaining habitat at the Rahui Road colony is very small, and at present is incapable of supporting much of an increase in snail numbers. Snail habitat at Te Horo has been severely degraded by cattle, with snails surviving in only a very small, wet streamside area. However, the forest remnant at Te Horo is large enough to sustain a reasonable snail population in the long term, though it will take many years for the forest floor to recover.

Actions Required

1. Investigate options such as weed control that may make it possible for snails to utilise more of the forest floor at the Rahui Road colony.
2. Seek to purchase or to place under covenant snail habitat at Te Horo, and keep stock out and possum numbers low.
3. Extend the replanting programme at the Manakau site to include the main swamp area.

Objective Two

Increase snail survival by more effective and extensive rat and hedgehog control.

Explanation

Despite an intensive rat-control programme, rat-eaten shells continue to be found in the main snail colony. Rats here have been controlled using the second-generation anticoagulant poison brodifacoum for almost 20 years, and it is highly possible that some resistance to the poison has built up in the rat population. Laboratory trials by Landcare Research found no sign that *Powelliphanta* were attracted to or affected by Talon poison. However, as in all pest-control operations, it is desirable to regularly switch control techniques to maximise pest control.

Until now, hedgehogs have not been targeted for control in the colonies of *P. t. otakia*, as their potential threat was unrecognised. It is possible that poison left for rats has also been taken by small hedgehogs (larger ones would probably have been kept from the bait by the small tunnel entrances to bait boxes), though little is known of hedgehogs' susceptibility to Talon. More specific hedgehog-control measures are required.

Actions Required

1. Set up a grid of rat snap-traps in both the Rahui snail colony and a nearby similar, but unpoisoned, bush remnant. Compare densities of rats at both sites. Test for brodifacoum in the liver of rodents caught in the snail colony bush.
2. Continue a regular (every 4-6 weeks) programme of rodent trapping both in the core Rahui snail area and in the surrounding bush of the main snail colony. After 1 year, remove the rat traps and replace them with a regular programme of 1080 poison cereal pellets in rat tunnels. After 2 years switch to using Talon for rat control for 4 years, then repeat the whole 7-year cycle. Maintain a regular programme of cage-trapping hedgehogs or spotlighting and removing them throughout the cycle.
3. Seek funds for the erection of a rat- and hedgehog-proof fence around the Te Horo snail colony. During planning for such a fence, control rats in the lower part of the bush with a grid of snap traps or 1080 bait stations. Do not use anticoagulant poisons such as brodifacoum, as it is important that the rat population does not build up a resistance to, or become shy of, brodifacoum as it is the best eradication tool. Once the fence is in place, eradicate rats within using brodifacoum, and eradicate hedgehogs with cage, pitfall or Fenn traps and spotlighting.
4. Evaluate the need for, and practicality of, rat and hedgehog control measures at the Manakau snail colony. Implement the appropriate control programme along the lines outlined for the main snail colony.

Objective Three

Increase snail recruitment by effective thrush control.

Explanation

Significant numbers of hatchling and juvenile *P. t. otakia* snails are killed by thrushes each year. However, even if thrush numbers could be controlled effectively inside the snail colonies, each colony is surrounded by pasture and gardens, and re-invasion is likely to be rapid.

It may be worth attempting to reduce thrush numbers using either a shotgun or air rifle.

An alternative approach is to reduce the opportunities of thrushes finding and killing snails by providing plenty of snail cover and by removing obvious thrush anvils. This is probably the only practicable option.

Actions Required

1. Cover, or if all else fails, remove, all stones or logs which are obviously used as thrush anvils. Keep in mind that big logs and stones are also likely to provide the best cool, stable and safe cover for the snails.

2. Keep site disturbance to a minimum to encourage the development of a dense litter layer and understorey.
3. Systematically assess the practicality and effectiveness of shooting, poisoning or trapping thrushes to reduce numbers in the snail colonies.

Objective Four

Determine population trends.

Actions Required

1. In order to assess snail density and the effectiveness of the pest-management regime establish three more 100 m² plots in the Te Horo colony.
2. Release the snail plots during winter every 2-3 years to monitor population trends.

Responsibility

Kapiti Area Office, Wellington Conservancy.

3.9 *POWELLIPHANTA HOCHSTETTERI HOCHSTETTERI*

Description

Powelliphanta hochstetteri hochstetteri was the first *Powelliphanta* snail to be formally described (as *Helix hochstetteri* in 1862) and is arguably one of the most beautiful. It is a large 'chunky' snail (maximum diameter 75 mm; height 35 mm), with many irregular spiral stripes, bands or zones (except on the umbilicus) on a khaki to old gold background.

The shell colour varies greatly over the length of the subspecies' range. Snails on the Pīkikiruna Range are known as the yellow-based form, as shells north of the Takaka Hill Road all have a plain (unstriped) old gold base. Snails to the south, on the Arthur and Lockett Ranges, always have a warm, reddish brown (unstriped) base and are known as brown-based.

The spirals on brown-based snails are dark brown to black and are narrow and fine in the Flora area, and wider and more frequent in the Cobb area.

The spirals on yellow-based *P. b. hochstetteri* are alternately black and mahogany red, and vary enormously in width. Shells with fine sparse lines appear mainly old gold-coloured, while a neighbouring snail with wide stripes may appear essentially dark mahogany red. This inter-population variability is striking and uncommon in the *Powelliphanta* genus.

Habitat

A high-altitude snail found at 750–1200 m a.s.l. under litter and logs in silver and red beech forest with occasional southern rata and cedar. About 50% of *P. b. hochstetteri* habitat lies on calcium-rich soils formed on marble.

Distribution

In the headwaters of the Takaka River on the Pīkikiruna, northern Arthur and Lockett Ranges and on the Cobb Ridge in Kahurangi and Abel Tasman National Parks, North West Nelson.

Cause of Decline, and Threats

1. Predation (on eggs, and even the largest adult snail) and habitat destruction by feral pigs.
2. Severe predation by possums since the late 1980s in the south of the snail's range, and from the mid-1990s in the Pīkikiruna Range.
3. Logging of the forest habitat on Barron Flat and on the eastern Pīkikiruna Range around Canaan and the Takaka Hill Road.

Past Conservation Efforts

1. Ground-based possum control over 1500 ha on the true left of Flora Stream annually since 1993, and numbers of live, brown-based *Powelliphanta hochstetteri hochstetteri* monitored in four 400 m² plots in 1993, 1997, 1998 and 2000.

2. Aerial 1080 poison operation to control possums in 2500 ha in the south branch of the Riwaka River in 1999 to protect brown-based *P. b. hochstetteri* and the southern rata-dominated forest habitat. Nine 100 m² snail-monitoring plots were established in 2000.
3. Aerial and ground 1080 poison operation to control possums in 2000 ha around Canaan to protect yellow-based *P. b. hochstetteri*, and establishment of thirteen 100 m² plots in 2001.

Current Conservation Status

1. Classified as in 'gradual decline' (Hitchmough 2002).
2. A brown-based *Powelliphanta hochstetteri hochstetteri* population has recovered well in the possum-controlled area in the Flora Valley (from less than 0.4 snails/100 m² in 1993 to 4.8 snails/100 m² in 1998). It is unclear whether intermittent possum control in the Riwaka catchment, where snail density was 1.5 snails/100 m² in 2000, is sufficient for recovery of the "brown-based" population.
3. The conservation outlook decreased during the 1990s for yellow-based *P. b. hochstetteri* snails and for the brown-based *P. b. hochstetteri* populations in the Cobb area with the sudden advent of predation by possums in addition to significant predation by pigs. Snail density was 5.7 snails/100 m² at Canaan in 2001 and in 2002 was 3.6 snails/100 m² in the Cobb.

Long-term Recovery Goal

A secure and relatively dense population (> 12 snails/100 m²) over an area of at least 500 ha in at least four different sites (Canaan, Riwaka, Flora and Cobb Ridge) which, together, encompass the full range of morphological diversity in *Powelliphanta hochstetteri hochstetteri*.

Objectives For The Next 10 Years

Objective One

Increase population density at key sites by sustained predator control.

Explanation

Powelliphanta hochstetteri. hochstetteri is still preyed on regularly by its natural enemy, the western weka. Numbers of introduced rats, hedgehogs and thrushes are probably relatively low in the high-altitude frequently wet habitat of *P. b. hochstetteri*, and their impact on the snail seems to be only moderate. However, feral pigs are a serious problem in most colonies, even though recreational pig hunting occurs occasionally. Despite these introduced predators, snail numbers were moderate until the early 1990s when the introduced possum also began to prey in *P. b. hochstetteri* snails. From experience elsewhere, predation by possums always leads to snail decline.

The combination of predation by both possums and pigs is cause for concern, especially as all populations now seem affected. Equally, however, the recovery of snails in the Flora Valley is encouraging, as are the relatively high numbers of snails still at Canaan.

Actions Required

1. Maintain the annual possum-control programme at Flora Stream. Regularly review possum and snail numbers, and adjust the timing and techniques of control to minimise control effort for maximum snail response. Establish four 400 m² non-treatment snail-monitoring plots nearby.
2. Establish at least ten 100 m² snail-monitoring plots (or similar) in the Riwaka possum control area, and releser two-yearly. Monitor the possum RTC two-yearly and repeat the 1080 aerial poisoning programme when RTC rises above 3%.
3. Extend predator control to include a representative population of yellow-based *P. b. hochstetteri*, preferably in the Canaan (Harwood's Hole - Rameka Track) area which is visited by large numbers of the public who would value the experience of a dense snail population. Keep possum and pig numbers at barely detectable levels in this area by frequent control operations. Establish at least ten 100 m² plots inside the Canaan control area, and a further ten in a non-treatment area nearby to compare changes in live snail numbers over time.
4. Establish an annual control programme for possums and pigs over a small area (about 300 ha) on Cobb Ridge to protect the western population of brown-based *P. b. hochstetteri*.

Objective Two

Increase snail recruitment through habitat improvement.

Explanation

Much of the land in the Canaan and Takaka Hill Road area is privately owned and stock graze the margins of the forest in this area. The grazing causes snail loss through crushing, and the trampling destroys the moist litter layer essential for snail survival. Feral goats and pigs over much of the range of *P. b. hochstetteri* cause similar habitat degradation, thus increasing juvenile snail mortality through desiccation, and also cause enhanced weka and thrush predation through the loss of protective vegetative cover. Logging from the area around Takaka Hill Road finally ceased in the late 1980s when the export of native wood chips was banned, but there remains some risk of logging for pasture and of development as a sustained forestry crop.

Actions Required

1. Encourage protection of privately-owned forest habitat of *P. b. hochstetteri* through advocating for the establishment of covenants and erection of stock exclusion fencing, and where possible by Crown purchase of the forest.
2. Carry out regular goat-control programmes in the best snail areas.

Responsibility

Flora and Riwaka: Motueka Area Office, Nelson/Marlborough Conservancy.

Canaan and Cobb Ridge: Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.10 *POWELLIPHANTA HOCHSTETTERI ANATOKIENSIS*

Description

A very large snail (maximum diameter 80 mm; height 35 mm) with a beautifully marked pattern of closely spaced, diffused, narrow reddish brown to black spiral lines and bands which, at the type locality in the headwaters of the Anatoki River, overlie a rich russet ground colour. In eastern populations of *P. b. anatokiensis* the background colour of the shell is yellow rather than red. The change in colour between the two forms is absolute; there is no gradual clinal change, and despite apparently suitable habitat in between, the red and yellow populations are physically discrete.

In places on the southeast flanks of Parapara Peak, *P. b. anatokiensis* is sympatric with the equally large *P. s. superba* and with the smaller *Powelliphanta* "Parapara" and *P. gilliesi fallax*.

Habitat

In the Anatoki headwaters, red-form *P. b. anatokiensis* lives under *Gabnia*, bush rice grass and the litter in forest of mountain beech and southern rata, mountain toatoa and *Dracophyllum traversi* 760–1050 m a.s.l.; and in red and silver beech forest with quintinia, Hall's totara, southern rata on river terraces at 610–750 m a.s.l.

The yellow form of *P. b. anatokiensis* is found largely on limestone, under litter in forests of red and silver beech with southern rata, pahautea and *Dracophyllum traversi* at 760–1240 m a.s.l.

Distribution

Red-form *Powelliphanta hochstetteri anatokiensis* occurs over about 200 ha, in the headwaters of the Anatoki River, on Yuletide Peak Ridge and on the river flats opposite the Anatoki Forks Hut, with low numbers of snails beside the river as far downstream as The Bend.

Yellow-form *P. b. anatokiensis* has a wider distribution, being found on the most easterly ridges of the Devil and Anatoki Ranges, and on Walker Ridge and the ridge between the Waikoropupu and Pariwhakaoho Rivers in Golden Bay.

Cause of Decline, and Threats

The main cause of the decline in both forms of *Powelliphanta hochstetteri anatokiensis* is predation by possums, but for the yellow form, predation by feral pigs is also a serious threat.

Past Conservation Efforts

1. In 1987 a systematic Protected Natural Area-type survey over the full range of *Powelliphanta hochstetteri anatokiensis* by the New Zealand Forest Service mapped snail distribution (S.P. Courtney, pers. comm.).
2. In 1995 and 2000 the Department of Conservation carried out a possum- control operation (aerially delivered 1080 poison) to protect the snails on Parapara Peak.

3. A 500 m² density-monitoring plot for yellow-form *P. b. anatokiensis* was established at Cedar Saddle (Walker Ridge) in 1995 and re-measured in 1998. In 2000, seven 100 m² plots were established on the eastern slopes of Parapara Peak to better monitor snail response to on-going possum control in the area, with a further four plots being established in 2002.
4. In 1996 a 500 m² plot for measuring the density of red-form *P. b. anatokiensis* was established at Anatoki Forks and re-measured in 1999 and 2001. A further ten 100 m² plots were established in 2001.

Current Conservation Status

When considered individually, both red-form and yellow-form *Powelliphanta hochstetteri anatokiensis* were ranked 'nationally endangered', and when assessed as a single unit were rated in 'gradual decline' (Hitchmough 2002).

Powelliphanta hochstetteri anatokiensis is now present in very low numbers (1.0 snails/100 m²) throughout its range. While all the habitat of this snail is protected within Kahurangi National Park, recovery in snail numbers has been slow after the first attempts to reduce predation on the yellow form of *P. b. anatokiensis*. The status of *P. b. anatokiensis*, particularly the red form, remains very vulnerable.

Long-term Recovery Goal

Moderately dense populations (< 6 snails/100 m² when occurring sympatrically with other *Powelliphanta* species, and > 12 snails/100 m² elsewhere), that are stable or increasing, which incorporate the diversity in both the red and yellow forms of *P. b. anatokiensis*.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained pest control.

Actions Required

1. Keep possums steadily at very low levels (< 3% RTC and preferably < 1% RTC) at both Parapara Peak and Anatoki Forks, to protect both forms of this snail.
2. Monitor possum numbers annually before each control operation until the relationship between possum numbers and snail health is clearer.
3. Investigate methods to keep pig numbers low within the possum control area on Parapara Peak, and in at least one site in the snail habitat at Devil Range.
4. Regularly monitor live snail numbers at representative sites across the range of the snail to determine the impact of pest control measures, and the snail population trends in populations without pest control.

Objective Two

Determine the genetic basis of the morphological diversity apparent in *P. b. anatokiensis*.

Actions Required

Facilitate research that compares the genetic profile of red and yellow forms of *P. b. anatokiensis*.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.11 *POWELLIPHANTA HOCHSTETTERI OBSCURA*

Description

On D'Urville Island, west of the type locality, French Pass, *Powelliphanta hochstetteri obscura* is a large snail (maximum diameter 70 mm; height 39 mm) with a uniformly dark brown to almost black base and a green-brown to yellowish olive upper surface, spirally lined in brown. However, the colonies further east and south of French Pass are progressively smaller and the base is dark brown. Adult snails at Mt Stanley are only half the size of those on D'Urville Island (maximum diameter 50 mm; height 23 mm).

These morphological changes appear clinal. At Mt Kiwi and Bobs Knob in the central Marlborough Sounds *P. b. obscura* snails meet snails of *P. b. bicolor* and intermediate hybrids occur. The genetic differences between *P. b. obscura* and both *P. b. bicolor* to the east and *P. b. consobrina* to the south are clear but not large. Consequently, it is not expected that the morphological differences exhibited amongst *P. b. obscura* populations indicate differences at the sub-species level. However, each population is now entirely geographically isolated through the drowning of the Marlborough Sounds' land mass and, with time, is liable to become even more distinctive. It is important to conserve this diversity by protecting snails across the full range of *P. b. obscura*.

Habitat

Essentially a high-altitude forest dweller, found under logs and litter in silver and black beech forest from 600 m a.s.l. and higher. However, a small distinctive colony exists at sea level in broadleaf/beech/podocarp forest at Matai Bay; on D'Urville Island snails occur at 305 m a.s.l. on the northern and eastern flanks of Wells Peak, and populations formerly existed about 152 m a.s.l. on Stephens Island and at Emslie Bay.

Distribution

In the western Marlborough Sounds, on many of the high points west of St Omer and north of State Highway 1, including D'Urville Island and Maud Island, although surprisingly they do not occur on Lookout Knob. There were formerly populations on Stephens Island and at Emslie Bay, French Pass (the type locality) (Powell 1930), but with forest clearance these populations are now extinct.

Cause of Decline, and Threats

1. Severe predation (on eggs, to the largest adult snail) and habitat destruction by feral pigs over a long period of time.
2. Severe possum predation since about the 1970s on almost all populations except those on D'Urville Island.
3. Severe predation on juvenile snails by thrushes.
4. Predation by rats on the snail colony at sea level at Matai Bay.
5. Degradation and desiccation of the litter habitat by frequently high numbers of feral pigs, deer and, on the mainland, goats.
6. Conversion of forest habitat to farmland on Stephens, Maud and D'Urville Islands and on the hills near French Pass.

Past Conservation Efforts

1. Possum-control operation (aerially distributed 1080) in 1994 on all the Tennyson Inlet snail populations, followed by maintenance control of possums in 1998 on Mt Stanley, and bait-station possum control around the snail colonies on Editor Hill and Mt Stanley annually since 1999. Possum-control operation (aerially distributed 1080) in Kenepuru Scenic Reserve in 1998, with annual ground control around the snail colonies thereafter.
2. Sporadic goat control in the Tennyson Inlet area.
3. Two 1800 m² pig exclosures built in 1997 on Attempt Hill, D'Urville Island, and the density of live snails and earthworms inside and outside exclosures measured annually since then, to quantify the impact of pigs.
4. A 500 m² snail-monitoring plot established on Mt Stanley and another on Editor Hill (both in the Tennyson Inlet area) in 1994, and a third plot in Kenepuru Scenic Reserve in 1997. The Tennyson Inlet plots were re-measured in 1996, 1998 and 2001. Ten more 100 m² plots were established on both Mt Stanley and Editor Hill in 2001.

Current Conservation Status

1. Ranked by Hitchmough (2002) as in 'gradual decline'.
2. Despite intense pig predation over a long period on D'Urville Island, snails have survived in pockets where large rocks provide safety from pigs. Snail numbers on D'Urville Island are presumably much lower now than they were formerly. Snail numbers increased once pigs were excluded by fencing, with more snail eggs surviving and hatching inside the exclosure. However, the increase in population size was not as large as expected since, with more small juvenile snails available, predation by thrushes increased dramatically. Average population density 1997-2001 inside the fence was 5.4 snails/100 m² and just outside was 2.4 snails/100 m².
3. On the mainland, where there has been predation by possums since the 1970s on top of long-term pig predation, snail populations have shrunk in both range and density, and the extinction of colonies within 50 years at the present decline rate seems possible. In 2001, after 6 years of possum control, there were still only 1.4 snails/100 m² on Editor Hill and 0.9 snails/100 m² on Mt Stanley.
4. On Maud Island removal of cattle and forest regeneration is allowing the small snail population to slowly increase.

Long-term Recovery Goal

Healthy snail populations at least on Attempt Hill, Mt Maud, Stephens and Maud Islands, Mt Stanley and Bobs Knob and in Kenepuru Scenic Reserve.

Objectives For The Next 10 Years

Objective One

Increase population density at key sites by sustained predator control.

Explanation

Private ownership of most of the forest on D'Urville Island, and of pasture surrounding the Kenepuru Scenic Reserve, Bobs Knob and Mt Kiwi forests, mean that pig control in the snail colonies is hard to achieve. Pig hunting is a prized activity and landowners have little desire to allow others to kill enough pigs to make a difference to snails. There are also logistic difficulties in controlling pigs in the mainland Marlborough Sounds, where pig numbers are highest in the lower altitude, scrubby land rather than on the mountain tops (where the snail colonies are), and there is regular pig movement up and down the hills.

D'Urville Island is free of possums and ship rats, making snail conservation a better long-term option than in some of the mainland colonies. However, attempts to eradicate pigs from D'Urville Island are probably a waste of resources, as they would almost certainly be re-introduced by determined pig hunters.

Actions Required

1. Seek funds and landowner approval to build and maintain in perpetuity a pig- and deer-proof fence around the summit of Attempt Hill, using the road as the eastern boundary. Shoot and poison all pigs and deer inside the fence.
2. On the Devils Staircase and Editor Hill and in the Kaiuma Forest, carry out annual campaigns to reduce pig numbers using a mix of Warfarin poisoning, trapping and shooting.
3. Keep possum numbers steadily at very low levels (< 3% RTC, preferably < 1% RTC) at least on Mt Stanley and Editor Peak and in Kenepuru Scenic Reserve. Measure snail population trends at regular intervals.

Objective Two

Restore the habitat and snail populations of Maud and Stephens Islands.

Explanation

On both Stephens and Maud Islands most forest was cleared for pasture in the early 1900s, and the litter in the tiny remaining bush patches has been trampled and dried out by grazing stock. On Maud Island enough cover has remained for *Powelliphanta hochstetteri obscura* to survive, albeit in much reduced numbers, but on much smaller and drier Stephens Island they have disappeared entirely. A large shell collected by Captain Bollons and now held at the National Museum is the only confirmation of their former presence on Stephens Island.

Both these islands are now nature reserves, with an active revegetation programme on Stephens Island and rapid natural regeneration over much of Maud Island gradually restoring their suitability for snails. The islands are free of most exotic snail predators except song thrushes and, as such, could provide long-term security for both the big D'Urville Island form of *P. h. obscura* on Stephens Island, and for the smaller Tennyson Inlet form on Maud Island.

However, while the existing Maud Island snail population will probably continue to slowly expand without much in the way of further assistance, the outcome of any snail restoration programme on Stephens Island is less certain. Unless a great many snails are released on the island at once, it will be hard for a population to build up in the face of both tuatara and thrush predation in the open understorey conditions. It is also unclear whether the humidity is now high enough on the forest floor to support *Powelliphanta* at all. Probably the only place cool and moist enough is under the boulders in the Frog Bank, on the summit of Stephens Island.

Actions Required

1. Determine the average seasonal humidity of possible snail habitat on Stephens Island and compare it with that on D'Urville Island.
2. If (when) forest floor conditions become suitable on Stephens Island, and all necessary approvals are granted, during winter months translocate at least 50 adult snails from D'Urville Island to Stephens Island. Place all the snails in the same general area, choosing a site as moist and thickly vegetated as possible. Consider fencing the area to exclude tuatara, and shooting thrushes for the first few years until the snail population becomes established.
3. Prepare and publish a detailed report on all aspects of the translocation, taking particular care to record the grid references of the collection site, and the size and colour of each individual animal, as well as dates and descriptions of the release site(s).
4. Survey and map the distribution of *P. b. obscura* on Maud Island. Establish ten to fifteen 100 m² snail-monitoring plots in the main snail areas to measure the status of the snail population. Reassess about 5 years later to assess population trends. If possible, retire more land near the summit of the island from sheep grazing as soon as possible to extend the area of suitable snail habitat.

Objective Three

Improve snail recruitment through habitat improvement.

Explanation

Goats are common and widespread in the mainland Marlborough Sounds snail colonies. They form big groups and camp together for long periods in small areas, and their concentrated browsing and trampling destroys the moist forest litter layer essential for snail survival.

Actions Required

Carry out regular campaigns to control goats and deer to bring them to low levels within the snail colonies.

Responsibility

Sounds Area Office, Nelson/Marlborough Conservancy.

3.12 *POWELLIPHANTA HOCHSTETTERI BICOLOR*

Description

A medium to large snail (maximum diameter 70 mm; height 32 mm), rather flattened in appearance with a low apex. The shell is a light yellowish olive colour and has a few irregular brown spiral bands at the periphery. The base is free from spirals, but there is always a small circular zone of a dark chocolate colour in and surrounding the umbilicus.

A small colony of snails with characteristics intermediate between *Powelliphanta hochstetteri obscura* and *P. h. bicolor* exists on Bobs Knob (the western boundary between the two subspecies).

Habitat

Essentially a high-altitude forest dweller, found under logs and litter in silver and mountain beech forest with southern rata at 600 m a.s.l. and higher. However, also present in lower-altitude tawa forests on Arapawa Island and down to sea level in forest of kohekohe, tawa and nikau and in regenerating manuka and five-finger coastal forest on Blumine Island.

Distribution

The high points in the eastern Marlborough Sounds, including the Mt Stokes massif, Mt Cullen massif, the peaks west of Picton from Mt Robertson to Kahikatea and on Arapawa Island, and from sea level to the summit of Blumine Island.

Cause of Decline, and Threats

1. Conversion of forest habitat to farmland or pine plantation on Arapawa and Blumine Islands, and on Puzzle Peak and Mt Furneaux.
2. Severe predation (on eggs to the largest adult snail) and habitat destruction by feral pigs, over a long period (all *Powelliphanta hochstetteri bicolor* populations except Blumine Island).
3. Severe possum predation since the 1960s on the Mt Robertson - Piripiri populations.
4. Desiccation of the snail's forest floor habitat caused by high numbers of feral goats over a long period (all *P. h. bicolor* populations except Blumine Island). More limited understorey degradation by deer.
5. Reduced recruitment through predation by thrushes on all populations.

Past Conservation Efforts

1. Blumine Island was retired from farming and established as a reserve for the protection of fauna and flora in 1920.
2. Goats were fenced out of the Arapawa Island Scenic Reserve in the 1980s.
3. Deer and pigs swimming to (or being deliberately released onto) Blumine Island were removed by the New Zealand Wildlife Service and the Department of Conservation between 1970 and 1995.

4. Weka, which had been released on Blumine Island in the early 1970s, were almost entirely removed by the New Zealand Wildlife Service in 1982, though numbers have subsequently risen again.
5. Possums in 145 ha on the summit of Mt Robertson have been controlled annually since 1996 using bait stations and a variety of poisons. A snail-monitoring plot of 500 m² was set up in 1996, and a further four 100 m² plots were established in 1999.
6. Possums and goats have been controlled annually since 1997 over 2000 ha of Mt Stokes - Mt McMahon - Mt Kiwi by shooting goats and poisoning possums at bait stations set along a grid of tracks. A 500 m² snail-monitoring plot was established and snail density measured on Mt Stokes in 1995.
7. A 500 m² snail-monitoring plot was established on Blumine Island in 1984, re-measured annually and live snails tagged until 1988, then measured again in 1990, 1993, 1998 and 2001.

Current Conservation Status

On Blumine Island, snails were in high numbers (17 snails/100 m²) in 1990 following an attempt to eradicate weka, but numbers gradually decreased to 3 snails/100 m² by 2001 with increasing weka numbers. Snails are common over much of the island, particularly near damp gullies and the unlogged bush, where native vegetation and snails had survived through the farming era.

Elsewhere, snail populations are now very low, with 0.8 snails/100 m² on Mt Robertson in 1999 and 0.9 snails/100 m² on Mt Stokes in 2001. *Powelliphanta hochstetteri bicolor* is considered in 'gradual decline' (Hitchmough 2002).

Long-term Recovery Goal

Moderately dense snail populations (>12 snails/100 m²) on Mt Stokes and Mt Robertson, in Arapawa Scenic Reserve and on Blumine Island.

Continued existence of snail populations (at lower numbers than before pigs were present) over the full range of the subspecies.

Objectives For The Next 10 Years

Objective One

Increase population density at key sites by sustained predator control.

Explanation

It is clear from the snail densities achieved on possum/pig/goat-free Blumine Island that mainland *P. b. bicolor* colonies are a poor shadow of their former glory.

From Arapawa Island, where possums are absent but snail numbers are very low, it seems that high numbers of pigs and goats alone are enough to devastate snail colonies. The lower than usual altitude of the snail habitat on Arapawa Island may mean snail populations were never very dense, but with dense populations of snails to sea level on nearby Blumine Island, this is an unlikely explanation.

Pigs were first landed in New Zealand by Captain Cook in Queen Charlotte Sound in 1773 and they probably built up to very high numbers between 1840 and 1880, before they depleted the food resource. Pig numbers are now presumably lower, but efforts to reduce numbers to levels compatible with snail recovery have so far been ineffectual.

Because most *P. b. bicolor* colonies are on the top of mountains, and pigs are most common at lower altitudes, a seemingly endless number of pigs can move up into the snail areas at irregular intervals. Because recreational pig hunting occurs in the eastern Marlborough Sounds, poisoning of pigs is difficult politically (and safely). On Arapawa Island, though a fence was erected to keep goats out of the floristically important Scenic Reserve on the northeastern part of the island, unfortunately it was not constructed to be pig-proof, so pigs continue to affect the snail colony in the Reserve.

Constant vigilance is required to detect and remove pigs that pig hunters apparently strand on Blumine Island in a misguided effort to increase the size of individual pigs.

On Mt Stokes where there is regular pest control over a large area from a network of tracks, it should be possible to keep pig, goat and possum numbers low enough for eventual snail recovery. However as on Mt Robertson, where since 1997 possum numbers have been regularly controlled, the unnaturally low snail density at present makes a boom in snail reproduction unlikely in the short term.

Juvenile snails in all *P. b. bicolor* populations are preyed upon by the introduced thrush and also by their natural enemy, the western weka. With the eastern Marlborough Sounds area now a patchwork of farmland, scrub and forest, thrush numbers are probably relatively high. It is difficult to quantify their impact, but it appears large: around one small stone anvil seen under manuka scrub on Blumine Island in the 1980s, over 90 recently killed juvenile *P. b. bicolor* snail shells were counted (K.J. Walker, pers. obs.).

The impact of weka on *P. b. bicolor* may be unnaturally high because years of browse by deer, goats, pigs and possums have thinned the forest understorey, reducing the vegetative cover for the snails.

Actions Required

1. Regularly check Blumine Island for pigs, and kill any found. Mount an aggressive local advocacy campaign against pig-stranding.
2. Pig-proof the goat fence around Arapawa Island Scenic Reserve, and eradicate pigs inside the fence.
3. Keep possum numbers steadily below 3% RTC and preferably lower than 1% RTC within the snail habitat on Mt Robertson. Establish at least six more 100 m² monitoring plots on Mt Robertson and measure two-yearly. Carry out regular pig-control programmes on the Mt Robertson - Piripiri ridge.
4. Keep pig, goat, possum and deer numbers to barely detectable levels on Mt Stokes. Measure snail density within the monitoring plots regularly until trends are clear.
5. Establish at least fifteen 100 m² snail-monitoring plots randomly in areas of good snail habitat on Mt Cullen - Dukeshed, and regularly measure snail density in the absence of pest control.
6. Through research, determine the most effective pig control strategies for the Nelson/Marlborough situation.

Objective Two

Improve snail recruitment through habitat improvement.

Explanation

Goats are common and widespread in all mainland *P. h. bicolor* colonies. They form groups and camp together for long periods in small areas, and their concentrated browsing and trampling destroys the moist litter layer essential for snail survival and probably makes it easier for weka and thrushes to prey on snails.

Actions Required

Carry out regular campaigns to control goats and deer to bring them to low levels within the snail colonies.

Responsibility

Sounds Area Office, Nelson/Marlborough Conservancy.

3.13 *POWELLIPHANTA HOCHSTETTERI CONSOBRINA*

Description

A medium to large snail (maximum diameter 63 mm; height 27.5 mm) with a reddish yellow shell. The top of the shell is usually plain, but occasionally there are a few narrow black spiral lines. On the base a zone of dark reddish brown extends from the umbilicus halfway to the periphery. This basal zone does not stop cleanly, but instead has diffused edges and is variable in size between snails: in a few snails, particularly around Mt Duppa, the dark zone covers the whole base, as in *Powelliphanta hochstetteri obscura*.

Habitat

A high-altitude species, found at 884–1280 m a.s.l., *Powelliphanta hochstetteri consobrina* lives under litter and bush tussock in mountain and silver beech forest containing occasional mountain toatoa, pahautea and southern rata, on predominantly schist substrates.

Distribution

Powelliphanta hochstetteri consobrina occurs over a relatively wide area in the mountains between the Waimea and Wairau River valleys in eastern Nelson. It is found on the Richmond Range between Grass Knob and Mt Baldy, and on the Bryant Range between Mt Starveall and Trig 16, just north of Mt Duppa. According to Powell (1930) this snail was formerly also on Gordons Knob, but most of the forest there has subsequently been burnt and this population is apparently extinct.

Cause of Decline, and Threats

1. Burning of the snail's forest habitat on Gordons Knob and around Rocks Hut - Dun Saddle, and deterioration of snail habitat in all the remaining forests caused by pigs (rooting) and relatively high numbers of feral goats and deer.
2. Predation by introduced pigs, possums, thrushes and, in some years in the lower-altitude colonies, rats. On the Richmond Range in 1996, 41% of snails found dead had been killed by possums, while 2% had been killed by pigs. On the Bryant Range between 1997 and 2000 on average 56% of snails were killed by possums, 14% by pigs and 8% by rats.

Past Conservation Efforts

So far there have been few explicit conservation measures for *Powelliphanta hochstetteri consobrina*. However, in 1997 an aerial 1080 operation at Timms Creek would have provided some relief for snails on the upper boundary of the block. In addition, shells collected during survey work on the Richmond Range between 1994 and 1996 provide good indications of predator impact on *P. h. consobrina* during those years.

Current Conservation Status

1. From general searches for live snails and shells, apparently in low numbers at most sites, though no plot data are available to quantify this.
2. Ranked in 'gradual decline' by Hitchmough (2002).

Long-term Recovery Goal

Dense (> 12 snails/100 m²) populations of *Powelliphanta hochstetteri consobrina* that are stable or increasing and which together represent protection of the full range of morphological diversity in the subspecies.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained predator control.

Explanation

Between 43% (Richmond Range) and 70% (Bryant Range) of *Powelliphanta hochstetteri consobrina* are killed by introduced pests (primarily possums, but significant numbers by pigs). This was not realised until the mid-late 1990s, and so far few efforts have been made to control pest populations. There are several practical difficulties associated with carrying out effective pest management in the Richmond Range. The snails live in low numbers on the tops of a long narrow chain of mountains and the shape of this distribution is not an ideal one for pest management. In addition, Mt Maungatapu is part of the water supply catchment of Nelson City, and approval for hunting pigs and goats, let alone aerial distribution of 1080 poison to control possums and rats, may be difficult to obtain. However, it is important that these issues be addressed and that programmes to control possums and pigs be undertaken in at least some key areas.

Actions Required

1. Keep possum and pig numbers steadily at very low levels in at least one key snail population on the Richmond Range and another on the Bryant Range. Preferred sites would be the areas around Mt Richmond, from Mt Maungatapu to Dun Mountain and from Saddle Hill to Mt Duppa. These sites are all dissected by popular walking tracks, and increased snail numbers would provide good opportunities for the public to see snails readily. They also incorporate much of the morphological diversity in *P. b. consobrina*.
2. Establish at least ten 100 m² plots in the snail habitat in each of the pest control areas and monitor snail numbers two-yearly at first, and then less frequently to assess the impact of predator control.

Objective Two

Improve quality of snail habitat.

Actions Required

Keep numbers of deer and goats at low levels in the possum/pig control blocks. The aim is to allow deep layers of moist litter to build up again to facilitate increases in snail recruitment and survival.

Responsibility

Motueka, Sounds and South Marlborough Area Offices, Nelson/Marlborough Conservancy.

3.14 *POWELLIPHANTA GILLIESI GILLIESI*

Description

A snail of only moderate size (maximum diameter 49 mm; height 24 mm) with a distinctly granulated parietal callus. At the type locality on Mt Burnett the top of the shell is warm brown, crossed by rather distantly spaced spiral bands of darker brown. The base is bright red-brown, like rosewood, with a large, sharply defined, dark red-brown, almost black area surrounding the umbilicus (Powell 1946).

In 1946, *Powelliphanta* snails were reported to be found further south along the Burnett Range as well, on the tops between Gorge and Coal Creeks (Powell 1946), but snails from there were critically examined only recently (K.J. Walker & G.P. Elliot, unpubl. data). These snails are significantly larger (maximum diameter 55 mm) and more lightly coloured than *Powelliphanta gilliesi gilliesi*. The top of the shell is a warm, light, orange-red with many fine, narrow spiral bands of dark reddish brown. The rich orange-red glossy colour on the base fades towards the periphery where there are a few narrow dark brown bands, rather than the wide solid black band of typical *P. g. gilliesi*. They are sympatric with *P. superba superba* on the eastern and western flanks of Trig L.

The southern snails are probably best regarded as a new undescribed subspecies of *Powelliphanta gilliesi*, but until genetic work can confirm this, they should be treated as a separate form of *P. g. gilliesi*.

Only *P. g. gilliesi (sensu stricta)* is considered in the following account.

Habitat

Mostly on calcium-rich soils on a dolomite substrate. Found under litter in dense podocarp/hardwood/broadleaved forest dominated at low altitudes by emergent northern rata and pukatea, and at high altitudes by silver beech, quintinia, kamahi and totara. While the snails occur from sea level to 640 m a.s.l., the densest colonies occur above 500 m a.s.l.

Distribution

Found between Plumbago Creek and Gorge Creek on the Burnett Range, north-west Golden Bay. Probably formerly present on the lowlands at the eastern side of the Burnett Range, but this area was cleared for farming early last century.

Cause of Decline, and Threats

1. Habitat loss in both lowland forest (farm land conversion) and upland forest (open-cast dolomite quarry).
2. Predation, since at least the early 1980s, by possums, and for a longer period though lesser extent, by rats, thrushes, hedgehogs and pigs.
3. Degradation of the understorey by cattle, goats and pigs.

Past Conservation Efforts

1. A possum-control operation (aerially distributed 1080 poison) was undertaken over the whole range of this snail by the Department of Conservation in 1994 and 2000. Ground control of possums at the base of Mt Burnett (where it meets farmland) has been carried out periodically between the two aerial operations to keep possum re-invasion low.
2. A 500 m² snail-monitoring plot was set up in 1994 near the summit of Mt Burnett, and re-measured in 1996, 1998 and 2000. An additional nine 100 m² plots were established in 2001 near Marble Creek and on the mid-eastern slopes and summit of Mt Burnett.

Current Conservation Status

After 7 years of possum control, snail density is now moderate on Mt Burnett with an average of 12 snails/100 m² in 2001, compared to 3 snails/100 m² in 1994.

If regular possum control can be maintained, the snail population as a whole may stabilise and increase in the long term. The best habitat is on the calcium-rich soils on dolomite substrate on the cool, wet summit of Mt Burnett, however, and this area is threatened by an expansion of open-cast quarrying for dolomite and by the forest clearance, roading and overburden-dumping associated with the quarrying.

Long-term Recovery Goal

No further retraction of the range, and the remaining population stable or increasing and no longer considered threatened.

Objectives For The Next 10 Years

Objective One

Protect the habitat of *Powelliphanta gilliesi gilliesi* from any further forest clearance.

Explanation

The habitat of *P. g. gilliesi* has been under attack since European settlement, and unfortunately still is. The lower slopes on the eastern flanks of the Burnett Range are still recovering from last century's logging, and clear felling on the western side in the headwaters of the Wairoa River was discontinued only in 1998. The summit of Mt Burnett has been cleared for a television translator, and an open-cast dolomite quarry has been operating on the southwestern flanks of the Three Sisters for many years. The proposed uphill extension of this quarry and the on-site dumping of more overburden would cause irrevocable harm to some of the best remaining snail habitat and destroy the type locality.

Actions Required

1. The current application for more conservation land on Mt Burnett for dolomite quarry purposes must not be granted.
2. All Crown-owned habitat of *P. g. gilliesi* should be included within Kahurangi National Park.

Objective Two

Increase population size and density by sustained predator control.

Explanation

Because the range of *P. g. gilliesi* now lies adjacent to farmland, and because much of it is at low altitude, in the last 150 years almost the full suite of potential snail predators has made impacts on the population: pigs (now in low numbers themselves), rats, thrushes and cattle.

In addition, in the 1980s possums began to prey on snails and the combination of older **and** more recent predators caused an alarming drop in the size of the snail population. However, the decline does not appear to have been as severe in the dolomite areas of the Burnett Range as it has been on the less fertile soils south and west of Mt Burnett, presumably because fertile forests contain many alternative possum foods.

Possums are ubiquitous throughout the range of *P. g. gilliesi*, unlike most of the snail's other predators. However, possums are relatively easy to control, and a reduction in their numbers directly benefits the snail's forest habitat. For these reasons, management efforts to control the predators of *P. g. gilliesi* should focus on possums.

Actions Required

1. Keep possum numbers steadily at very low levels (< 3% RTC, preferably < 1% RTC).
2. Where practicable, and particularly at lower altitudes, select possum-control techniques which are also effective in the control of rats (e.g. broadcast of cereal 1080 pellets).
3. Monitor two-yearly the density of live snails in the established snail plots until population trends are clear, and thereafter less frequently.
4. As soon as possible, fence stock from those parts of the habitat of *P. g. gilliesi* that are publicly owned.
5. Through regular hunting programmes, keep goat and pig numbers low within the snail's habitat.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.15 *POWELLIPHANTA GILLIESI* “HAIDINGER”

Description

A medium-sized snail (maximum diameter 55 mm; height 28 mm) with strong, wide, dark brown to black stripes on a gold background on the upper surface, and a dark reddish brown lower surface. The parietal callus is dark grey with distinct, fine granules. The shell whorls are inflated, and the inner whorls peaked.

The beautiful, strongly marked shell is hard to confuse with that of other subspecies of *Powelliphanta gilliesi*, largely because of the relatively wide banding. It was first discovered by Greg Napp and Simon Walls in 1995 and is still not formally described.

Habitat

Under litter and *Gabnia* tussock bases in mid-altitude manuka shrubland and kanuka forest (620 m a.s.l.) on leached and infertile coal-bearing sandstone soils.

Distribution

Apparently extremely localised, with only one population known, in a small remnant of forest on the summit of Mt Haidinger on the Burnett Range, northwest Golden Bay.

Cause of Decline, and Threats

1. Loss of most of the snail's forest habitat is the major cause of decline. The Haidinger Tops were burnt last century, probably during searches for minerals, and regeneration of the forest cover has been slow on the poor soils. The summit forest was cleared more recently to erect a trig station.
2. Introduced predators are a potential threat, but their present impact seems limited. There is no sign of predation by possums on this population. However, since possums to both the north and south along the Burnett and Wakamarama Ranges are having major impacts on other subspecies of *Powelliphanta gilliesi*, the potential threat is high. There is some predation by thrushes, and limited predation by weka, but rats, feral pigs and probably hedgehogs are absent.

Past Conservation Efforts

A possum-control operation (aerially distributed 1080 poison) was undertaken by DOC in 1994 and 2000 over the whole range of *Powelliphanta gilliesi* “Haidinger”.

A 3-day survey of the Haidinger area for signs of *Powelliphanta* was carried out by Golden Bay Area staff in 1995, and in 2001 two 100 m² snail-monitoring plots were established in the colony.

Current Conservation Status

As a tiny relict population of a naturally rare species, this snail is one to watch closely. However, there is limited predation by exotic intruders at present and snail numbers in the tiny colony are low to moderate (5 snails/100 m²). Because of the small total population, it is ranked ‘nationally critical’ (Hitchmough 2002).

Long-term Recovery Goal

A dense (> 12 snails/100 m²) population throughout most of the snail's presumed former range on the summit of Mt Haidinger (approximately 30 ha).

Objectives For The Next Five Years

Objective One

Protect the remaining habitat of *Powelliphanta gilliesi* "Haidinger".

Explanation

Mt Haidinger lies within the Kahurangi National Park and so has legal protection as public conservation land. However, the forest habitat of this snail is now so small that considerable vigilance must be maintained to ensure that no further vegetation clearance occurs.

To a large extent, the remote location of the colony provides the best protection: there are no tracks and the terrain and dense vegetation make it very difficult to access.

Actions Required

Control human activities on the Haidinger Tops to minimise the risk of fire or clearance of further vegetation.

Objective Two

Estimate total population size.

Explanation

Transect searches to the north, west and east of the known colony made by two people over 3 days yielded the total information known about the distribution and density of this snail. It is important to determine whether the taxon has a wider distribution than assumed, as a larger total population would reduce the urgency of other conservation actions. That said, a substantially wider distribution does not look very likely. The previous search found that just north of Point Height 536, snails were more like *P. g. gilliesi* than like *P. gilliesi* "Haidinger". A search along the Wakamarama Range summit just south of the Kaituna River failed to locate any *Powelliphanta* (K.J. Walker, pers. obs.). Most other subspecies of *P. gilliesi* also have, apparently naturally, very restricted ranges.

Actions Required

1. Determine the boundaries of the known *P. gilliesi* "Haidinger" colony, and measure snail density across the range of micro-climates in which it occurs.
2. Carry out a comprehensive survey of the wider Haidinger area and map the presence and/or density of any additional populations.

Objective Three

Determine the level of genetic distinctiveness of the Mt Haidinger snails from other *P. gilliesi* snails. If appropriate, formally describe the taxon.

Explanation

Based on morphological characters, the Haidinger snails are clearly different from other snails of *P. gilliesi*, including those living only 1.5 km away. Because seven of the other subspecies of *P. gilliesi* studied so far have at least one unique fixed allelic difference, it is likely that genetic profiling of the Haidinger snails could be useful in resolving the group's taxonomy.

As the overall aim is to protect the diversity of *Powelliphanta*, assessment of the distinctiveness of this newly discovered taxon is a priority.

Action Required

1. Depending on the outcome of Objective 2, collect a small sample of live animals for genetic comparison with other *P. gilliesi* snails, and for storage as a type specimen and series.
2. If appropriate, formally describe and name the new taxon.

Objective Four

Maintain the current density of *P. gilliesi* “Haidinger” at its known location through vigilance against predation by possums.

Explanation

As with many other very small colonies of *Powelliphanta*, there is no sign of predation by possums on *P. gilliesi* “Haidinger” at present, though possums are certainly present. However, as possum damage was found on *P. g. gilliesi* shells just north of the *P. gilliesi* “Haidinger” colony, this situation may change. Given the small size of the *P. gilliesi* “Haidinger” population and the limited quantities of other preferred possum foods on the infertile soils, possums should not be allowed to develop a taste for snails in this area.

Actions Required

1. Keep possums consistently at low levels on the Haidinger Tops by intermittent (every 5–6 years) possum control over the wider Burnett Range area and, in the intervening years, by occasional trapping and poisoning programmes in the immediate vicinity of the colony.
2. Make annual checks for possum damage on shells lying around the colony. If it is found to be occurring, begin quarterly possum-control operations in the immediate vicinity of the colony to keep possum numbers very low and to eradicate the problem possums. In the medium to longer term, if the problem persists, either construct and maintain a possum-proof fence over a small part of the Haidinger colony, or take some snails into long-term captivity.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.16 *POWELLIPHANTA GILLIESI MONTANA*

Description

A medium-sized snail (maximum diameter 52 mm; height 28 mm) with a finely granulated parietal callus. The shell colour is a rich mahogany brown on the top surface and a deep red-dark brown on the bottom. A few fine, or occasionally wide, black spiral bands mark the periphery.

Habitat

In mid- to high-altitude forest (830–1100 m a.s.l.) on relatively infertile soils.

Lives under leaf litter in forests of silver beech, southern rata, quintinia, kamahi and toro, and in high-altitude leatherwood scrub.

Distribution

On the upper slopes of the Wakamarama Range, northwest Golden Bay. The type locality is Bock Peak (no longer named on topographical maps), and the snails are found along the summit of the range about 2 km both north and south of Bock Peak.

The much larger snail *Powelliphanta superba superba* occurs sympatrically with *P. gilliesi montana* throughout its range. The distribution of *P. g. montana* is reasonably well known, and is naturally small (250 ha).

Cause of Decline, and Threats

1. Intensive predation by possums since at least the 1970s.
2. Low recruitment through predation by thrushes, exacerbated by forest understorey changes caused by goats and deer.

Past Conservation Efforts

A possum-control operation (aerially distributed 1080 poison) was undertaken by DOC in May 1999 over the whole range of *Powelliphanta gilliesi montana*. In 1999, seven 100 m² snail-monitoring plots were established on transects in the snail habitat. These were re-measured in 2001 and a further five 100 m² plots were set up.

Current Conservation Status

A snail with a very localised natural range that declined dramatically in the 1970s and 1980s, and which is apparently still declining. Now at dangerously low numbers (0.25 snails/100 m²) throughout its small range.

Long-term Recovery Goal

To increase snail numbers to a density of more than 12 snails/100 m² throughout most of the snail's range; and a stable or increasing total population.

Objectives For The Next 10 Years

Objective One

Increase population size and productivity by predator control.

Action Required

1. Keep possum numbers steadily at very low levels (< 3% RTC, preferably < 1% RTC) over the range of the snail.
2. Monitor snail numbers within the established plots regularly until it is clear that an effective management regime reversing the decline is in place.

Objective Two

Improve quality of snail habitat.

Actions Required

Keep goat and deer numbers low in the snail habitat by regular control programmes.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.17 *POWELLIPHANTA GILLIESI SUBFUSCA*

Description

Powelliphanta gilliesi subfusca is a medium-sized snail (maximum diameter 47 mm; height 26 mm), with fine, irregular, reddish brown spiral lines on the top, and a plain olive-brown dorsal surface that deepens to greenish or reddish brown towards the umbilicus (Powell 1930, 1946, 1979). The purple parietal callus is coarsely granulated.

Habitat

A lowland species (sea level to about 200 m a.s.l.) found on old sand-dunes and on sandy mudstones, siltstones and limestones. Lives under litter in forest of northern rata, pukatea and northern cedar, and also under kanuka in regenerating shrublands.

Distribution

Presumably once occupied all the forest in northwest Golden Bay from the North Head of Wanganui Inlet to Cape Farewell, and in the north Pakawau Forest from the coast to the headwaters of the streams draining west.

However, much of these forests has been cleared for farmland and *Powelliphanta gilliesi subfusca* is now confined to isolated, mostly small, forest remnants around Kaihoka Lakes, Greenhills Stream, Oyster Point and Mt Lunar. It also occurs sparsely in the northwestern edge of the cutover Pakawau Forest.

Cause of Decline, and Threats

1. Loss and fragmentation of forest habitat is the main cause of decline, and trampling of part of the remaining habitat by cattle and feral goats is a continuing threat.
2. Predation by rats, thrushes and hedgehogs at all sites.

Past Conservation Efforts

To protect the snail populations, the forest remnants at both Oyster Point and Greenhills Stream mouth were legally protected in the late 1980s and early 1990s, respectively. At the same time, both sites were fenced to exclude cattle.

Current Conservation Status

Snails are in high densities (33 snails/100 m²) in the best parts of the best habitat (covering less than 1 ha around the Kaihoka Lakes), in low to very low density (below 0.01 snails/100 m²) in Pakawau Forest and probably in low-moderate densities (about 3 snails/100 m²) elsewhere. So far there is no sign of predation by possums in any of the colonies, and the habitat is recovering well at the recently fenced sites. *Powelliphanta gilliesi subfusca* is regarded as in 'gradual decline' (Hitchmough 2002).

Long-term Recovery Goal

All populations stable or increasing; removal from listing as a threatened taxon.

Objectives For The Next 10 Years

Objective One

Maintain population density and genetic diversity by habitat protection and enhancement.

Explanation

Much of the forest habitat of *Powelliphanta gilliesi subfusca* has been lost, and the remaining c. 200 ha is very fragmented—which hinders gene flow. In several colonies, the forest habitat is not legally protected and domestic stock continue to dry out the litter layer and trample snails. Feral goats and deer inhibit regeneration of the Pakawau Forest.

Actions Required

1. Seek to place snail habitat near Mt Misery and Kaihoka Stream Swamp under covenants or other legal protection; seek approval and funds to fence stock from those forest areas.
2. Encourage the regeneration of shrublands which could provide land bridges between *P. g. subfusca* colonies.

Objective Two

Determine the population biology of *P. g. subfusca* at Kaihoka Lakes, and the population trends in all colonies.

Explanation

Kaihoka Lakes Scenic Reserve is one of the few sites that has a relatively dense snail population and is easily accessible. As such it is an invaluable site from which to obtain information on the key population parameters of *Powelliphanta* today, and to examine the relative impact of predation by hedgehogs, thrushes and rats on *Powelliphanta* and techniques for their control.

Actions Required

1. In order not to compromise the value of Kaihoka Lakes Scenic Reserve for conservation research on *Powelliphanta*, all predator management at the site should be part of a formal written strategy.
2. Establish at least four 100 m² plots to monitor snail density in each colony of *P. g. subfusca*. Releaser annually for the first 2 years to determine population trends and the causes of any declines.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.18 *POWELLIPHANTA GILLIESI AUREA*

Description

A medium-sized snail (maximum diameter 56 mm; height 28 mm) with a dark red, densely granulated parietal callus. The shell is an olive-brown colour on the dorsal surface, spirally lined in dark chestnut and with a few dark green lines; the base is golden to olive coloured, with a small area of reddish brown about the umbilicus (Powell 1979).

Habitat

Occurs from 50 to 300 m a.s.l., though much more common at higher elevations. Found in litter under dense pukatea/northern rata forest with abundant kiekie and supplejack. The soils are calcium rich, formed on a scarp and talus slope of Tertiary limestone.

Distribution

Powelliphanta gilliesi aurea is now restricted to probably less than 50 ha of limestone cliffs just west of Mangarakau in North West Nelson.

Cause of Decline, and Threats

1. The main cause of the decline of *Powelliphanta gilliesi aurea* is the destruction and conversion to pasture of the forest habitat over much of its naturally small range.
2. Continuing forest loss and predation by introduced rats, pigs, thrushes, probably hedgehogs and, only recently, possums.

Past Conservation Efforts

1. Part of the snail's habitat is legally protected within the Mangarakau Scenic Reserve.
2. Three 100 m² snail-monitoring plots were established in the lower part of the Reserve in 2001, and a brief survey was completed.

Current Conservation Status

Despite substantial predation by pigs and rats, *Powelliphanta gilliesi aurea* was in better numbers than many other *Powelliphanta* until recently. However, sometime between 1996 and 2001, possums began preying on the snails. Very low numbers of snails (0.3 snails/100 m²) and, for the first time, many possum-damaged shells, were found during the 2001 survey. *Powelliphanta gilliesi aurea* was ranked 'nationally endangered' by Hitchmough (2002).

Long-term Recovery Goal

A dense (> 20 snails/100 m²) population that is stable or increasing, on legally protected habitat throughout the snail's range.

Objectives For The Next 10 Years

Objective One

Increase population size by predator control.

Explanation

Like many other low-altitude fertile sites with abundant possum-preferred vegetation and presumably high possum numbers, until recently there was no sign that possums preyed on snails at Mangarakau. However, for unknown reasons this changed recently. Given the devastating effect of possums and the difficulties of snail recovery once predatory behaviour is widespread in the possum population, it is urgent that possum numbers be drastically reduced throughout the Mangarakau Scenic Reserve.

Action Required

1. Measure the density of possums before any control is undertaken to better understand the relationship between possum densities, forest type and snail predation.
2. Reduce possums to very low densities in the Mangarakau Scenic Reserve. Select possum-control techniques that keep rat numbers low.
3. Maintain a regular programme of pig control in the Mangarakau forests and scrub.

Objective Two

Accurately determine distribution and total population size.

Explanation

It was formerly presumed that most *P. g. aurea* habitat was protected within Mangarakau Scenic Reserve. However, snails are only present in the northeastern end of the Reserve, and are in relatively low numbers on the limestone talus slope. The core habitat of *P. g. aurea* seems to be on the highest points of the western-facing limestone scarp itself, around the type locality at 250 m a.s.l. Only a remnant of original intact forest remains at this altitude, as fires from the west swept up to and over the scarp both north and south of the type locality.

When Powell described *P. g. aurea* in 1946, he compared its distribution with that of *P. g. brunnea* (found only in 0.5 ha), noting 'both *aurea* and *brunnea* are restricted to small areas and their survival is uncertain' (Powell 1946).

The distribution of snails on the western slopes needs to be ascertained as the remaining forest and scrub is privately owned. Their legal protection should be sought.

Actions Required

Survey the distribution and density of *P. g. aurea* on the western slopes of the Mangarakau scarp, and determine the accurate boundaries of the snail's range to the north and south of Mangarakau School.

Objective Three

Determine population trends.

Actions Required

1. Establish ten to fifteen 100 m² plots in sites representative of the range of habitats in which *P. g. aurea* is found.
2. Annually measure the density of live snails within each plot until population trends are clear.
3. Examine each plot's annual crop of empty shells to determine cause of death, and rates of induced mortality.

Objective Four

Maintain and increase the area of the habitat of *P. g. aurea* and improve habitat quality.

Actions Required

1. Seek legal protection for snail habitat that is privately-owned forest or regenerating scrub.
2. Ensure that domestic stock is securely excluded from areas of snail habitat and, also if possible, from areas of former snail habitat in which forest cover is likely to naturally regenerate.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.19 *POWELLIPHANTA GILLIESI BRUNNEA*

Description

A medium-sized snail (maximum diameter 56 mm; height 32 mm). The shell is bright reddish brown. The base is entirely plain, but dark brown fine lines circle the upper surface.

The parietal callus is dark brown to black, and crowded with fine granules.

Habitat

Under litter in coastal lowland forests of cabbage tree, mahoe, kawakawa, nikau, kiekie and flax, on sandy soils with limestone outcrops.

Distribution

Only known from near the mouth of the Paturau River on the northwest coast of Golden Bay. Confined to a tiny 0.2 ha patch of remnant forest now surrounded by pasture and within 30 m of a farm house and utility buildings.

The distribution was formerly more extensive (according to A.W.B. Powell (1979), it was found north along the coast for about 3 km), but no trace of snails has been found in any of the nearest remaining forest habitat (about 1 km away) or to the south of the Paturau River.

Cause of Decline, and Threats

1. Clearance of almost the entire forest habitat for farmland, and degradation of the remaining fragment through cattle trampling and grazing.
2. Predation by rats, hedgehogs and thrushes.

Past Conservation Efforts

1. The site was fenced by the New Zealand Wildlife Service in 1980.
2. In 1985 flax plants were transferred from the beach edge, several hundred metres away, to the area between the fence and the bush. This was done to increase available snail cover, protect the bush from wind damage and eliminate the rank grass that had resulted from fencing. Until at least 1985 the owner regularly put stock inside the fence to reduce the fire risk that the rank grass had created.
3. In 1991 two plots were established: a 100 m² plot in the northeastern corner of the bush and a 50 m² plot beside a limestone outcrop in the south corner. The number of live snails in each plot was measured then (6.6 snails/100 m²), and re-measured in 1998 (10 snails/100 m²).
4. Poisoned rat bait was left in bait stations at the colony sporadically in 1991. Bait stations were regularly refilled (about every 6 weeks) with Talon from 1999.
5. Several unsuccessful attempts have been made since 1985 to legally protect the forest remnant through purchase by the Crown or placement under a QEII covenant.

Current Conservation Status

Ranked by Hitchmough (2002) as 'nationally critical', and considered endangered because of: the very small size and degraded nature of the remaining habitat, and the low juvenile and adult survival brought about by introduced predators.

After 15 years without stock, the habitat is greatly improved and a deep moist litter layer has aided recruitment, and probably also reduced predation, making the outlook for this snail much brighter than it was 20 years ago. To secure its survival, some intensive management will be required for at least another decade.

Long-term Recovery Goal

To increase total wild population size to more than 5000 breeding adults, and to at least double the size of available habitat.

Objectives For The Next 10 Years

Objective One

Increase population density in the Paturau colony to over 20 snails/100 m² through improved recruitment and survival by sustained predator control.

Explanation

The nature of the remaining colony's micro-habitat means that thrushes, hedgehogs and rats are particularly common and will require on-going regular control efforts if their numbers are to be kept low enough to improve snail recruitment. There is no sign of predation by possums at present, and in this isolated forest remnant it is unlikely that possums will learn snail-eating behaviours. However, as a precaution possum numbers should be kept low.

Actions Required

1. The optimum, though initially more expensive, option is to erect a rodent- and hedgehog-proof fence around the Paturau snail colony and, through a poisoning and trapping programme, eradicate rats and hedgehogs inside the fence. The fence could also be built to exclude possums, but this would make it much more expensive and conspicuous. The preferred option is to install a number of possum kill-traps in the forest, thus keeping on-going maintenance costs low and the degree of protection afforded very high.
2. An interim, short-term solution for rat control is to regularly re-supply (every 6-8 weeks) fresh rat poison to 10-20 dog-proof bait stations within the forest. At intervals of 3 or 4 years the poisoning regime should be suspended and replaced for 6 months with regular rat trapping using standard break-back snap traps to avoid the development of poison resistance in the rat population. Future attempts to eradicate rats may be compromised by the prolonged use of poisons, even second-generation anticoagulants, and this risk should be kept in mind when determining rat control plans.
3. A short-term solution for hedgehog control is regular patrols of the bush just after dark or in the early hours of the morning with a spotlight, particularly during spring before the start of the hedgehog breeding season.

4. Adequate control of thrushes is probably not practicable. Scattering a bird poison such as chlorophase in the forest may kill some thrushes, but such actions would need to be on-going, and the side effect of non-target bird kills makes this option unpalatable. An alternative approach is to reduce the opportunities of thrushes finding snails by providing plenty of snail cover and by removing obvious thrush anvils. The natural regeneration of the forest after stock removal has already greatly increased the amount of natural snail cover, and this is probably a sufficient thrush deterrent.

Objective Two

Increase population size by increasing the area of habitat available.

Actions Required

1. Seek landowner permission to extend the size of the existing habitat by fencing stock from the relict tall native trees in the southwest corner of the colony (i.e. on the seaward side of the farm drive and behind the bach). Some weed control and judicious replanting will be required once this land is fenced off. As with the adjoining original colony, purchase of the site or placing it under covenant is highly unlikely given its proximity to the main farm buildings. Snails should expand into this area of their own accord once numbers in the original colony increase and ground cover in the newly fenced area is dense enough.
2. Seek landowner permission to purchase or place under covenant a nearby second area of forest in which snails were not formerly present. Prepare the site by fencing to exclude stock. Because of the rocky terrain it is probably impossible to make the fence rodent- and hedgehog-proof, but options for this should be investigated before cattle fencing proceeds.

Objective Three

Translocate snails to the new habitat.

Actions Required

1. Before translocation, maximise the size of the donor population (via Objective 1) and accurately census the population through systematic density searches across all the micro-habitats in Paturau Bush. Only translocate the snails when the actions of Objective 1 have increased the population sufficiently.
2. Little is known about the natural rate of snail increase, but indications are that it is highly density dependent. Because of this, construct a snail-proof enclosure within a small part of the best of the young forest habitat, and put all the translocated snails within it, thereby maximizing snail density while minimizing the number of snails needed in the transfer.
3. Control predators in the release site, at least until the snail population becomes properly established.

Objective Four

Prevent collection of the live snails through advocacy.

Explanation

The *P. g. brunnea* colony at Paturau is well known by shell enthusiasts, but fortunately collecting land snails has greatly decreased since the giant snails were protected by law.

Action Required

A display detailing the conservation status of *P. g. brunnea* and the conservation management measures being undertaken at Paturau should be erected on the site. The illegal nature of, and potential harm done by, collecting live *P. g. brunnea* should be highlighted.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.20 POWELLIPHANTA GILLIESI KAHURANGICA

Description

A medium-sized (maximum diameter 54 mm; height 28 mm) snail with dark reddish base and strong narrow spirals on the upper surface. The purple callus is heavily granulated.

Habitat

On sandy, free-draining soils under primary forests of hard beech, northern rata and pukatea. Also under regenerating forest of manuka, kanuka and nikau. Ground cover in all sites: scrambling rata, *Carex* spp. and bush rice grass.

Distribution

Confined to about 400 ha at Kahurangi Point, North West Nelson.

The centre of distribution appears to be the sand-dune country in the catchment of Camp Creek, but they occur from just south of the Kahurangi River mouth to Lagoon Creek, and from the coastline, inland up to about 300 m a.s.l.

Cause of Decline, and Threats

1. Clearance of the forest habitat for farmland; degradation of much of the remaining habitat by cattle trampling.
2. Predation by introduced rats, pigs, possums, thrushes and hedgehogs.

Past Conservation Efforts

1. A number of attempts have been made over the last decade to limit the impact of possums on *Powelliphanta gilliesi kahurangica*. In 1993 ground-based possum control was carried out over several months in the immediate vicinity of Kahurangi Point. In 1997 a much larger and more effective control operation using aerially distributed 1080 poison was carried out. In addition to causing a major reduction in possum numbers, the 1080 probably killed most rats present, thereby greatly reducing predation pressure on the snails. It would have taken up to a year for rodent numbers to increase again.
2. A 500 m² plot to monitor snail density was established in 1996 and re-measured in 1999, 2000 and 2002. Three 100 m² snail-monitoring plots were added in 1999, two within the possum-control area and one outside it, and were re-measured in 2000 and 2002.

Current Conservation Status

Snail density increased dramatically after possum control and on the Camp Creek dunelands snail numbers are very high (32 snails/100 m²) in the few small fragments of original forest, and low-moderate in the surrounding regenerating shrublands.

The snail is still regarded as 'nationally endangered' (Hitchmough 2002).

Long-term Recovery Goal

Maintenance of a strong core population through predator control, and increase in colony size through rehabilitation of former habitat.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained control of possums.

Explanation

Possums were first seen at Kahurangi Point about 1959 (McClennan & McCann 1991). The vegetation is luxuriant in the warm wet climate, and possum numbers increased to relatively high numbers (46% RTC in 1996). Perhaps because there was such a large alternative food supply, there was no sign of snail predation by possums until the early 1990s.

When the first snail-monitoring plot was measured in 1996, 64 shells of possum-killed snails were found but there were still 54 live snails present in the 500 m² plot—amongst the highest snail densities found in *Powelliphanta* today. It seems likely that only a proportion of possums at Kahurangi Point had learnt to prey on snails.

With the reduction of possum numbers to 0.03% RTC in 1997, snail numbers increased dramatically to 147 live snails (about 100 of them less than 2 years old) in the monitoring plot by mid-1999, and no sign of any recent predation by possums. By 2002 there were 152 live snails in 400 m² of the plot (51% of them juveniles), but also 14 possum-damaged shells.

It is expected that possum numbers in this vegetation will recover relatively quickly (RTC was 3.6% by December 1998). To maintain the gains in snail numbers, possum control will need to be repeated at perhaps 3–4-yearly intervals. Monitoring of this situation is required, and when possum control is needed again, consideration should be given to using techniques that kill rats too.

Actions Required

1. Annually check snail plots in Camp Creek for signs of freshly killed snails (i.e. possum-damaged shells). Because of the fragility of the sandy litter layer and the number of easily desiccated juvenile snails present, do not disturb the litter but only collect shells from the surface.
2. Measure possum density (RTC) when evidence of fresh possum-killed snails first reappears.
3. Repeat possum control within 1 year of detecting renewed predation, and select poisons and techniques which also control rodents.

Objective Two

Improve snail recruitment and survival through habitat restoration.

Explanation

Most of the forest habitat of *Powelliphanta gilliesi kaburangica* was destroyed by the fires associated with European settlement. Construction of the lighthouse settlement was probably the reason for the original forest clearance, but ever since then cattle farming around the lighthouse and on nearby private land has restricted regeneration and caused on-going degradation of all the remaining forest and regenerating shrublands—even those on public conservation land. Cattle are also killing young snails and eggs directly by crushing them and killing snails indirectly by trampling and drying out the litter layer which is particularly fragile on the sandy soils. Beach access during low tides and shifting sand-dunes make the option of fencing out of stock not cost effective.

Actions Required

1. As a matter of urgency, seek removal of cattle from Kahurangi Point, preferably through Crown purchase of the enclave of private land.
2. If land purchase cannot be achieved, seek to either provide on-going compensation payments to the farmer for **not** grazing the land, or fence cattle out of some of the best snail habitat.

Objective Three

Maintain high snail density in Camp Creek by supporting initiatives to control pigs, hedgehogs, thrushes and rats.

Explanation

The Kahurangi Point landscape is a patchwork of open country and lowland coastal scrub and forest on light soils, so hedgehogs and thrushes are likely to be common. They are probably affecting snail recruitment, but the scale of the problem is unknown.

Feral pigs caused high snail mortality from at least the 1970s to the 1980s, but increased hunting pressure seems to have significantly decreased pig numbers lately.

While at present the most cost-effective measures seem to be possum control and habitat restoration, methods should, where possible, be selected for their ability to also control and quantify the impacts of smaller predators.

Actions Required

1. Using spotlights along transects at night around the Kahurangi House, roughly quantify the number of hedgehogs present at Kahurangi Point.
2. Encourage pig control initiatives at Kahurangi Point which do not harm kiwi (e.g. baited wire-mesh pig traps).
3. Releaser the numbers of snails in the permanent plots at Kahurangi Point two-yearly.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.21 *POWELLIPHANTA GILLIESI JAMESONI*

Description

Powelliphanta gilliesi jamesoni is a small to medium-sized snail (maximum diameter 46 mm; height 24 mm) with a smooth, dark grey parietal callus. Snails at the type locality near the Goulard Downs Hut have a russet-coloured shell, spirally lined and radially streaked with darker brown.

According to Powell (1946) there are 'at least three recognisable forms of this species along the Goulard Downs track from the vicinity of [Goulard Downs Hut] ... to the Collingwood [County] Boundary. Collingwood Boundary examples can be readily distinguished from those of ... the type locality by their more reddish-brown colour, strong spiral banding of the top and peripheral area and obsolescence of the basal dark axial streaks. A third form from near Saxon Creek has dense narrow spirals on the dorsal surface ... but the base is bright reddish-brown with strong subperipheral broad black spiral bands ...' He believed, 'further collecting, especially from intermediate localities, is essential before these forms of *jamesoni* can be satisfactorily evaluated'.

Unfortunately, this was never done. Samples collected for genetic comparisons of *P. g. jamesoni* with other *Powelliphanta* were all from the type locality near Goulard Downs Hut, so the genetic basis for the morphological differences obvious within the *P. g. jamesoni* group has not been examined.

Habitat

Powelliphanta gilliesi jamesoni is an upland snail, living at 610–762 m a.s.l. In the bush at Goulard Downs Hut *P. g. jamesoni* lives under bush rice grass in silver beech forest on calcium-rich limestone soils. Elsewhere the snails live in infertile, highly leached granite soils, under moss, red tussock or *Gabnia* skirts on the edge of boggy clearings in stunted manuka forest, or in forest of quintinia, kamahi, southern rata, silver beech and *Dracophyllum traversi*.

Distribution

Even if the habitat of all three forms of *P. g. jamesoni* is included, the natural range of this snail is small. It occurs in a narrow band over about 600 ha on the southern and western flanks of the Slate Range, in the Saxon River headwaters and in the Goulard Downs Hut bush (beside the Heaphy Track in Kahurangi National Park).

Cause of Decline, and Threats

1. Intense predation by possums since the late 1970s in all western colonies, and moderate predation by possums in Goulard Downs bush; some predation by rats in Goulard Downs bush.
2. Some loss of forest habitat between the 1860s and 1900 through burning and sheep grazing.

Past Conservation Efforts

1. Possum control (aerially delivered 1080) over the Saxon - Slate Range snail colonies in 1994, and over the Goulard Downs Hut bush in 1995. Ground-based possum control over about 60% of the Saxon population, annually since 2000.
2. A 300 m² density-monitoring plot established in the upper Saxon River area in 1991 was re-measured in 1994, 1996 and 1999. Two smaller 100 m² plots were established in the same general area in 2000, with a further two set up in 2001.
3. A 500 m² density-monitoring plot was set up in Goulard Downs Hut bush in 1995 and re-measured in 1998 and 2000. A 100 m² plot was also set up there in 2000.
4. A 500 m² snail enclosure was built near the Saxon River in 2000 and six live snails from the Collingwood County Boundary were placed inside it. Possum numbers are being kept very low in the vicinity of the enclosure and snail numbers inside monitored to see if the snails will increase when predation is kept very low and snail density is artificially increased.

Current Conservation Status

1. *Powelliphanta gilliesi jamesoni* is ranked as 'nationally endangered' (Hitchmough 2002).
2. Numbers of *P. g. jamesoni* at the type locality are moderate-low (1.8 snails/ 100 m²), low at the Collingwood County Boundary (0.4 snails/person hour) and very low (0.6 snails/100 m²) at Saxon River.
3. The Saxon River form and probably also the Collingwood County Boundary form of *P. g. jamesoni* would be classified as 'nationally critical' if considered as subspecies rather than forms. The small, individual ranges of the three forms make them all particularly vulnerable.

Long-term Recovery Goal

Moderate densities (> 12 snails/100 m²) of snails in stable or increasing populations over most of the range of each of the three distinctive forms of *Powelliphanta gilliesi jamesoni*.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained predator control.

Actions Required

1. Keep possum numbers steadily at barely detectable levels (< 1% RTC) throughout the snail's range.
2. Rotate methods of possum control, using (when possible) methods which also kill rats at Goulard Downs Hut bush (1080, feracol), but generally avoiding the use of accumulative poisons, such as brodifacoum, and the use of the same acute poison on recent consecutive occasions. For both pests, use traps instead of poisons at regular intervals.

3. Monitor pest-mammal numbers annually prior to control operations to determine the relationship between predator density and snail population health.

Objective Two

Determine population trends.

Actions Required

1. Increase the number and geographic spread of snail-monitoring plots so all three forms can be adequately monitored.
2. Measure snail density regularly until the impacts of intensive predator control and artificially enhanced snail density are clear; thereafter monitor less frequently.

Objective Three

Determine the taxonomic status of the three forms of *P. g. jamesoni*.

Actions Required

1. Facilitate research into the genetic distinctiveness of the three forms of *P. g. jamesoni*.
2. If appropriate, revise taxonomy.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.22 *POWELLIPHANTA GILLIESI* “HEAPHY”

Description

A medium-sized snail (maximum diameter 47 mm; height 22 mm) with a purplish brown, smooth callus. The dorsal surface is lined with fine, dark brown to almost black spiral bands. The ventral surface is a rich, dark reddish brown, with two thick black spiral bands near the periphery. This snail was only discovered c. 1990, and has yet to be formally described.

Habitat

A mid-altitude calcicol, found at 180–310 m a.s.l. on Tertiary limestones. Lives under litter in tall forest dominated by northern rata, kamahi, silver beech, toro and nikau.

Distribution

So far, this snail is known only from a 30–40 ha area on the true left of the Heaphy River just above its junction with the Gunner River. Judging from the availability nearby of similar habitat, its total range is likely to be no more than 1000 ha, and probably much less. Throughout its range *Powelliphanta gilliesi* “Heaphy” is sympatric with the much larger and more widespread *P. superba* “Gunner River”.

Cause of Decline, and Threats

1. Predation by possums and rats are the main cause of this snail’s unnaturally low density.
2. High numbers of possums and deer are threatening the viability of the forest ecosystem, causing extensive canopy dieback and browsing the understorey. The forest collapse is likely to have started with a pathogen attack on a particular tree species, as the collapse is widespread on the slopes of the lower Heaphy Valley.

Past Conservation Efforts

1. A 500 m² snail density-monitoring plot was established in 1995.
2. A possum-control operation (aerially distributed 1080 poison) was undertaken by DOC in 1994 and 1999 over the known range of *P. gilliesi* “Heaphy” to protect both the snails and the northern rata forest.

Current Conservation Status

1. From the small area sampled, density is apparently moderate to low (1.6 snails/100 m²).
2. Ranked as ‘nationally endangered’ (Hitchmough 2002).

Long-term Recovery Goal

A moderately dense (> 6 snails/100 m²) population that is stable or increasing throughout most of the range of *P. gilliesi* “Heaphy”.

Objectives For The Next 10 Years

Objective One

Increase population size and productivity by sustained predator control.

Actions Required

1. Keep possum numbers steadily very low (< 3%, preferably < 1% RTC) over the range of the snail.
2. Select possum-control techniques, particularly in beech mast years, which also kill rats.
3. Extend geographic coverage, and increase the number, of snail density-monitoring plots and releaser at three-yearly intervals.

Objective Two

Extend knowledge of the conservation status of *P. gilliesi* “Heaphy”.

Explanation

The late discovery of this large snail is due to the remote and difficult nature of the land it occupies. The area is away from main routes, and the combination of dense wet lowland forest on karst topography make walking and navigation difficult. However, to properly assess the urgency and priority of conservation management actions for *Powelliphanta gilliesi* “Heaphy”, better knowledge of its range and population size is essential. Most other *P. gilliesi* subspecies have ranges that are very restricted, and early indications are that the range of *P. gilliesi* “Heaphy” will also be small.

Actions Required

Survey the Heaphy River catchment to determine the distribution and density of *P. gilliesi* “Heaphy”, particularly just north of its known range and including the area between Cadigan Creek and the mid-Heaphy River, and the limestone areas between Ryan Creek and the middle stretch of the Gunner River.

Objective Three

Formally describe *P. gilliesi* “Heaphy”.

Actions Required

1. Assess the genetic closeness of *P. gilliesi* “Heaphy” to its geographical and morphological nearest neighbour, the Saxon River form of *P. gilliesi jamesoni*.
2. If appropriate, formally describe the taxon.

Objective Four

Improve quality of snail habitat.

Actions Required

Keep deer numbers low in the snail habitat by regular control programmes.

Responsibility

Buller Area Office, West Coast Conservancy.

3.23 *POWELLIPHANTA GILLIESI COMPTA*

Description

Powelliphanta gilliesi compta is a medium-sized snail (maximum diameter 48 mm; height 28 mm) with a dark pinkish grey parietal callus, lightly scattered with granulations. The shell colour is warm golden brown, with fine dark brown spiral lines on the dorsal surface and periphery, and a secondary series of lines in light green. The base is largely plain, but deepens to streaks of russet brown around the umbilicus. Unlike all other *Powelliphanta*, *P. g. compta* shells all have a light brown zone inside the umbilicus which is rough in texture, almost like freshly sanded wood, so that the shell base appears matt rather than glossy.

Habitat

A mid-altitude snail that lives at about 610 m a.s.l. on the back slopes of a Tertiary limestone scarp in litter under a forest of silver beech, kamahi, toro, southern rata and rimu.

Distribution

The distribution of *Powelliphanta gilliesi compta* seems naturally small, with snails restricted to less than 300 ha on a remnant of limestone, The Castles, perched above the Rocky River on the eastern Aorere peneplain in Golden Bay.

Cause of Decline, and Threats

1. Burning of part of the snail's habitat during searches for gold in the 1860s, and logging of most of the lower-altitude forest in the 1950s and 1960s.
2. Predation on all ages of snail by rats and latterly possums, and predation on juvenile snails by thrushes and possibly hedgehogs.
3. Deterioration of the snail's micro-habitat through trampling and browsing by feral goats and deer.

Past Conservation Efforts

1. Possum control (ground trapping and cyanide poisoning) over the whole range of *Powelliphanta gilliesi compta* in 1995, followed by aerially delivered 1080 in 2000.
2. A 125 m² snail density-monitoring plot set up in 1991 was expanded to 500 m² and re-measured in 1995, 1998 and 2001. Ten more 100 m² plots were established in 2001.

Current Conservation Status

Now in moderate numbers (5.5 snails/100 m²) over most of its very small range, *Powelliphanta gilliesi compta* was ranked 'vulnerable' by Hitchmough (2002).

Long-term Recovery Goal

Throughout the remaining forest at The Castles, a dense (> 12 snails/100 m²) population of *Powelliphanta gilliesi compta* that is stable or increasing.

Objectives For The Next 10 Years

Objective One

Increase population density by sustained predator control.

Actions Required

1. Keep possum numbers steadily at very low levels (< 3% RTC, preferably < 1% RTC) over the range of the snail.
2. Select, particularly in beech mast years, possum-control techniques which also kill rats (1080, feracol). Use standard tracking and trapping methods to monitor rat and possum numbers annually so that the data can be used to both guide future control plans and determine the relationship between pest-mammal density and the health of the snail population.
3. Select a small part of the snail's habitat within which it is practicable to keep rat and hedgehog numbers low between possum-control operations. Grid the area with tracks and, using traps and poisons, annually carry out rat and hedgehog control.
4. To reduce the risk of poison shyness developing in the possum and rat populations, rotate control methods, and use possum-proof bait stations for rat control.
5. Ensure that there are at least four 100 m² plots for monitoring snail density within the rodent control area and measure snail density within all the plots regularly until the impact of pest control and snail population trends are clear.

Objective Two

Increase snail recruitment through habitat restoration.

Explanation

The block and fissure nature of the karst landscape of the The Castles makes it easy for introduced thrushes to find anvils to smash open the shells of *P. g. compta*. Low goat and deer numbers will assist in restoring a dense, moist forest understorey, which will in turn decrease the chances of thrushes locating and killing snails, and will reduce losses of juvenile snails to desiccation.

Actions Required

Keep goat and deer populations at very low levels throughout the range of *P. g. compta*.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.24 *POWELLIPHANTA GILLIESI FALLAX*

Description

A small to medium-sized snail (maximum diameter 48 mm; height 26 mm) of variable colouring. On most shells the base is a greenish colour with black axial streaks, but on others it is an unstreaked dark reddish brown. Narrow spiral bands of dark brown and green line the upper surface. The parietal callus is dark purplish brown and completely smooth.

In 1990, allozyme data showed unequivocally that *Powelliphanta gilliesi* snails at high altitude on Walker Ridge, on the southern end of Parapara Peak, with uniformly strong radial striping, were not *P. g. fallax* as originally thought, but a cryptic new species, *Powelliphanta* “Parapara”.

Even among the remaining, largely low-altitude *P. g. fallax* snails, the genetic distance between snails from the northern and southern extremes of the range is as large as the genetic distance between many of Powell’s original subspecies. Further taxonomic study of *P. g. fallax* is required.

Habitat

Powelliphanta gilliesi fallax is mostly a lowland species, though it occurs from sea level to at least 600 m a.s.l. It lives in the litter in calcium-rich soils on limestones and siltstones under forests of northern rata and pukatea with dense nikau understorey, and on relatively infertile soils under beech and rimu forests and in regenerating manuka shrublands.

Distribution

Powelliphanta gilliesi fallax occurs on the northern and eastern flanks of Parapara Peak in Golden Bay between the Parapara and Waikoropupu Rivers.

In the higher parts of its range, *P. g. fallax* is sympatric with the much larger *P. hochstetteri anatokiensis* and *P. superba superba*, and with the smaller, still undescribed snail, *Powelliphanta* “Parapara”.

Cause of Decline, and Threats

1. Predation by rats, thrushes, hedgehogs, pigs and, in some populations, possums.
2. Destruction of forest habitat.

Past Conservation Efforts

1. In 1983 and 1985 the New Zealand Wildlife Service successfully lodged objections with the Planning Tribunal to mineral prospecting applications in *P. g. fallax* habitat on Parapara Ridge.
2. A systematic grid-square survey of the fauna and flora of the Parapara area, undertaken in 1986 by the New Zealand Forest Service, provided data on the distribution of *P. g. fallax* (S.P. Courtney, pers. comm.).

3. Since the mid-1980s, J. Walls has continuously trapped a variety of snail predators on about 15 ha of privately-owned habitat of *P. g. fallax* at Onekaka. This predator-control operation has focused on possums, but rats have also been caught.
4. A 500 m² snail-monitoring plot was set up in 1995 in the Pariwhakaoho catchment and was re-measured in 1998 and 2001. A further three 100 m² plots there, plus one at Waikoropupu, were established in 2001.
5. Possum-control operations (aerially distributed 1080 poison) carried out by the Department of Conservation in 1995 and 2000 on the upper slopes of Parapara Peak reduced possum numbers over about 50% of the range of *P. g. fallax*.
6. To protect *P. g. fallax*, rat, possum and hedgehog trapping over 5 ha of privately-owned snail habitat at Parapara Bush was initiated in 1999 by K.J. Walker and G.P. Elliott.

Current Conservation Status

While the habitat of this snail is continuing to be fragmented through vegetation clearance for farming and lifestyle blocks, *Powelliphanta gilliesi fallax* has successfully recolonised some areas of tall, dense manuka and gorse scrub.

The snail's main natural predator, weka, disappeared from the area in the mid-1990s. However rats, and to a lesser extent pigs, thrushes, hedgehog and possums, are having a substantial impact on the population density of *P. g. fallax*. In the snail-monitoring plots at Pariwhakaoho snail density was moderate (5.6– 6.2 snails/100 m²) in 1995–98, but dropped to 0.9 snails/100 m² by 2001. The decline was apparently caused by a beech mast, the resultant rat plague and the onset of predation by possums. Snail densities are similarly low at Waikoropupu and Parapara.

Powelliphanta gilliesi fallax was ranked in 'gradual decline' by Hitchmough (2002).

Long-term Recovery Goal

Dense populations (> 12 snails/100 m²) in at least three areas which protect the full range of diversity of *Powelliphanta gilliesi fallax*. Continued existence (albeit at lower numbers than before rats were present) over the full range of the taxon.

Objectives For The Next 10 Years

Objective One

Maintain a number of high-density representative snail populations by sustained predator control.

Explanation

The privately-initiated predator-control programmes at Onekaka and Parapara should be encouraged and supported to maximise the benefit to *Powelliphanta gilliesi fallax*.

The possum-control programme on Parapara Peak should be refined to ensure that as much lowland forest as possible is included in it, and that control techniques take into account the need to control rat numbers.

Actions Required

1. Provide the private landowners who are committed to voluntary predator control for *P. g. fallax* with sufficient rat, possum and hedgehog traps to carry out the work effectively.
2. Establish at least five 100 m² plots to monitor snail numbers in the predator control sites at both Parapara Bush and Onekaka, and an additional four in the Waikoropupu area where predators are not controlled. Regularly releaser all the plots to determine the level of predator control required for effective *P. g. fallax* conservation.
3. Use 1080 poison as the method to control possums, as frequently as the risk of 1080 shyness allows, as this poison also suppresses rat numbers for up to six months.
4. Through consultation, seek to extend the existing aerial possum-control programme at Parapara Peak to cover key privately-owned snail habitat.
5. Reduce possum numbers to low levels (< 3% RTC, preferably <1% RTC) on the north, east and southern flanks of Parapara Peak, and prevent possum numbers rising much beyond those levels.
6. Encourage and facilitate recreational pig hunting in the habitat of *P. g. fallax*.

Objective Two

Understand the genetic diversity within *P. g. fallax*.

Explanation

A better knowledge of the genetic make-up of *P. g. fallax* will ensure that conservation resources are managed to preserve the diversity within the taxon.

Actions Required

1. Collect representative empty shells of *P. g. fallax* from the Onehau, Onekaka and Waikoropupu powerhouse areas and compare their morphology with those from Parapara Bush and with the *P. g. fallax* type snails found on the mid-slopes (about 600 m a.s.l.) of eastern Parapara Peak.
2. Facilitate a study of mitochondrial DNA of all Parapara Peak *Powelliphanta*.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.25 *POWELLIPHANTA* “PARAPARA”

Description

A small to medium snail (maximum diameter 48 mm; height 26 mm). The shell has faint traces of dark narrow spiral stripes on the upper surface, similar to those of *Powelliphanta gilliesi*, but the main impression is of abundant, crowded, irregular brown and green wavy axial stripes over most of the shell. The parietal callus is smooth and dark purplish brown.

Allozyme and morphological data show *Powelliphanta* “Parapara” to be equi-distantly related to the *P. gilliesi* group and to *Powelliphanta* “Anatoki Range”—a high-altitude snail of tussock grasslands found just south of the range of *Powelliphanta* “Parapara”. Snails similar to *Powelliphanta* “Anatoki Range” have been reported within the range of *Powelliphanta* “Parapara” on the alpine summit of Parapara Peak (Peter Jamieson, pers. coll.; and a single specimen marked ‘Parapara Peak’ in the Takaka Museum collection). It is possible that *Powelliphanta* “Parapara” arose from an early cross between *P. gilliesi* and *P. “Anatoki Range”*. However, several intensive searches on the top of Parapara Peak have so far failed to locate any further evidence of *Powelliphanta* “Anatoki Range” presence. Today, *Powelliphanta* “Parapara” seems a highly stable species across a fairly large area with no sign of hybridization where it overlaps with *P. g. fallax*.

Habitat

Powelliphanta “Parapara” is an upland snail, found at 600–900 m a.s.l. under leaf litter in forest of silver beech, southern rata, quintinia and kamahi on calcium-rich soils on a marble substrate.

Distribution

The range of *Powelliphanta* “Parapara” is naturally small, being limited to the high montane southern and eastern slopes of Parapara Peak. It is sympatric with the much larger snails *P. superba superba* and *P. hochstetteri anatokiensis*, and in the lower part of its range, overlaps with the similarly sized snail *P. gilliesi fallax*.

Cause of Decline, and Threats

1. Severe predation by possums since about the 1970s, affecting the entire population.
2. Predation by feral pigs on some populations, and widespread predation of juvenile snails by thrushes and possibly hedgehogs, though the impact of the latter species is likely to be limited.

Past Conservation Efforts

1. Possum-control operations (aerially distributed 1080 poison) carried out by the Department of Conservation in 1995 and 2000 over about 75% of the range of *Powelliphanta* “Parapara”.
2. A 500 m² snail-monitoring plot was set up in 1995 at Cedar Saddle, west of Walker Ridge, and re-measured in 1998. An additional nine 100 m² plots were established on the eastern slopes of Parapara Peak and on Walker Ridge in 2002.

Current Conservation Status

Density of *Powelliphanta* “Parapara” is now low (1.3–2.5 snails/100 m²), and there is little sign of recovery since the first possum knock-down operation (although snail monitoring was probably inadequate to be sure of this).

Powelliphanta “Parapara” was ranked ‘nationally endangered’ by Hitchmough (2002).

Long-term Recovery Goal

A moderately dense (> 6 snails/100 m²) population that is stable or increasing, in most of its naturally small range.

Objectives For The Next 10 Years

Increase population size by sustained predator control.

Explanation

Possums apparently began preying on *Powelliphanta* (all species) on Parapara Peak in the late 1970s, and now they are the primary cause of mortality in *Powelliphanta* “Parapara”.

Feral pigs are uncommon but, along with thrushes, contribute to keeping snail numbers very low.

Actions Required

1. Throughout the habitat of *Powelliphanta* “Parapara”, keep possum numbers steadily very low (< 3% RTC, preferably <1% RTC).
2. Encourage recreational pig hunting within the snail habitat.
3. Establish several more 100 m² snail-monitoring plots on Walker Ridge and releser them two-yearly to assess the effectiveness of the possum-control regime.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.26 *POWELLIPHANTA SUPERBA SUPERBA*

Description

Powelliphanta superba superba has a large (maximum diameter 80 mm; height 40 mm) inflated shell, uniformly yellowish old gold in colour with a smooth, dark brown parietal callus. The body of the snail is a pink-grey colour, with a pale but distinct white frill along the margins of the foot.

Habitat

Lives in high-altitude forests (800–1150 m a.s.l.) on relatively infertile soils. Found under leaf litter, *Gabnia* skirts and bush rice grass and in high-altitude silver and mountain beech forests with quintinia, kamahi, *Dracophyllum townsoni*, southern rata, toro and occasional cedar.

Distribution

In forests on both the western and eastern sides of the Aorere Valley, in Golden Bay. It is found in a few small areas on the Burnett Range, from Mt Higgins to Mt White on the Wakamarama Range, on the southwestern slopes of Mt Olympus, on Cedar Ridge (the type locality) and Brown Cow Ridge on the Haupiri Range, and on the western, southern and northern flanks of Parapara Peak.

Sympatric with smaller *Powelliphanta gilliesi gilliesi*-like snails above Knuckle Hill and in the headwaters of Coal Creek, with *P. g. montana* at Bock Peak, with *P. g. compta* at The Castles, and with *P. g. fallax*, *P. "Parapara"* and the large *P. hochstetteri anatokiensis* on Parapara Peak.

Cause of Decline, and Threats

1. The major cause of the dramatic decline of this taxon has been intensive predation by possums at all sites since at least the 1970s. In the late 1970s, large numbers of empty, possum-damaged shells were conspicuous throughout the range of *Powelliphanta superba superba*. In three shell collections made between 1978 and 1981, 681 shells were collected and 96% of them were recently possum damaged (K.J. Walker, pers. obs.). By 2000, empty shells were much less frequently seen—2 shells/person hour on Parapara Peak and 15 shells/person hour on Bock Peak (G. Napp, pers. comm.), compared to 30 shells/person hour in 1979 (K.J. Walker, pers. obs.). Intensive searches for live snails found very low densities (< 0.3 snails/100 m²). Unfortunately, live snail densities prior to 1970 are unknown, so the full scale of the population decline, presumed from changes in shell numbers and condition, cannot be determined.
2. Forest clearance and fires at the type locality.
3. Predation by thrushes and hedgehogs is also a threat, but the scale of their impact is unknown.

Past Conservation Efforts

1. Possum-control operations (aerially distributed 1080 poison) were under-taken by the Department of Conservation in 1995 and 2000 on Parapara Peak and in 1999 on the mid-Wakamarama Range.

2. A 500 m² snail-monitoring plot was set up in 1995 at Cedar Ridge, and re*measured in 1998. Only one live snail was found in this plot initially, and no snails were found in 1998.
3. Snail density was measured in seven 100 m² plots scattered to the north and south of Bock Peak, Wakamarama Range, in May 1999. In 2001 these were re*measured and a further five 100 m² plots were set up.

Current Conservation Status

Snail density declined dramatically in all colonies between the 1970s and the 1990s, and is now dangerously low (0.3 snails/100 m² at Bock Peak). It is very possible that without specific management action, the smaller populations will disappear within 25 years. *Powelliphanta superba superba* is classified as in 'serious decline' (Hitchmough 2002).

Long-term Recovery Goal

As a minimum goal: maintenance of a large stable population in the two largest colonies, on the southern Wakamarama Range and Parapara Peak, where they co-exist with many other *Powelliphanta* taxa. Preservation of a population at the type locality is also highly desirable.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained predator control.

Explanation

Most potential snail predators are either in low numbers (i.e. thrushes, hedge-hogs) or absent (i.e. rats, pigs) from the high-altitude forests where *Powelliphanta superba superba* lives, and this snail was apparently in good numbers till about the 1960s. Since then, predation by possums has become the prime cause of mortality, and even though possum numbers are relatively low, possums continue to have a major effect on the snail population.

The population of *P. s. superba* on Parapara Peak failed to respond to a reduction in possum numbers in 1995, though snail monitoring was limited to small areas and may have failed to detect pockets of recovery. Snail numbers before possum control had shrunk to less than 1 snail/500 m², and such a density is probably too low for snails to meet easily and breed, especially in the presence of other 'back-ground' causes of enhanced mortality (e.g. drought; predation by weka, thrush, hedgehog).

The present regime at both Parapara and Bock Peaks consists of a single possum-control operation every 6–7 years, with possum numbers rising considerably between knockdowns. If possum numbers are kept **steadily** very low for a long period, the snail population may gradually recover. However, it is probably not safe to assume the taxon will survive without some greater intervention and the best option may be to artificially increase the density of snails at several sites to trigger a more immediate response. This would require research into suitable techniques.

Actions Required

1. Keep possum numbers steadily at very low levels (< 3% RTC, preferably < 1% RTC) in at least two of the main colonies (Parapara Peak and the southern Wakamarama Range).
2. Regularly monitor snail numbers until the effect of the management regime becomes clear.

Objective Two

Improve quality of snail habitat.

Explanation

Deer and feral goats occur in most of the range of *P. s. superba* and low to moderate numbers of pigs live on parts of the Haupiri Range and Parapara Peak. All species degrade the snail habitat and reduce recruitment and survival.

Actions Required

Keep ungulate numbers low in the snail habitat by regular control programmes.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.27 *POWELLIPHANTA SUPERBA RICHARDSONI*

Description

Powelliphanta superba richardsoni is a large snail (maximum diameter 76 mm; height 36 mm), superficially similar in appearance to *P. s. superba*. However, the shapes of their shells differ, with the shell of *P. s. richardsoni* being more depressed than in typical *superba*. The inner whorls of *P. s. richardsoni* are sunken so that the apex barely appears above the outer or last whorl. The ground colour of the shell is old gold, but darker than in typical *superba*, and diffused with narrow, very pale reddish brown axial streaks and olive-coloured axial lines. Genetic studies found this snail quite distinct from neighbouring *P. s. superba* and *P. s. mouatae*.

Habitat

An upland snail, found at 850–1220 m a.s.l. on highly leached, infertile granite soils. *Powelliphanta superba richardsoni* lives under bush rice grass and litter beneath lichen-festooned silver beech forest with an understorey of *Dracophyllum traversi* and kapuka.

Distribution

Found from about Mt Perry to Kaka Saddle on the north end of the Goulund Range in Kahurangi National Park.

Cause of Decline, and Threats

1. Burning of about 50% of the snail's habitat from the 1860s to the 1880s during exploration and attempts at pastoralism.
2. Intense predation by possums at all sites since at least the 1970s.

Past Conservation Efforts

1. The Department of Conservation carried out possum control (aerially delivered 1080) over the whole range of the snail in 1995.
2. Establishment of a 500 m² plot to monitor snail density in 1995 and re-measurement in 1998 and 2000. A further five 100 m² plots were established in 2000.

Current Conservation Status

Powelliphanta superba richardsoni is in a poor state, with densities of live snails very low (0.7 snails/100 m²) and no sign yet of recovery following initial possum control operations. It was ranked 'nationally endangered' by Hitchmough (2002).

Long-term Recovery Goal

A moderately dense (> 12 snails/100 m²) population that is stable or increasing throughout the range of *P. s. richardsoni*.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained predator control.

Actions Required

Keep possum numbers steadily low (< 3% RTC, preferably < 1% RTC), throughout the range of the snail.

Objective Two

Determine population trends.

Actions Required

1. Increase the geographic spread and number of snail-monitoring plots. Establish eight to ten new 100 m² plots in sites representing the full range of *P. s. richardsoni* habitat.
2. Releaser the snail plots annually until population trends and the impacts of predator control are clear.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.28 *POWELLIPHANTA SUPERBA HARVEYI*

Description

A handsome subspecies with conspicuous broad axial streaks in reddish brown upon a yellowish brown glossy shell. The parietal callus is brown and sparsely but distinctly granulated. The spire is almost flat, with the sutural area deeply sunken (Powell 1979). It is a large snail, with a maximum diameter of 64 mm and height of 31 mm.

Habitat

Powelliphanta superba harveyi is an upland snail occurring at about 762 m a.s.l. under moss and *Gabnia* in stunted forest of mountain beech, pahautea, tanekaha and yellow-silver pine, and also under the skirts of red tussock in boggy clearings. The granite soils are highly leached and infertile, and the topography a gently undulating peneplain.

Distribution

This snail has a naturally limited range on the MacKay Downs, northwest of Heaphy River in Kahurangi National Park.

Cause of Decline, and Threats

1. Severe predation by possums since the late 1970s.
2. Loss of some forest and habitat degradation caused by fire and sheep grazing in the late 1890s.

Past Conservation Efforts

1. In 1994 a 500 m² snail-monitoring plot was established, and the numbers of live snails present was re-measured in 1996.
2. In 1993/94 a ground-based possum-control operation (traps and cyanide) was carried out over much of the range of *Powelliphanta superba harveyi*. Hand-laid 1080 poison was applied over much the same area in 1995, and possum numbers were monitored in 1996. In 1999 an aerial 1080 operation over all the Mackay Downs reduced possum numbers to 0.3% RTC.

Current Conservation Status

Powelliphanta superba harveyi was classified as 'nationally endangered' by Hitchmough (2002). Despite some possum control, snail numbers were still very low when last checked in 1996 (0.5 snails/100 m²), and the long-term survival of the subspecies is uncertain.

Long-term Recovery Goal

A moderately dense (> 12 snails/100 m²) population of *Powelliphanta superba harveyi* that is stable or increasing throughout most of its natural range.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained predator control.

Explanation

Although possum numbers are low in these infertile forests (3% RTC before possum control began in 1993), possums seem to be driving this snail to extinction. Large numbers of empty possum-damaged shells were visible on the MacKay Downs in early 1980s, but today both shells and live snails are rare.

Actions Required

1. Keep possum numbers steadily below 1% RTC over most of the range of *Powelliphanta superba harveyi* (including in the immediate vicinity of the Heaphy Track to ensure trampers have a chance to see snails) through regular control operations.
2. Regularly monitor possum density until the relationship between possum and snail numbers is better understood.

Objective Two

Determine population trends of *P. s. harveyi*.

Explanation

The existing single snail-sampling plot is too small and the population density too low to yield valid data about population trends. More monitoring plots are required, and they need to be spread to sample a wider area.

Actions Required

1. Establish at least ten to fifteen 100 m² snail-monitoring plots throughout the snail habitat.
2. Releaser both the existing and new plots two-yearly until the population trends are clear; thereafter as frequently as required to assess the impact of pest control measures.

Responsibility

Buller Area Office, West Coast Conservancy.

3.29 *POWELLIPHANTA SUPERBA MOUATAE*

Description

Powelliphanta superba mouatae is of medium size (maximum diameter 62 mm; height 36 mm) and the shell is a plain, cinnamon brown colour, with a few irregular axial streaks of darker brown. The whole shell appears glossy, and the parietal callus is dark brown and quite smooth.

Habitat

Lives under litter in high-altitude (600–900 m a.s.l.) silver and mountain beech forest with occasional cedar and southern rata; less frequently found under red tussock skirts in boggy clearings within the forest.

Distribution

Powelliphanta superba mouatae has a naturally limited distribution of less than 1200 ha in the headwaters of the Saxon River on the Goulund Downs, Kahurangi National Park. The range of this subspecies abuts that of *P. s. superba* on the northern slopes of the Slate Range, and that of *P. s. harveyi* west of Mt Teddy. *Powelliphanta superba mouatae* is sympatric with the smaller snail *P. gilliesi jamesoni* on the lower southern and western slopes of the Slate Range.

Cause of Decline, and Threats

1. Severe predation by possums since the late 1970s. In the 1980s large numbers of empty damaged shells were conspicuous throughout the range of *Powelliphanta superba mouatae*. The cause of death for the great majority of these snails was predation by possums, which had probably reached high numbers in the area only in the late 1960s. By 2000, empty shells were seldom seen and intensive live snail searches found very low densities of live snails. Unfortunately live snail densities before the possum invasion in the 1960–70s are unknown, so the full scale of the population decline, presumed from changes in shell numbers and condition, cannot be determined.
2. Loss of some forest habitat to fire and sheep grazing in the late 1890s.

Past Conservation Efforts

1. In 1994, an aerial 1080 poison operation to control possum numbers over the entire range of *Powelliphanta superba mouatae*. Annual possum control using feratox and traps has been undertaken over 100 ha of habitat in the Saxon River headwaters since 2000.
2. A 300 m² plot to monitor snail density was established in 1991 and a second 400 m² plot was set up in 1994. The number of live snails in these plots was re-measured in 1994, 1996 and 1999. A further six 100 m² plots were set up in 2000/01.

Current Conservation Status

Ranked as 'nationally endangered' (Hitchmough 2002), with snail numbers everywhere now being very low (1.1 snails/100 m²). No recovery has yet been detected following the start of predator control. It is unclear whether *Powelliphanta superba mouatae* can persist, at very low densities, or whether it is headed for extinction in the medium term (about 50 years).

Long-term Recovery Goal

A moderately dense population (> 12 snails/100 m²) over most of the snail's range.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained predator control.

Explanation

Most of the usual introduced predators of *Powelliphanta* are either absent (pigs) or rare (rats and hedgehogs) in the high-altitude forests where *Powelliphanta superba mouatae* occurs. However possums, though rare (11.1% RTC in 1994 before the first possum control operation; 1% RTC in 1995, but about 5.5% RTC by 1999), seem to be driving this snail to extinction.

The forests in the headwaters of the Saxon River contain limited numbers of plant species which possums find palatable. For this reason snails may be an important component of the possum diet, and may be sought out even when scarce. The gradual increase of possum numbers after each possum control operation exacerbates this problem.

Actions Required

1. In most of the habitat of *P. s. mouatae*, keep possum numbers steadily below 1% RTC (i.e. to barely detectable levels) through regular control operations.
2. Regularly rotate possum control methods (cyanide and 1080 poisons, and trapping) to avoid shyness.
3. Due to the presence of great spotted kiwi and weka in the Saxon headwaters, set all traps and bait stations at least 1.5 m above the ground.
4. Establish five more 100 m² snail-monitoring plots throughout the possum control area, and measure the snail density two-yearly in these and the existing two larger plots.

Objective Two

Artificially increase snail density to trigger a population recovery.

Explanation

There is some evidence that the lack of response by *P. s. mouatae* and most other *P. superba* subspecies to lower possum numbers is a result of the very low densities to which the snails have been reduced. The snails are now so sparse that they probably meet and mate only rarely, and thus have a low productivity. As a result, even at very low possum densities, the rate of predation by possums may exceed snail productivity.

Population density should be experimentally increased in a small area, while keeping possum numbers steadily very low. Snail population size and structure should be regularly measured in both the area of enhanced snail density and that of low snail density. This detailed study of *P. s. mouatae* could provide information useful for other less accessible *P. superba* subspecies.

Actions Required

1. Erect several 500 m² snail-proof enclosures in good snail habitat in the Saxon River headwaters.
2. Collect up to 30 adult *P. s. mouatae* from the near each enclosure; measure and number each snail and place it inside the enclosure.
3. Keep possum numbers around the enclosures very low (through Objective One).
4. Annually assess live snails for size and health inside the enclosures and compare the density data with that from the standard monitoring plots described in Objective One, Action 4.

Responsibility

Golden Bay Area Office, Nelson/Marlborough Conservancy.

3.30 *POWELLIPHANTA SUPERBA PROUSEORUM*

Description

The largest *Powelliphanta* is *P. superba prouseorum* which measures a gigantic 90 mm across (height 40 mm). The fist-sized snail weighs over 90 g, about the same as a tui. It has an old-gold coloured shell, with a finely granulated, purplish brown parietal callus. The granulated callus and larger size is the feature which best distinguishes it from the similarly coloured *P. s. superba*. There is substantial morphological variation within *P. s. prouseorum*; for example, snails just north of the Heaphy River mouth are only half the usual size (maximum diameter 65 mm). Along the eastern edge of its range *P. s. prouseorum* meets and overlaps the range of *P. s. harveyi*.

Habitat

A mid- to high-altitude (450–610 m a.s.l.) snail, usually found under litter and *Gabnia* clumps in forest of southern rata, quintinia and mountain beech. Also under red tussock in boggy clearings amid mountain beech and bog-pine scrub. *Powelliphanta superba prouseorum* mostly occurs on highly leached and impoverished granite soils.

Distribution

Between the Anaweka and Heaphy Rivers, along the western flanks of the MacKay Downs and the Iwituaroa Range in northwestern Kahurangi National Park.

Cause of Decline, and Threats

Since the late 1970s, intensive predation by possums.

Past Conservation Efforts

So far there have been no efforts towards conservation of *Powelliphanta superba prouseorum*.

Current Conservation Status

Powelliphanta superba prouseorum is classified as 'nationally endangered' (Hitchmough 2002), having high levels of pest-induced mortality, low numbers throughout its range and no restorative management programme yet in place.

Long-term Recovery Goal

A moderately dense (> 12 snails/100 m²) population that is stable or increasing over most of its natural range.

Objectives For The Next 10 Years

Objective One

Determine population size.

Explanation

The distribution and density of *Powelliphanta superba prouseorum* is poorly known because of the comparatively remote nature of its habitat. As with other upland *P. superba* snails in the Heaphy area, gaining information on population trends is likely to be a slow process due to the difficulties of meaningful monitoring when population numbers are so low.

Actions Required

1. Undertake walk-through transects in specific areas, collecting all shells found in timed searches. Identify cause of death for all fresh shells found.
2. Once the snail's distribution is better understood, establish at least fifteen 100 m² snail plots across the core snail habitat. Monitor plots every two years until population trends and the impact of conservation measures are clear.

Objective Two

Increase population size by sustained pest control.

Explanation

Possums were first seen at Kahurangi Point in 1959, and their spread at first was apparently slow. In the 1960's there was little sign of snail predation by possums, with 34 intact shells and one possum-damaged shell found by F. Climo in the mid-upper Kahurangi River in 1964 (Museum of New Zealand collection). Les Pracy trapped only four possums in the Heaphy Valley in the early 1970s. However, by 1980 the situation had changed dramatically, with 76% of 80 shells found in the upper Kahurangi River damaged by possums, and by 1988, though many possum-damaged shells were found, it took over 6 person hours to find one small live snail (K.J. Walker & G.P. Elliott, pers. obs). In 1999 a walk across the middle of the snail's range, from Rocks Point to the top of the MacKay Downs, yielded only three *P. s. prouseorum* shells (G. Napp, pers. comm.).

Since 1994, possum numbers have gradually been lowered in all the adjacent forests and tussocklands, and to prevent re-invasion of those lands, as well as to protect *P.s. prouseorum*, the possum control programme should be expanded to include all *P.s. prouseorum* habitat.

Actions Required

1. Keep possum numbers steadily low (< 1% RTC).
2. Monitor possum numbers prior to control operations, to determine the correlation between possum density and any snail recovery.

Responsibility

Buller Area Office, West Coast Conservancy.

3.31 *POWELLIPHANTA SUPERBA* “GUNNER RIVER”

Description

A medium- to large-sized snail (maximum diameter 61 mm; height 28 mm) with a finely granulated tan parietal callus. The shell is also tan, lighter on the top than on the bottom, and completely covered in reddish brown, yellow and tan axial streaks.

There is substantial variability within the taxon, with the shells of lowland populations being larger (up to 67 mm diameter), darker and more uniform in colour than those in the high-altitude colonies. The lowland populations have a smooth parietal callus.

The snail was first discovered in 1982 (Walker 1982b) during a survey of the distribution of *Powelliphanta annectens*, and has yet to be formally described. It is very likely that the lowland and upland Gunner River snails should be considered as two new subspecies of *P. superba* rather than as one.

Habitat

Under moss and litter in high-altitude (914 m a.s.l.) forests of silver beech on limestone and in mountain beech forests (and occasionally under red tussock) on granite soils; and under litter in low-altitude (30–305 m a.s.l.) silver beech and northern rata forest on karst landforms, and in nikau forest on alluvial river flats.

Distribution

On the northeastern flanks of the Gunner Downs in the headwaters of the Gunner River; and on limestone plateaux on either side of Gunner River near its confluence with the Heaphy River in Kahurangi National Park. On the northern side of the lower Gunner River, it is sympatric with another undescribed snail, *Powelliphanta gilliesi* “Heaphy”.

Cause of Decline, and Threats

1. Intensive predation by possums since the late 1970s.
2. Predation by rats and song thrushes in the lowland colonies.

Past Conservation Efforts

1. A 500 m² density-monitoring plot was established in 1994 in the low-altitude population near the Heaphy River.
2. Possum numbers were reduced over much of the low-altitude and some of the high-altitude habitat of *P. superba* “Gunner River” by aerially delivered 1080 poison in 1993/4, with follow-up ground control in 1996/7 beside the lower Heaphy and Gunner Rivers.
3. Possum control was carried out in the northern end of the snail’s range between Ryans Creek and the Heaphy River using aerially delivered 1080 in 1999, and on the lower Heaphy River flats using ground trapping in 2000.

Current Conservation Status

Powelliphanta superba “Gunner River” is classified as ‘nationally endangered’ (Hitchmough 2002).

Long-term Recovery Goal

A moderately dense (>12 snails/100 m²) population that is stable or increasing, of both the lowland and upland forms of *Powelliphanta superba* “Gunner River”.

Objectives For The Next 10 Years

Objective One

Determine population size and conservation status.

Explanation

The remote and rugged nature of the habitat of *Powelliphanta superba* “Gunner River” is the cause of its late discovery and poorly known status. Some limited possum predation was apparent in the upland colony in 1982, but it has almost certainly increased greatly since then, as it did for every other population of *P. superba* in the Heaphy area in the 1980s and 1990s. More information on the status of upland *P. superba* “Gunner River”, and on the location of the northeastern boundaries of both the upland and lowland populations, is needed to guide conservation management activities.

Actions Required

1. Survey the distribution of *P. superba* “Gunner River” in the forests on the northern and southeastern flanks of Charlies Flag and Mt Ross by walk-through transects, collecting all shells found in timed searches. Identify cause of death for all fresh shells collected.
2. Establish fifteen 100 m² snail-monitoring plots in accessible sites to collect data representative of the full range of the upland populations, and a further ten 100 m² plots in the lowland colonies. Monitor plots every two years until population trends and the impact of conservation measures are clear.

Objective Two

Increase population size by sustained predator control.

Actions Required

1. Keep possum numbers steadily at very low levels (< 3% RTC, preferably < 1% RTC) in the low-altitude colonies and, depending on the outcome of Objective One, also in the high-altitude population. Select possum-control techniques for the low-altitude colonies which also kill rats (1080, fercol).
2. Monitor possum and rat density before each control operation and monitor snail density plots regularly to establish the nature of the relationship between pest density and snail health.

Objective Three

Determine the taxonomic status of the Gunner River snails.

Actions Required

1. Facilitate a study of the genetic distinctiveness of the Gunner River snails (both lowland and upland forms) and the relationship between the Gunner River snails and *P. superba* and *P. annectens*.
2. If appropriate, describe and name the Gunner River *Powelliphanta*.

Objective Four

Improve quality of the habitat of lowland *P. superba* "Gunner River".

Explanation

Moderate to high deer numbers in the lower Heaphy River Valley have caused a thinning of the understorey and forest floor, allowing thrushes to find and kill large numbers of juvenile *P. superba* "Gunner River". Around the 1980s a (presumably natural) wide-spread die-off of beech trees in the terraces above the lower Heaphy River caused forest collapse, and a substantial deer population is inhibiting their recovery.

Actions Required

Reduce deer numbers on the limestone plateaux and river flats in the lower Gunner River and Heaphy River valleys.

Responsibility

Buller Area Office, West Coast Conservancy.

3.32 *POWELLIPHANTA ANNECTENS*

Description

Powelliphanta annectens is a very large snail (maximum diameter 85 mm; height 38 mm) with a deep purple parietal callus, thickly crowded with large granules. The top third of the shell has a matt appearance because it is densely sculptured with fine spiral striae, but the remainder of the shell is glossy. The background colour of the shell is reddish brown, striped with close, narrow axial streaks of claret brown, sepia and black. The black foot has a white frill around the edge; the only *Powelliphanta* to be decorated so, although a faint trace of a frill is seen on *P. superba* (K.J. Walker, pers. obs.). In the northern part of its range, *P. annectens* merges in a clinal fashion on Bellbird Ridge with the undescribed upland snail *P. superba* "Gunner River", and overlaps at the Heaphy Hut with the distinctive lowland form of *P. superba* "Gunner River".

Habitat

The densest populations of *Powelliphanta annectens* are: in silver beech forest at high altitudes (between 610 m and 975 m a.s.l.) on granite soils; on alluvial soils on limestone substrate in silver and red beech forest with occasional rimu at 150–245 m a.s.l., and in nikau forests on alluvial soils on coastal flats at the mouths of small creeks just above sea level. *Powelliphanta annectens* also lives in low to very low densities in the mid-altitude forest of kamahi, quintinia, rimu and southern rata found between the areas of high snail density.

Distribution

Powelliphanta annectens occurs in a narrow band beside the lower and middle Oparara River, on the plateau west of the Oparara River, and on the western flanks of the Gunner Downs between the Kohaihai River and Bellbird Ridge. There are three small outlying populations of uncertain status: one on the northern end of the Stormy Range, one on the eastern slopes of the Fenian Range above the mid-reaches of the Ugly River, and one on both sides of the Karamea River near its junction with Fuschia Creek.

Cause of Decline, and Threats

1. Possum predation since the 1970s on all populations, with particularly severe impacts in the high-altitude snail colonies.
2. Logging of a large proportion of the snail's habitat in the Oparara Valley in the 1980s, followed by fires in the remnant vegetation and replanting with exotic species.
3. Predation by rats in all the low-altitude colonies, and by thrushes particularly along tracks and roads and in open areas.

Past Conservation Efforts

1. Comprehensive survey in 1982 of the distribution and density of *Powelliphanta annectens* (Walker 1982b) as part of the New Zealand Wildlife Service submission to the New Zealand Forest Service, seeking a halt to the Oparara logging.

2. A 500 m² plot to monitor *P. annectens* density at the Heaphy River mouth was established in 1994 and re-measured in 1996, 2000 and 2002. A further three 100 m² plots were established there and on Bellbird Ridge in 2000, and in 2002, three more were added on Bellbird Ridge.
3. Possums were trapped and poisoned in a narrow band of coastal forest between the Kohaihai and Heaphy Rivers in 1993/4 and over a small area around the Heaphy Hut in 1996/7, largely for northern rata protection. Possums were poisoned (aerially delivered 1080) on the western flanks of the Gunner Downs between the Bellbird Ridge and Katipo Stream in 1993/4, and in 1999.

Current Conservation Status

Powelliphanta annectens was ranked in 'serious decline' by Hitchmough (2002). Its conservation status varies considerably across its range, with small localised populations at the mouths of the Swan Burn and Heaphy River having relatively high numbers in 2002 (24 snails/100 m²), the upland populations in low numbers (3.5 snails/100 m²), and the populations at the Oparara Arches being somewhere between.

Long-term Recovery Goal

Stable or increasing snail populations representative of the full range of genetic and morphological diversity in *Powelliphanta annectens*.

Objectives For The Next 10 Years

Objective One

Determine the population trends in both low-altitude and upland populations of *Powelliphanta annectens*.

Explanation

Unfortunately, the monitoring plots at the Heaphy River mouth are measuring a somewhat atypical *P. annectens* colony, where rats rather than possums are the major cause of mortality. Additional information on population trends in the high-altitude snail colonies and in the Oparara Valley and Plateau is urgently required.

Actions Required

1. Establish at least five 100 m² plots on the ridges between Katipo Creek and the Swan Burn at 760–1000 m a.s.l.; five 100 m² plots between Little Arch and the Top Arch in the Oparara Valley; two 100 m² plots on the Oparara Plateau, and one 100 m² plot near the quarry where the Oparara River emerges from the hills.
2. Measure snail numbers in the new plots every two years until the population trends in the different environments are apparent.

Objective Two

Increase population size by sustained predator control.

Actions Required

1. Keep possum numbers steadily below 3% RTC (preferably < 1% RTC) on the western flanks of the Gunner Downs and in the Oparara Valley.
2. Rotate possum control methods, and in lowland sites use methods which also kill rats.
3. Monitor possum numbers regularly, including prior to control operations to allow information to be gathered on the relationship between pest numbers and snail health.

Objective Three

Increase population size by increasing the area of snail habitat available.

Actions Required

After the first crop of exotic trees is harvested from the Oparara Valley, allow the native forest to regenerate rather than replanting with exotic plantation species, and legally protect the land from future logging.

Responsibility

Buller Area Office, West Coast Conservancy.

3.33 *POWELLIPHANTA LIGNARIA LIGNARIA*

Description

A medium-sized snail (maximum diameter 65 mm; height 39 mm) with a beautiful, very distinctive shell. The base is glossy and has a yellowish ground colour while the top has a reddish ground colour and is minutely spirally sculptured so that it appears matt. The colour division occurs sharply, just above the periphery and coincides with the outer extremity of the spiral sculpture. The whole shell is covered with axial stripes of dark reddish brown to almost black. These stripes tend to be narrow so that much of the ground colour shows through.

Habitat

Under litter and logs in dense, low-altitude rain forest of beech, northern rata, rimu, supplejack and kiekie. The substrate is calcium-rich, formed largely on limestone, although a small part of the snail's range is on a sandstone basement.

Distribution

Found just north of the Mokihinui River mouth, between the Karamea Bluffs Road and the coast, with the snail's northern boundary being the ridge between Kongahu Point and the saddle between Carlins Flat and Corbyvale.

Cause of Decline, and Threats

1. Predation by rats and possums, and to a much lesser extent thrushes and probably hedgehogs.
2. Podocarps were logged from almost 50% of the forest habitat of *Powelliphanta lignaria lignaria* in the early 1900s, but this caused only a temporary loss of snail habitat as fortunately much of the logged area was left to regenerate. Conversion to pasture occurred in the headwaters of Six Mile Creek (Carlins Flat), around Stillwater and Mumm Creeks and on the coast south of Gentle Annie Point, causing the loss of between 5% and 10% of the forest habitat of *P. l. lignaria*.

Past Conservation Efforts

1. Ground-based and, subsequently, aerial 1080 possum control for TB protection by the West Coast Regional Council over at least 50% of the range of *P. l. lignaria* in 1994/95 would have incidentally helped *P. l. lignaria*. The Department of Conservation carried out limited ground control of possums in 1997 between the Karamea Bluffs and Six Mile Creek, reducing possum numbers from 18.5% RTC to 5% RTC. It also carried out an aerial 1080 operation in the northern end of the snail habitat in 2000, while the West Coast Regional Council carried out ground control along the southern boundaries.
2. A 500 m² plot established on the Karamea Bluffs in 1994 to monitor live snail density was re-measured in 2000 and 2002, and an additional six 100 m² plots were established at Sawyer and Six Mile Creeks in 2000.

Current Conservation Status

Until the late 1980s *Powelliphanta lignaria lignaria* was considered relatively secure as the snails were still present in about 85% of the original 5400 ha range, and only rats seemed to be having a significant impact on the snail population.

However, in the early 1990s, predation of *P. l. lignaria* by possums began, and live snail numbers were found to be much lower (2.7 snails/100 m² in 2000) than originally thought. Because of the patchwork of land ownership, comprehensive and consistent reduction in possum numbers over the snail's range has been difficult to achieve. *Powelliphanta lignaria lignaria* is now ranked as 'vulnerable' (Hitchmough 2002).

Long-term Recovery Goal

A stable, dense (> 12 snails/100 m²) population of *Powelliphanta lignaria lignaria* over most of its naturally small range.

Objectives For The Next 10 Years

Objective One

Increase population density by sustained predator control.

Explanation

Given the area of habitat available, it is likely that the snail population could survive, albeit at substantially reduced densities, if rats were the only significant predator. Unfortunately predation by possums, by itself, can cause snail populations to collapse, and when it is combined with predation by rats, is cause for considerable concern.

Hedgehogs are a potential problem for *Powelliphanta lignaria lignaria*. Their presence in wet forests was, until recently, unsuspected and their potential impact probably underestimated. However, hedgehogs, like thrushes, can attack only juvenile *P. l. lignaria* so their effect is probably much less than that of possums and rats.

Actions Required

1. Keep possum numbers consistently low (< 3% RTC, preferably < 1% RTC) over the full range of *P. l. lignaria*. Regularly alternate traditional methods of possum control (cyanide and trapping) with use of 1080 poison, as this poison will also significantly reduce rat numbers for up to six months. Use 1080 in any winter that follows a beech mast summer when rat numbers will be particularly high.
2. Establish at least ten 100 m² snail-monitoring plots throughout the snail's range, and releser snail density within the plots every 2-3 years.

Objective Two

Increase size of snail population by habitat protection and enhancement.

Actions Required

1. Pursue the protection of privately-owned habitat of *P. l. lignaria* through purchase by the Crown or arranging private covenants.
2. Encourage restoration of forest margins by fencing to exclude stock.

Responsibility

Buller Area Office, West Coast Conservancy.

3.34 *POWELLIPHANTA LIGNARIA LUSCA*

Description

Powelliphanta lignaria lusca is a medium-sized snail (maximum diameter 58 mm; height 35 mm) with a solid, heavily calcified shell. The shell is similar to, but readily distinguished from, that of *P. l. lignaria*. The ground colour of the shell is reddish brown and the whole shell is covered with dark reddish brown to black axial stripes. The base of the shell is glossy, but above the periphery minute spiral sculpturing gives the surface a matt appearance. The parietal callus is white and smooth.

Habitat

A lowland species, found on calcium-rich limestone soils from sea level to 30 m a.s.l. *Powelliphanta lignaria lusca* lives under bush rice grass and litter in forests of rimu, miro, silver and red beech, kamahi and toro, often with an understorey of tree ferns. Though snails occur in hard beech forest on drier ridges, the highest snail numbers are found on fertile alluvial soils in moist river valleys.

Distribution

From the mouth of Little Wanganui River to Kongahu Point, and inland to State Highway 67 on the Karamea Bluffs, North Westland.

Cause of Decline, and Threats

1. Predation by rats and, since the 1980s, possums; to a much lesser extent, predation by thrushes and probably hedgehogs.
2. Conversion of the snail's forest habitat into pasture at Corbyvale, at the mouths of Glasseye Creek and Falls Creek and from there, along a narrow coastal strip to Kongahu Point.
3. About 50% of the habitat of *P. l. lusca* is privately owned, and there is an on-going threat of further forest logging and conversion to pasture.
4. Construction of a highway through prime snail habitat around Happy Valley Saddle has led to locally high mortality (road kill).

Past Conservation Efforts

1. A walk-through survey of snail presence between Lake Hanlon and the road bridge over Glasseye Creek was carried out in 1986.
2. A possum-control operation over much of the habitat of *Powelliphanta lignaria lusca* was carried out by the West Coast Regional Council for TB control in 1993/94 and an aerial 1080 operation over the eastern edges of the block in 1998. In 2000 the Department of Conservation carried out an aerial 1080 operation over the southern end of the snail habitat.
3. A 500 m² plot to measure live snail density was established at Lake Hanlon in 1994 and another at Happy Valley Saddle in 1995 (re*measured in 2000). An additional 100 m² plots were set up at the mouth of Glasseye Creek and three more below Glasseye Creek bridge in the summer of 2000.

Current Conservation Status

The average density of *Powelliphanta lignaria lusca* is moderate to low, at 2.7 snails/100 m². However, the status of the populations varies greatly, with a few colonies near the coast suffering very little predation and in high numbers (7 snails/100 m²), those at Happy Valley in moderate health (2.8 snails/100 m²) and those at Lake Hanlon almost extinct (< 0.01 snails/100 m²). The subspecies was ranked as 'vulnerable' by Hitchmough (2002).

Long-term Recovery Goal

A dense (> 12 snails/100 m²) population of *Powelliphanta lignaria lusca* that is stable or increasing over most of its natural range.

Objectives For The Next 10 Years

Objective One

Increase population density by sustained predator control.

Actions Required

1. Keep possum numbers steadily low (< 3% RTC, preferably <1% RTC) over the full range of *Powelliphanta lignaria lusca*. Regularly alternate traditional methods of possum control (cyanide and trapping) with use of 1080 and feracol poisons, as these will also reduce rat numbers. Use 1080 in any winter that follows a summer of heavy beech seeding when rat numbers will be particularly high.
2. Increase the number and geographic spread of snail-monitoring plots. Measure live snail density every two years until the impact of pest-control measures and snail population trends are clear. Monitor possum and rat density prior to each control operation to determine the relationship between pest-mammal density and snail health in this environment.

Objective Two

Improve quality and quantity of snail habitat.

Actions Required

1. Negotiate legal protection of the forests in privately-owned snail habitat near Corbyvale and Little Wanganui.
2. Encourage restoration of forest margins by fencing to exclude stock from the snail habitat.
3. Keep deer numbers low to allow regeneration of a dense forest understorey, to protect the snails from predation by weka and thrushes.

Responsibility

Buller Area Office, West Coast Conservancy.

3.35 *POWELLIPHANTA LIGNARIA OCONNORI*

Description

A medium to large snail (maximum diameter 52 mm; height 42 mm) with a smooth, bluish white parietal callus. At the type locality in the Leslie Valley, the background colour of the shell is a warm cinnamon brown. Very fine, narrow, reddish brown to black spiral lines cover the whole shell, and these are overlaid by a smaller number of irregular diffused dark brown to black axial stripes.

The shells of snails to the east of Leslie Valley have an orange-brown background and only a few sparse black axial stripes. In the western snail populations the axial stripes are abundant and the shell appears much darker.

Habitat

Powelliphanta lignaria oconnori is a low- to mid-altitude snail, mostly living at 335–488 m a.s.l., but also occurring down to 180 m a.s.l. and up to 900 m a.s.l. It is found almost exclusively on calcium-rich mudstone and limestone substrates. It lives under litter in red and silver beech forest, and also on alluvial flats in forests of matai, kahikatea, totara and rimu.

Distribution

This snail is known from two separate localities in the lower and middle reaches of the Karamea River in Kahurangi National Park. It is found around the lower reaches of Kakapo River and at Paryphanta Saddle near the Karamea Gorge, and on limestone talus slopes and alluvial terraces beside the middle reaches of the Karamea River between the Leslie and Crow Rivers.

It is possible that the two populations are contiguous, with snails occurring on the true left of the Karamea River on the footslopes of Garabaldi Plateau. A small population is already known to exist on the true right of the Karamea River near its junction with the Roaring Lion.

The distribution of *Powelliphanta lignaria oconnori* is closely correlated with the distribution of limestone in the area.

Cause of Decline, and Threats

1. Predation by rats and thrushes in all colonies.
2. Since about 1990, predation by possums on some of the snail populations in both the Leslie and Kakapo Valleys. The extension of predation by possums into all colonies is a threat.
3. Probably increased predation by weka, made possible by deer – and in the upper Karamea goat – induced thinning of the forest understorey.

Current Conservation Status

Powelliphanta lignaria oconnori was ranked 'vulnerable' by Hitchmough (2002) because, relative to other *Powelliphanta*, it has a wide distribution, has two separate populations, and snail numbers are moderate despite significant predation by rats in the colonies in podocarp forests. However, possums also began to prey on some snail colonies in both populations in the early 1990s, putting the populations at greater risk.

The average density of *P. l. oconnori* in 2000 was moderate, at 4.1 snails/100 m². However, the status of the populations varies widely; a few small sites suffer very little predation and are in very high numbers (20–30 snails/100 m²), while most are in moderate numbers and a few are in very low numbers (0.6 snails/100 m²).

Past Conservation Efforts

A single 500 m² snail density-monitoring plot was established in each snail population in the mid-1990s, and re-measured in 2000. An additional twelve 100 m² plots were established near Karamea Bend and Wilkinson Creek in 2000.

Long-term Recovery Goal

Dense (> 15 snails/100 m²) and stable or increasing snail colonies in both the Kakapo and mid-Karamea populations of *Powelliphanta lignaria oconnori*.

Objectives For The Next 10 Years

Objective One

Increase snail numbers by predator control.

Explanation

Possoms have only recently turned to eating *Powelliphanta lignaria oconnori* snails, so snail density is still moderate and populations may be capable of relatively rapid recovery with possum control alone. From experience elsewhere, for best effect it is important to begin possum control early, before snail populations become too sparse to respond.

Possum numbers should be reduced over most of the range of this snail to decrease predation in presently affected populations and to decrease the likelihood of predation starting in other snail colonies. If possum populations are kept below the carrying capacity of the vegetation, it is possible that predation of snails may never occur.

While about 50% of snail deaths are caused by possums, in heavy podocarp fruiting years rats account for a further 25%, and in the areas selected for possum control, rat numbers should be also kept low.

Actions Required

1. Keep possum density steadily below 3% RTC, preferably under 1% RTC, within the core snail areas.
2. Choose possum-control techniques and strategies which are also effective in controlling rat numbers (1080, feracol), particularly in the winters following heavy beech or podocarp seeding.
3. On the river flats between the mid-Leslie River and the junction of the Crow and Karamea Rivers, where podocarps predominate and rat numbers reach high densities, keep rat numbers low through poison-baiting or trapping programmes at six-monthly intervals in the periods between the (less frequent) possum control operations.

Rat control here will make snails more visible in an area heavily used by recreationalists; will increase the productivity and survival of birds such as kaka, parakeet and robin which breed in the podocarp forest, and will allow better regeneration of these significant stands of lowland forest as less seed will be destroyed by rats.

Objective Two

Determine population trends of *P. l. oconnori*.

Actions Required

Increase the number and geographic spread of snail-monitoring plots in the Kakapo Valley, and re-evaluate these and the existing plots in the upper Karamea regularly until the impact of predator control measures is clear.

Objective Three

Improve snail recruitment and survival by improving habitat quality.

Explanation

The sunny limestone bluffs beside the Karamea River provide good goat habitat, and goats and deer are reasonably common throughout the snail's range. However, goat- and deer-induced thinning of the forest understorey is probably increasing predation by weka and thrushes on *P. l. oconnori*.

Actions Required

Keep numbers of feral goats and deer low within the snail habitat.

Objective Four

Define more accurately the distribution of *P. l. oconnori*.

Actions Required

1. Systematically survey for *P. l. oconnori* in the headwaters and on the true right of the Leslie River; on the true left of the Karamea River between Karamea Bend and Karamea Gorge, and around the margins of the Kakapo Valley population.
2. Carry out timed searches for shells during the distribution survey and examine all shells found for cause of death to determine the status of the boundary snail populations.

Responsibility

Karamea-Leslie: Motueka Area Office, Nelson/Marlborough Conservancy.

Kakapo Valley: Buller Area Office, West Coast Conservancy.

3.36 *POWELLIPHANTA LIGNARIA RUFORADIATA*

Description

A snail with a medium-large (maximum diameter 58 mm; height 29 mm) inflated shell having irregular, dark reddish brown axial streaks on a khaki background. The parietal callus is smooth.

Habitat

Low- to mid-altitude (150–400 m a.s.l.) forests on fertile soils; the largest populations (and biggest individuals) occur on calcium-rich limestone and mudstone substrates. Found under leaf litter and bush rice grass in beech forest.

Distribution

On the lower slopes of Maori Gully (type), with smaller populations on river terraces on the north side of Mokihinui River near the Mokihinui Forks.

Powelliphanta lignaria ruforadiata on the floodplains between Sinclair Creek and the Hemphill River mouth show signs of hybridization with the snail of the south Mokihinui River, *P. l. unicolorata*. These two taxa have probably been brought into contact during major flood events on the Mokihinui River.

The north and south branches of the Mokihinui River drain large wet catchments, but all the water gathered must pass through the long, narrow bottleneck of the Mokihinui Gorge. The most recent large-scale flooding incident at Mokihinui Forks followed the Murchison earthquake in 1929 in which a slip dammed the Mokihinui River just below the Forks. In this case the flood waters would certainly have mixed snails above the Forks, forming the hybrid colony described.

When the dam finally burst, live snails of both *P. l. ruforadiata* and *P. l. unicolorata* were apparently carried rapidly downstream. As the river emerged from the gorge it slowed, and some snails washed up in bends. A small hybrid colony formed at Chasm Creek when *P. l. ruforadiata* and *P. l. unicolorata* from the upper catchments of the Mokihinui River, along with *P. l. rotella* from the Seddonville terraces, washed up against an existing *P. l. johnstoni* colony. Another colony formed at Sawyers Creek when *P. l. ruforadiata* washed up against a *P. l. lignaria* colony, and a third formed at Waimare when *P. l. ruforadiata*, *P. l. lignaria* and *P. l. unicolorata* snails met.

Cause of Decline, and Threats

1. Predation by possums since about the early 1980s.
2. Predation by rats and song thrushes.
3. A relatively large deer population thinning the forest understorey, leaving the snails more exposed to weka (still abundant in the area) and thrushes.

Past Conservation Efforts

1. Density of live snails in a 500 m² monitoring plot in Maori Gully was measured in 1995 and 2002, and eight more 100 m² plots were established in 2002.
2. A ground-based possum-control operation was carried out by contractors over 500 ha on the true right of lower Maori Gully in 1999.

Current Conservation Status

Throughout its restricted range, *Powelliphanta lignaria ruforadiata* is affected by high numbers of almost the full suite of snail predators. It is in very low numbers (0.5 snails/100 m²) and is ranked 'nationally endangered' by Hitchmough (2002).

Long-term Recovery Goal

Restoration of a strong population (> 12 snails/100 m²) in at least 400 ha around the type locality (mid-Maori Gully).

Objectives For The Next 10 Years

Objective One

Improve snail survival by sustained predator control.

Explanation

The inaccessibility of the habitat of *Powelliphanta lignaria ruforadiata* will make sustained predator control difficult to achieve, but it is a core requirement for the long-term survival of this taxon.

The small size and elongated shape of the core snail area, plus its high fertility and low altitude, mean that re-invasion by possums after control operations will be rapid. An annual possum control programme (or intermittent control over a much larger area, incorporating substantial buffer zones) is required indefinitely.

The poison 1080 should be the possum control tool every 3-5 years because it will also kill rats and help control deer. However, if possum control is carried out annually the methods used need to be alternated regularly to prevent resistance or shyness in the pest population.

It is important to synchronize the use of 1080 with the beech mast cycle. In the year following a heavy beech seedfall, rat numbers will be particularly high and their impact on snails will be correspondingly more severe.

The remote nature of *P. l. ruforadiata* habitat makes rat control a very expensive option. It is possible that intermittent rat control (as a byproduct of 1080 possum control) is sufficient to allow snail recovery, particularly if there is long-term relief from the major snail predator (possums). Accordingly, no specific rodent control programme is suggested for the first 5 years of this plan.

Actions Required

1. Keep possum numbers steadily below 3% RTC, and preferably under 1% RTC, in the core snail habitat in Maori Gully through an annual possum-control programme (or less frequent control over a larger area).
2. Use 1080 cereal pellets as the preferred possum poison as frequently as the risk of 1080 shyness allows, to also reduce rat and deer numbers. Use 1080 in the season following a heavy beech seedfall whenever possible.
3. Establish six to eight more 100 m² snail-monitoring plots and regularly re-lease all plots until population trends and the effect of the management regime are clear.

Objective Two

Determine the size of the *P. l. ruforadiata* population through distribution and density surveys.

Explanation

Snails are not present on, or westward of, Mt O'Connor, nor are they on the Johnson Ridge. Beyond that, however, their distributional boundaries within the Maori Gully area are not well known. While *P. l. ruforadiata* has not yet been found above 1000 m a.s.l., it is possible that they may occur higher on Webb Ridge.

The lower slopes above Lake Dora, and on the north (true right) bank of the Mokihinui River Gorge, should also be surveyed.

Actions Required

Make transect searches for snail shells outwards from the known range of *P. l. ruforadiata*.

Responsibility

Buller Area Office, West Coast Conservancy.

3.37 *POWELLIPHANTA LIGNARIA UNICOLORATA*

Description

A small to medium-sized snail (maximum diameter 50 mm; height 29 mm) with a smooth white parietal callus. The shell is a plain olive-brown colour, occasionally streaked with a few wavy, irregular, reddish axial bands.

Habitat

A lowland species found at 80–500 m a.s.l., particularly on flat areas with deep litter on limestone soils. They live under litter in red and silver beech forest with rimu and kahikatea, a subcanopy of kamahi, toro, mountain wineberry and putaputaweta, and an understorey of tree ferns, small-leaved *Coprosma* species and crown fern.

Distribution

In North Westland, on both sides of the South Branch of the Mokihinui River from Silver Creek to the Forks, and on the true left of the Mokihinui River between the Forks and Chasm Stream at the western end of the Seddonville Flat. Patchily distributed in the South Branch of the Mokihinui River, with most snails on the limestone areas between the mouths of Silver and Mountain Creeks, near the mouth of Limestone Stream, and near Goat Creek.

Cause of Decline, and Threats

1. Destruction of the snail's forest habitat on the river flats at Seddonville.
2. In all colonies, predation by rats and, since the 1980s in some colonies, predation by possums.

Past Conservation Efforts

1. A 500 m² snail-monitoring plot was established near Mountain Creek in 1995, and re-measured in 2000. An additional four 100 m² plots were established near Goat Creek in 2000.
2. Ground control of possums over about 200 ha between Mountain and Silver Creeks was carried out in 1995, 1997 and 1999 to protect the snails. In 1996 a 1080 operation by the West Coast Regional Council over a wide area around Seddonville for TB possum control, would have helped the small population of *Powelliphanta lignaria unicolorata* near the mouth of Mokihinui Gorge.

Current Conservation Status

Too small an area has been sampled to be confident of the conservation status of *Powelliphanta lignaria unicolorata*. Near Goat Creek the snails are in high numbers (17.8 snails/100 m²) with little sign of predation, but they are in much lower numbers (1.2 snails/100 m²) at Mountain Creek where predation by possums is common. Relative to other *Powelliphanta*, the distribution of *P. l. unicolorata* is wide and there are still pockets where snails are common. It is ranked as 'vulnerable' by Hitchmough (2002).

Long-term Recovery Goal

Stable or increasing populations in at least two sites: in the South Branch of the Mokihinui River and at the eastern end of the Seddonville Flat.

Objectives For The Next 10 Years

Objective One

Determine more accurately the distribution and density of *Powelliphanta lignaria unicolorata*

Explanation

Our knowledge of *P. l. unicolorata* comes largely from the most accessible areas. To ensure that the most appropriate areas for management have been selected, more detailed information on distribution and density is needed.

Actions Required

1. Survey the distribution of *P. l. unicolorata* above the South Branch of the Mokihinui River (both sides) and above the Mokihinui River Gorge to determine the altitudinal limit of the subspecies.
2. During the distribution survey, systematically make timed collections of shells at regular intervals to determine snail density and predation levels.

Objective Two

Determine population trends.

Actions Required

1. Establish ten more 100 m² plots in the densest snail populations, ensuring that most representative areas are covered.
2. Measure snail density in all plots two-yearly.

Objective Three

Increase population density through improved recruitment and survival by sustained predator control.

Explanation

In a comprehensive collection of all shells found within a large part of the range of *P. l. unicolorata* (in 1979), 60% of shells were from animals killed by introduced pests: 47% by rats and 13% by thrushes (Meads et al. 1984). In this collection, as in one made in 1971, there was no sign of predation by possums—it must have begun some time in the 1980s. Most collections from 1990 have shells of possum-killed snails. When the first snail-monitoring plot near Mountain Creek was measured in 1995, 83% of shells within it were possum damaged, and live snail density was low (1.2 snails/100 m²). However, there are still some sites where possums, though present, are not yet preying on snails and snail density remains high (i.e. 17.8 snails/100 m² at Goat Creek). It is important to control possums at such sites before snail density declines too drastically.

Actions Required

1. Using the information gained from Objective One, select several areas representative of the diversity within *P. l. unicolorata*, including one area upstream from hybrid influences of other *P. lignaria* taxa. The areas should have a relatively high density of snails and be of a shape, size and location that will be practical for long-term pest control.
2. Keep possum numbers steadily at less than 3% RTC, preferably under 1% RTC, within the selected areas. Regularly alternate traditional methods of possum control (cyanide and trapping) with use of poisons which also kill rats (1080, feracol). Use the latter poisons in any winter after beech mast summers when rat numbers will be particularly high.
3. Support research on the timing of possum control that best protects snails from rats.
4. Monitor rat and possum numbers annually at first to better understand the relationship between pest numbers and snail density, and the impact of possum-control techniques on rat numbers in the Mokihinui Valley.

Responsibility

Buller Area Office, West Coast Conservancy.

3.38 *POWELLIPHANTA LIGNARIA ROTELLA*

Description

A medium-sized snail (maximum diameter 43 mm; height 28 mm) with a dense pattern of dark reddish brown spiral lines on the upper surface. Only very faint lines on the otherwise plain, yellowish olive base.

Habitat

A lowland species, confined to highly leached, infertile, poorly drained soils. Found under *Gabnia* and moss in forest and scrub of yellow-silver pine and mountain beech.

Distribution

Naturally small distribution on the poorer soils of Mokihinui Forest, between Charming Creek and the Glasgow Range.

Cause of Decline, and Threats

1. Logging of over 75% of the forest habitat of the snail; and burning, draining and conversion to exotic pines of about 50% of the logged area (including the type locality).
2. Predation by possums.
3. Mineral prospecting and mining activities (particularly for coal and gold) are a past problem and potential future threat to the habitat.
4. Illegal burning of the land to attract deer.

Past Conservation Efforts

1. The entire remaining range of the snail was threatened by proposed gold prospecting activities in 1983. The New Zealand Wildlife Service appeared at a Planning Tribunal hearing for the prospecting application and gave evidence that resulted in the proposal being declined.
2. In 1986, New Zealand Wildlife Service submissions to the Protected Areas Scientific Advisory Committee resulted in recommendations that the snail habitat in native forest be given Ecological Area status. Subsequently the habitat was protected as public conservation land under the Blakely Accord.
3. A possum-control operation (aerially distributed 1080 poison) was undertaken in the least modified snail habitat in 1995, and over the central and western parts of the snail habitat in 2000.
4. A 500 m² plot set up near St Andrew pakihi in 1994 to monitor recovery of live snails following possum control, was re-measured in 2000. An additional five 100 m² plots were established in 2000.

Current Conservation Status

Ranked as 'nationally endangered' by Hitchmough (2002). In low numbers (2.3 snails/100 m²) because of many years of intensive predation by possums and habitat destruction.

Long-term Recovery Goal

A thriving population (density of live snails > 12 snails/100 m²) in over 300 ha of the best habitat, and no further range reductions.

Objectives For The Next 10 Years

Objective One

Increase population density and size by sustained possum control.

Explanation

The remaining area of habitat of *Powelliphanta lignaria rotella* is small, and it abuts Timberlands' pine plantations in which possum numbers are not controlled. These features make the current regime of intermittent possum control for snail protection ineffectual, as possum re-invasion of the snail habitat is relatively fast.

Actions Required

1. Instigate a programme of intensive possum control (annual, or even more frequent, ground operations) in the core habitat of *P. l. rotella* to keep possum numbers steadily below 3% RTC, preferably under 1% RTC.
2. Cycle control techniques to avoid possum resistance.
3. Regularly monitor possum numbers to provide information on the relationship between the size of the snail population and possum density.
4. About every 5 years, carry out possum control over the wider Ngakawau - Mokihinui Forest area and in the core snail habitat, to keep possum numbers low in a wide buffer zone.
5. Establish at least ten 100 m² snail-monitoring plots throughout the range of *P. l. rotella* and re-visit two-yearly.

Objective Two

Increase snail population size by restoration of degraded habitat.

Explanation

The type locality for *P. l. rotella* is the St Andrew pakihi. In 1982 this was burnt by the New Zealand Forest Service and planted in *Pinus radiata* and *Eucalyptus* spp. To help the trees grow, the ground was v-bladed to break up the pakihi pan and drain the swamp.

When the pakihī was burnt, it became clear it had been prime habitat for *P. l. rotella* as thousands of burnt shells were found on the site. Because of this finding and because the site is entirely surrounded by native forest, the pakihī was finally legally protected as conservation land in 1986, despite the fact it had been converted to pine forest and despite the scarcity of snails by then. It was considered to have good potential as snail habitat if appropriately restored.

Between Chasm and Coal Creeks, and between Chasm and St Andrew Streams, snails have recolonised some areas of former habitat now in exotic trees with a dense understorey of regenerating native vegetation. However, when these forests are harvested, log hauling and burning or bulldozer clearing of the undergrowth before replanting will reverse any recovery of the snail population.

Actions Required

1. Seek to purchase the remaining habitat of *P. l. rotella* covered by exotic forestry species and in private ownership, protect it as a conservation reserve and restore its ecological value.
2. Harvest the crop of pine trees on the St Andrews pakihī (and also at Chasm Creek if possible) with great care, avoiding ground hauling logs in order to maintain a good topsoil and litter layer. Carefully protect all gully remnants of native forest during pine felling as they are likely to be harbouring snails and are good sources of recolonising snails. Ensure that all machinery is thoroughly cleaned of weed seeds.
3. When the existing crop of exotic trees is harvested, do not replant with pines, but instead allow regeneration of the native forest. In the areas which were v-bladed, consider options for blocking up the ditches immediately after the pines are harvested.

Objective Three

Obtain the understanding and support of the local community towards protection measures for *P. l. rotella*.

Explanation

Community acceptance of the value of *P. l. rotella* is required to reduce the likelihood of further destructive fires in the pakihī habitat.

Actions Required

1. Advocacy in local schools on the special land snail fauna of the Mokihinui area.
2. Publicity in the local Westport area news media on the actions being taken for the recovery of *P. l. rotella*.

Responsibility

Buller Area Office, West Coast Conservancy.

3.39 *POWELLIPHANTA LIGNARIA JOHNSTONI*

Description

A medium-sized snail (maximum diameter 46 mm; height 25 mm) with a smooth off-white parietal callus. The background colour of the shell is a yellowish olive and, except for a plain yellow area around the umbilicus, the whole shell is conspicuously spirally lined with a variable number of dark reddish brown fine bands. The width of bands, particularly on the upper surface, varies so much that shells appear either mostly red or mostly yellow.

Habitat

This lowland (300 m a.s.l.) snail lives in acidic soils which have frequent coal measure exposures and are leached by high rainfall. The snail lives under litter and moss in silver beech and rimu forest, and in shorter forest and scrub of manuka, yellow-silver pine, mountain beech, *Dracophyllum* spp. and rimu.

Distribution

Occurs patchily in the catchment of Charming Creek and its tributaries, Watson Stream and Frank Stream, in the Mokihinui Forest, between Ngakawau and Seddonville, North Westland.

Cause of Decline, and Threats

1. Between 1900 and 1999, logging and burning of the snail's forest habitat for coal mining and timber extraction. Reforestation of some areas with exotic pines involving very hot burns of remnant natural cover and some drainage and root-raking of the soil.
2. In small parts of the remaining habitat, snail numbers remained high into the 1980s, perhaps because of a surprisingly low density of rats for a site of such low altitude. However, predation by possums in all populations since the 1980s has caused a major population decline.

Past Conservation Efforts

1. In 1981 a comprehensive survey of the distribution and density of *Powelliphanta lignaria johnstoni* was undertaken (Walker 1982a). Snail conservation recommendations were made by the New Zealand Wildlife Service to New Zealand Forest Service's land-use planning process in 1982.
2. Proposals for Ecological Area status for parts of the Mokihinui Forest to protect *P. l. johnstoni* were approved by the Protected Areas Scientific Advisory Committee in 1986, and enacted during the land transfers of the Blakely Accord in the early 1990s.
3. A 500 m² snail-monitoring plot was established in 1984 near Charming Creek and has been re-measured annually. Snails inside the plot are individually marked and data on growth rates and movement collected. Four more 100 m² plots were established in 2000.

4. Possum control over 300–500 ha of forest in the middle of the snail's range has been carried out annually by the Department of Conservation since 1993. A variety of ground-based trapping and poisoning techniques have been used, but it has proved difficult to keep possum numbers low.
5. In 1995, possum numbers were reduced over a wide area on the north end of Radcliffe Ridge and between Seddonville and the end of the Charming Creek Walkway by the West Coast Regional Council. The operation, involving aerial distribution of 1080 poison for TB control, would also have benefited *P. l. johnstoni*.

Current Conservation Status

The logging of this snail's forest habitat has finally come to a halt and, with care, the damaged forests may eventually recover. The main problem now is a large, recent population decline caused by predation by possums, and a very slow recovery under the current possum-control regime. Snail numbers dropped from 20 snails/100 m² before possums became a problem (in 1986), to 0.8 snails/100 m² during the early 1990s, and then rose slowly to 3.5 snails/100 m² in 2001. *Powelliphanta lignaria johnstoni* is ranked 'nationally endangered' by Hitchmough (2002).

Long-term Recovery Goal

Moderate snail densities (> 12 snails/100 m²) in most parts of the taxon's former range.

Objectives For The Next 10 Years

Objective One

Increase population size by sustained predator control.

Actions Required

1. Keep possum numbers in the core snail habitat steadily below 3% RTC, and preferably under 1% RTC. Monitor possum numbers before each control operation to determine the relationship between possum and snail density.
2. Intermittently, carry out possum control over the entire Mokihinui Forest, including Radcliffe Ridge, to slow possum re-invasion in the core snail area and to provide some protection for the rest of the *Powelliphanta lignaria johnstoni* population. Measure possum density in this area just before control operations.
3. Establish four to eight more 100 m² snail-monitoring plots away from the core area and re-measure two-yearly to allow a comparison of snail recovery under an intensive predator control regime with recovery under an intermittent one.

Objective Two

Increase population size and genetic flow between populations through habitat restoration.

Explanation

The total range of *P. l. johnstoni* is naturally small—less than 1500 ha. As late as the 1975–90 period, over 600 ha of the snail’s forest habitat was clear felled and most of that was burnt and replanted in exotic trees by the New Zealand Forest Service, later Timberlands. This included some of the best snail habitat, and shells of hundreds of snails, burnt alive, were visible following the fires preparatory to pine planting.

The logged forests that were not planted in pines were transferred to the Department of Conservation in 2002. Though barren now, with some weeds that arrived with the logging and roading machinery, these areas will regenerate with predominantly native forest species and in time will become suitable snail habitat again.

The land under the plantation forest was transferred from the Crown to Nga Tahu as part of a Treaty of Waitangi settlement, with the timber still managed by Timberlands. The trees are ready, or nearly ready, for harvest but snails have re-invaded some of the older pine plantations where a dense understorey of native vegetation has regenerated. If the plantation area is to be regularly logged and replanted, snails will gradually be completely excluded, thereby reducing the total population size, and permanently fragmenting the gene pool.

The poor soils at Mokihinui and the site’s remote location make exotic plantation forests only marginally economic. The time has come for proper protection of an irreplaceable natural area and of species badly served by humans thus far.

Actions Required

1. Seek to purchase of the snail habitat in private ownership in Mokihinui Forest, protect it as a conservation reserve and restore its ecological values.
2. When the existing crop of pine trees is harvested on land under Crown management, do not replant with pines, but instead allow regeneration of the native forest. In the areas that were root-raked, consider options for filling in the drainage ditches immediately after the pines are harvested. Carefully protect all native forest remnants in gullies during pine felling as they are likely to be harboring snails, and are good sources of recolonising snails. Select a logging technique which protects the soil and litter layer, and the snails inhabiting it.

Responsibility

Buller Area Office, West Coast Conservancy.

3.40 *POWELLIPHANTA* “BULLER RIVER”

Description

A small snail (maximum diameter 40 mm; height 20 mm). The shell colour is a plain yellowish brown, rather similar to nearby *Powelliphanta lignaria unicolorata*, but the shell itself is shaped quite differently. The shells of adult *Powelliphanta* “Buller River” snails have a very distinctive high peaked apex and a rapidly-dropping body whorl. The parietal callus is smooth and dark brown. Allozyme data (Appendix 2) indicated *Powelliphanta* “Buller River” has no close relatives and should be described as a separate new species (K.J. Walker, unpubl. data).

Habitat

A lowland species, found at 50-100 m a.s.l. on alluvial soils. The main colony occurs on mudstone/siltstone soils overlain with limestone talus.

Distribution

Powelliphanta “Buller River” was first discovered by Peter Cresswell about 1978 in regenerating forest below White Cliffs Bluff, just south of Inangahua Junction in the middle Buller River gorge. Snails appear to be confined to the lower slopes where a few tiny pockets of primary forest remain.

Numerous comprehensive searches in the vicinity near the original locality on White Cliffs have failed to find additional populations, but in 1996 David Roscoe found a second small colony near the mouth of Ten Mile Stream in the lower Buller Gorge.

Cause of Decline, and Threats

1. It seems likely that the main White Cliffs population was formerly much larger and that its range included the river terraces across the road from the colony. However, these terraces may occasionally be flooded, and in addition, they have now been completely deforested and the lowland forest replaced with pasture. The habitat of the extant White Cliffs colony was also logged but, being on reasonably steep hill country, the gullies were left intact and the rest of the habitat regenerated into secondary forest and scrub.

Most of the White Cliffs colony is on private land, and habitat destruction was recently renewed with vegetation cleared for lifestyle blocks in the 1990s. Forest on the southern edge of the snail colony was logged by Timberlands and cleared for Heaphy Coal Mine activities in the 1980s and 1990s.

2. Rats are significant predators of this snail in both its colonies, and pigs also prey on the White Cliffs colony. Thrushes and probably hedgehogs prey on snails at both colonies, but the scale of their damage is unknown.

Past Conservation Efforts

1. A 500 m² plot established at the White Cliffs colony in 1995 to monitor the density of snails was re-measured in 1999 and 2002.
2. Brief surveys of the extent of the White Cliffs colony were carried out by a Conservation Corp team in 1991, by K.J. Walker and G.P. Elliot in 1993, by R. Buckingham in 1999 and by DOC staff in 2002.
3. An operation to control possums over the White Cliffs area, including the snail colony, was carried out by the West Coast Regional Council in 1995 for TB control.

Current Conservation Status

Powelliphanta “Buller River” is in low numbers at White Cliffs (1.4 snails/100 m²) and apparently at Ten Mile Stream. It is vulnerable because the total known population is small, the continued existence of the main habitat is not secure and introduced predators are having a detrimental and continuing impact on both populations. It is ranked as ‘nationally endangered’ by Hitchmough (2002).

Long-term Recovery Goal

A dense (> 12 snails/100 m²) population that is stable or increasing, over at least 10 ha in at least two secure sites.

Objectives For The Next 10 Years

Objective One

Maintain a viable population by long-term protection of snail habitat.

Explanation

The Ten Mile Stream snail habitat is protected as a scenic reserve, but there is a strong likelihood of further habitat loss at White Cliffs through forest clearance.

Actions Required

Seek to purchase and reserve, or protect through the establishment of covenants, the privately-owned snail habitat at White Cliffs.

Objective Two

Determine the natural range of *Powelliphanta* “Buller River”.

Explanation

The immediate White Cliffs vicinity has been searched fairly well for the presence of snails, but there have been no searches further afield. The recent finding of snails at Ten Mile Stream supports the possibility of a larger distribution for the taxon. Knowledge of total population size is important in assessing the intensity of conservation management required at the existing colonies, and information on former range helps in understanding habitat requirements.

Actions Required

1. Seek out historical information from library and local farmer sources of snail presence, vegetation changes and river flooding levels on the flats opposite the main White Cliffs snail colony.
2. Survey the wider area around Ten Mile Stream to determine the extent and density of the snail colony.
3. Search for snails at other sites along the Buller Gorge which are similar in character to Ten Mile Stream. Also survey Orikaka Forest on the true right of the Buller River, particularly on the northern extension of the Whitecliffs limestone scarp.

Objective Three

Determine the taxonomic status of *Powelliphanta* "Buller River".

Explanation

Allozyme studies in the 1990s found *Powelliphanta* "Buller River" to be genetically very different from its nearest (geographic) neighbour, *P. lignaria unicolorata* from the South Branch of the Mokihinui River (four fixed differences at five loci). It is also very different from the small alpine snail *P. gagei* on the Paparoa Range (K.J. Walker, unpubl. data). In addition to these genetic differences, the snail is morphologically very distinctive. Formal recognition of the species would make the conservation measures required for its long-term survival much easier to achieve.

Actions Required

Facilitate work aimed at formal description of the Buller River *Powelliphanta*.

Objective Four

Determine the identity and impact of predators of *Powelliphanta* "Buller River" and monitor population trends.

Actions Required

1. Supplement the existing snail-monitoring plot with five to ten 100 m² plots throughout the range of the snail at White Cliffs, and with five to ten plots at the Ten Mile Creek colony. Releaser at least two-yearly for the first 4 years so that any shells found are fresh enough to determine cause of death.
2. There is limited sign of pig and/or possum damage to shells seen recently, probably because the snail populations are so small and localised. However, both pests substantially degrade the snail's forest habitat, and their control in the snail colonies is highly desirable.

Responsibility

Buller Area Office, West Coast Conservancy.

3.41 *POWELLIPHANTA* “PATRICKENSIS”

Description

A small snail (maximum diameter 35 mm; height 21 mm) with a thin, smooth, polished and glossy, almost entirely chitinous shell, reddish brown in colour with numerous radial dark-brown stripes (Powell 1949), found on the Stockton - Denniston Plateau.

The published name for this snail is *Powelliphanta rossiana patrickensis*, but an examination of the genetic make-up of *Powelliphanta* in the 1990s found very large genetic differences between South Westland *Powelliphanta rossiana* and the Stockton - Denniston snails (K.J. Walker, unpubl. data; Appendix 2).

On a genetic basis, the closest relatives to *Powelliphanta* “patrickensis” are *Powelliphanta* on the Garibaldi Plateau, and more distant relatives are those on Baton Saddle and Kirwans Hill, though there are substantial morphological, ecological and genetic differences between those groups. *Powelliphanta* “patrickensis” has a distinctive blue mucous that is unique amongst *Powelliphanta* (most have clear mucous), though some of the other alpine snails of western Nelson have faint traces of this colour (K.J. Walker, unpubl. data).

Because *Powelliphanta* “patrickensis” live on infertile, sour coal measures, their shells lack the usual calcium lining and are thin and fragile. This is in marked contrast with their closest genetic relative, *Powelliphanta* “Garibaldi” which are calcicols, living only on limestone.

Due to the size of the genetic, ecological and morphological differences between *Powelliphanta* “patrickensis” and other *Powelliphanta*, it is likely to be elevated to full species status.

Considerable morphological variation exists within *Powelliphanta* “patrickensis”. The shells of snails around the type locality are much redder on the upper surface than shells from further south, and those below the confluence of the Wilson Creek and Waimangaroa River are finely sculptured on the dorsal surface so that the upper half of the shell appears matt rather than entirely glossy. Whether these differences in shell morphology reflect genetic diversity within the taxon is unknown.

The profound habitat differences between the very exposed acidic conditions on coal measures and more benign land snail environments on the alluvial flats on mudstones in the Happy Valley area of the Upper Waimangaroa River may be expressed in shell morphology.

Habitat

Powelliphanta “patrickensis” is confined to the infertile, poorly drained Brunner coal measures and siltstones and mudstones (Kaiata Formation) of the Stockton - Denniston Plateau. The plateau is frequently covered with mist and although it is not particularly high (the snails occur at about 550–850 m a.s.l.), it is generally a cold wet environment.

The snails live in stunted manuka and wire rush shrubland where they shelter beneath *Gabnia* and mountain flax; in more open red tussock/bogpine/manuka shrub tussockland on peaty soils on alluvial flats, and occasionally in low southern rata-mountain beech/podocarp forest.

Distribution

Powelliphanta “patrickensis” occurs sparsely and patchily within about 1500 ha in the upper Waimangaroa and Whareatea Rivers and in the headwaters of St Patrick Stream in the highest parts of a large, uplifted, faulted tableland collectively known as the Stockton - Denniston Coal Plateau, north of Westport.

The type locality for this snail is the very head of St Patrick Stream (Powell 1949), and the core area of occupation extends from this point to near the junction of Deep Stream and Waimangaroa River.

While *Powelliphanta* “patrickensis” may be more common in this zone where coal measures meet the more benign conditions on the Kaiata Formation mudstones, their distribution also extends up to Mt Rochford on the southern Denniston Plateau and Mt Frederick on the Stockton Plateau. The lower western slopes of the Mt William Range marks their eastern-most boundary.

Cause of Decline and Threats

The causes of the decline of *Powelliphanta* “patrickensis” are the dual impacts of habitat loss and increased levels of mortality—the latter brought about by new exotic predators and increased efficiency among natural predators in the now degraded habitat.

Much of the snail’s habitat has already been lost to mines, overburden dumps, human-made lakes, and extensive roading associated with coal prospecting as well as mine operation.

Much of the remaining snail habitat has suffered from repeated burning, and at times even the thin peat soils themselves burnt, reducing some areas to rock pavements (Overmars 1992). In the most infertile and exposed sites the fires removed the dense, ground-level vegetation which formerly provided some protection from the snail’s natural predator, the weka. At the same time, exotic thrushes, possums and rats arrived, and the combination of habitat degradation and new, efficient predators has proved formidable.

The planned development of a large, open-cast coal mine, which would affect most of the best remaining snail habitat beside the upper Waimangaro River, poses the most substantial threat yet to survival of *Powelliphanta* “patrickensis”.

Current Conservation Status

Powelliphanta “patrickensis” is classed as ‘endangered’ by Hitchmough (2002).

Long-term Recovery Goal

Maintenance of a strong core population through habitat protection and predator control, and an increase in colony size through rehabilitation of former habitat.

Objectives For The Next 10 Years

Objective One

Protect the snail habitat from any further reduction in size or quality.

Actions Required

1. Seek formal reservation of the remaining snail habitat.
2. Through appropriate constraints on human activity in the snail habitat, protect it from further mining, burning and roading.

Objective Two

Increase population density and size by sustained possum control.

Explanation

Because of the extreme fragility of the shells of snails on the coal measures, it is more difficult than usual to determine the cause of death from marks on the shells.

In a large survey in 1998, where 528 shells were collected from across much of the snail's range, the cause of death for almost 40% was indeterminable because of shell collapse, but more than half of these showed signs of predator attack. Of the remaining 320 shells, 31% had been killed by possums, 13% by thrushes and 4% by rats.

The only practical way to limit predation by thrushes is through restoration and maintenance of a deep litter layer and dense covering vegetation. Direct control of possum numbers is, however, achievable in this accessible area. Possums are likely to be having an impact on the snail population quite out of proportion to their numbers on the Plateau. In harsh infertile environments, with few palatable species, snails are probably a valuable food resource for possums, even when both predator and prey are at low densities.

Actions Required

1. Keep possum numbers at barely detectable levels within the core snail habitat.
2. Monitor the density of live snails in up to forty 25 m² plots through the possum control area and in a similar non-treatment area.

Responsibility

Westport Area Office, West Coast Conservancy.

3.42 *POWELLIPHANTA SPEDENI SPEDENI*

Description

A small snail (maximum diameter 43 mm; height 25 mm), but globose. The base is smooth, shiny and dark greenish brown in colour, while the reddish-coloured dorsal surface is finely and regularly striated giving the upper half of the shell a matt finish. There is a cline in shell morphology and colour, with snails in the east having more dorsal sculpturing and red colour on the shell than those in the west.

Powelliphanta spedeni spedeni eggs are large relative to the size of the snail, with eggs being about 29% of the maximum diameter of an adult snail, compared with only 16% in the much larger *P. hochstetteri anatokiensis*.

Habitat

Powelliphanta spedeni spedeni most commonly occurs at or just above the upper limit of mountain beech and *Dracophyllum* scrub, though the snails are also found well above the forest and scrub in pure tussock, and occasionally well down in the forest. The snails live in moist sites under litter and fern in beech forest, and under the dense skirts of *Astelia nervosa*, narrow-leaved snow tussock and red tussock in grassland, at altitudes of 750–1300 m a.s.l.

Distribution

Found very patchily in small parts of the less modified tussock grasslands in the southern Eyre Mountains, on the Garvie Range and on the Umbrella Range (including Leithen Bush) in northern Southland.

Cause of Decline, and Threats

1. The main cause of decline is widespread and repeated burning of the snail's tall tussock habitat. This led to the loss of many populations, and to the genetic isolation of those remaining in a fragmented landscape. Fire to promote new grass growth remains a significant threat in privately-owned snail habitat.
2. Browsing and trampling by both feral deer and farmed cattle and sheep destroyed the moist litter habitat. In many places, particularly in beech forest, conditions are now too dry and there is too little protective ground cover for eggs and young snails to survive.
3. Most shells found today are broken, probably by song thrushes, hedgehogs and perhaps mice. Enhanced mortality levels caused by introduced pests are a factor of unknown dimensions in the snail's decline.

Past Conservation Efforts

1. Protected Natural Area (PNA) surveys of Nokomai and Umbrella Ecological Districts in the 1980s, and invertebrate surveys of South West Otago in the early 1990s recorded all *Powelliphanta spedeni spedeni* shells found.
2. A 10 person-day survey of the distribution of *P. s. spedeni* in the Windley River headwaters, southern Eyre Mountains, was carried out in March 1990. A broader survey incorporating timed searches in many of the known sites was carried out in 1999.

3. In the Eyre Mountains in 2000, 150 m² of snail plots and 39 *Astelia nervosa* plants were searched. In 2001 several 100 m² plots were established in the same general area.

Current Conservation Status

Powelliphanta spedeni spedeni is one of the more widely distributed *Powelliphanta*, occurring in four adjacent ecological districts. However, it is present only in fragments of habitat, many of them unprotected and/or degraded, within this range. Population density is very patchy, ranging from 0.2 snails/person hour to 9.8 snails/person hour, but averaging about 3.5 snails/person hour. From very limited area-based density data there are 2.7 snails/100 m² in good snail habitat.

The snail is ranked in 'serious decline' by Hitchmough (2002).

Long-term Recovery Goal

Moderate densities and stable or increasing populations of *Powelliphanta spedeni spedeni* within representative parts of most of its natural range.

Objectives For The Next 10 Years

Objective One

Determine the population size, and identify key areas for habitat protection.

Explanation

Land development is continuing to lower the chances of the long-term survival of *Powelliphanta spedeni spedeni*. The best remaining habitat on each of the three mountain ranges where the snail occurs needs to be identified and management agreements sought with the landowners to protect and enhance the snail habitat.

Actions Required

1. Examine land tenure and management regimes in each of the known snail locations, to determine the level of on-going habitat modification. The urgency of the following actions depends on the outcome of this assessment.
2. Systematically survey live snail numbers within the known snail localities, and identify key habitat characteristics.
3. Identify apparently similar habitat in the northern Southland ranges and systematically survey for snail presence in these locations.
4. Select those areas with both good numbers of snails and reasonable chances of landowner consent for habitat protection, and attempt long-term habitat protection through the most appropriate tool (purchase by the Crown, lease exchange agreements, establishing covenants, land management agreements etc.).

Objective Two

Determine population trends.

Explanation

Population trends will determine the urgency of recovery actions for *P. s. spedeni*. Population monitoring also provides representative samples of shells useful for understanding causes of any population change noted.

Actions Required

1. Establish at least ten 100 m² snail-monitoring plots randomly in representative parts of the range of *P. s. spedeni*. Plots should be established in both pristine and developed tussocklands and within a range of rainfall regimes and altitudes. Suitable sites with easy access include the Argyle Burn in the Umbrella Ranges, off the Garston/Nevis road in the Garvie Mountains and on the Mt Bee Ridge in the Eyre Mountains. Less accessible sites to sample include high-altitude forest and grassland in the Windley headwaters (Eyre Mountains) and near Lake Gow (Garvie Mountains).
2. Counting the snails in tussock plots is particularly time consuming and destructive because of the dense nature of the vegetation. After 4 years of two-yearly counts to determine mortality rates and causes, re-measure most sites at only five-yearly intervals.

Objective Three

Identify the main snail predator(s).

Explanation

In common with most high-altitude *Powelliphanta* species, *P. s. spedeni* has a shell that is only thinly calcified and therefore easier for predators to break into than the larger, heavier shells of lowland *Powelliphanta*. This means that there are fewer visible signs left on the damaged shell by which the predator can be identified. The ability to identify the predator responsible is further reduced by the high degree of sun exposure which empty shells on the open alpine tops receive as, once broken, the thin shells often curl, deform and fragment in the heat.

On the positive side, there are fewer potential snail predators in the harsh environment well above the bush line in New Zealand. The main predators of *P. s. spedeni* are thought to be mice, hedgehogs and thrushes. Because of the high costs and difficulties associated with control of any of these species in the high country, more certainty as to their identity and impact is required.

Actions Required

1. Ensure that the tussock ground cover in the snail colonies is as dense and healthy as possible (via Objective 2) to improve snail productivity, recruitment and survival, and to reduce their vulnerability to predators.
2. If a large enough population of *P. s. spedeni* is found (see Objective 1) for a few snails to be sacrificed without threatening the population further, run trials feeding snails of varying size to wild caught mice, thrushes and hedgehogs to identify any characteristic signs of damage left on the shells by each potential predator.
3. Critically examine shells found in snail-monitoring plots to determine the proportion of the population killed by exotic pests. Model the impact such predation is having on the snail population to determine if the enhanced mortality is significant.
4. If pest control is required, identify the abundance of predator(s) within the snail colonies, and design and implement a predator control programme.

Responsibility

Murihiku Area Office, Southland Conservancy.

