

Potential threat of hedgehogs to invertebrates with a restricted range, Otago region

William J Hamilton
Ecosystems Consultants Ltd
PO Box 6161
Dunedin

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1. Introduction

The European hedgehog *Erinaceus europaeus occidentalis* was introduced to New Zealand during the late 1880s from Great Britain. It is the only member of the order Insectivora present in New Zealand. Hedgehogs were first released in Canterbury in 1870, but it was not until 1885 that hedgehogs were liberated in Otago. The initial release occurred in Dunedin and five years later hedgehogs were found in Sawyers Bay, 12 km north-east of Dunedin. Further releases of New Zealand-born hedgehogs were made in Southland, South Canterbury and Westland by 1909. South Island hedgehogs were also introduced to the North Island between 1907 and 1912.

New Zealand hedgehogs are smaller than their European counterparts. During the majority of the year they weigh between 620 and 700g, but this falls to 540-650g, in winter. New Zealand hedgehogs lose less of body weight (10%) while hibernating, than hedgehogs in Europe (25%) (Morris 1964). Hibernation usually occurs when the mean earth temperature drops to 10 °C - 11 °C. Where the temperature is mild and relatively frost-free, New Zealand hedgehogs may not enter into a continuous hibernation period (Brockie, 1974). The average hibernation period here is 3 months, compared with 5 months in Europe. Males tend to emerge from hibernation several weeks before females (Parkes & Brockie, 1977). Mortality is highest during the winter months. Morris (1973) found that 65% of juveniles in southern England died during their first winter. With the relatively short mild winters in New Zealand, juvenile mortality is lower and relatively few hedgehogs die during hibernation (Brockie 1974).

Hedgehogs are nocturnal insectivores, but they will eat any animal substance including birds' eggs. In Britain they are thought to be a serious predator of colonial nesting seabirds (Axel 1956; Kruuk 1964). There are suggestions that hedgehogs have also reduced the numbers of ground-nesting game birds in New Zealand (Caithness 1982). At Tawharanui, north of Auckland the eggs of the endangered New Zealand dotterel are continually lost to hedgehog predation despite over 400 hedgehogs being killed in the last 4 years (Hutching 1998).

While hedgehogs are active throughout the night, their maximum activity period is between 2100 and 2400 (Campbell 1973). They are usually solitary and non-territorial. Individuals may have a preferred foraging area, but hedgehogs will crowd together to exploit a rich food source, such as emerging insect larvae. Local abundance can also change during the season. Campbell (1973) found that the hedgehog population in a 8 ha block varied from 30 (winter) to 64 (early autumn). Hedgehog home ranges can be as small as 0.8 ha (Campbell 1973) or greater than 6.5 ha (Parkes 1975). Home ranges also vary between sexes, with females having slightly larger feeding ranges than males most of the year (Campbell 1973). During the breeding season males will expand their ranges to increase mating opportunities.

The average life span of hedgehogs is 2-3 years and they can be sexually mature by 11 months. Males can be fertile from September through to March. In

the North Island the first litters occur between November and December. Second litters are born through to February. The average litter size of North Island hedgehogs is 2.7. The reproductive biology of South Island hedgehog populations is generally unknown. Coupled with the low death rate during hibernation and a longer breeding season than occurs in Europe the lowland parts of New Zealand support populations that are between 20 and 60 times higher than comparable places in Europe.

2. Distribution

Since their first successful release, hedgehogs have spread rapidly over much of New Zealand. This rapid dispersion has been brought about by a combination of natural movement and also aided dispersal (Brockie 1975). Two major surveys of their New Zealand distribution found that hedgehogs were occupying habitats similar to those of their European ancestors, i.e. pasture, hedgerows, sand dunes and suburban gardens (Brockie 1975; Morris & Morris 1988). These surveys also showed that high numbers of hedgehogs could be found in lowland regions of New Zealand, especially in areas of high drainage and near the coast. Hedgehog distribution was patchy in upland regions (> 800 m) and they were rare in mountainous areas. Low temperatures also restricted their distribution and they were scarce or absent in areas with more than 250 frost days per year, e.g. upland Southern Alps and part of the central North Island plateau. New Zealand hedgehogs have been found at altitudes above 1800 m where invertebrates are abundant and there is a dry habitat for nesting (R Brockie, Victoria University pers. comm.).

Hedgehogs nest in a variety of places (e.g. tree roots, compost heaps, under leaf mould, under logs, under houses, tussock, rabbit burrows, rocks, gorse, marram grass, tussock, in sand dunes, flax). While they are catholic in their choice of nest habitat, the availability of dry nest sites and a dry hibernacula is a significant factor in determining their distribution and habitat (Morris 1973). Hedgehogs can drown during hibernation or die from exposure if their nesting areas are constantly wet. Therefore, they are rare or absent in areas with high rainfall (> 250 cm/year) and few occur in New Zealand rainforests. For example, in South Westland, hedgehogs were absent from the forested townships of Franz Josef and Fox Glacier, but can be found in the coastal sand dunes, 20 km west of these towns. Similarly in the Maruia Valley (Buller/Westland) hedgehogs were common in pasture habitat, but were rarely found in the nearby (5 km) beech forest (W. Hamilton, Ecosystems Consultants Ltd., pers. comm.).

Brockie (1975) suggested that by 1975 hedgehogs had reached a stable distribution. The survey by Morris & Morris (1988) and an informal survey by Brockie in the 1980s confirmed that hedgehogs were still restricted more to lowlands, coastal areas and areas of relative dryness. Colonisation is continuing, but on a smaller scale. For example, during Morris and Morris's survey (1988) they saw no evidence of hedgehogs between Haast and Westport. But, on a recent trip between Greymouth and Otira, several hedgehog road-kills

were observed (W. Hamilton pers. comm.). In and around Hokitika and Greymouth hedgehogs are now also frequent visitors to home gardens, but they are still absent from the surrounding forests (B. Paroa pers. comm.). Within the last five years hedgehogs have also arrived on some offshore islands including Motutapu Island. Their arrival on this island is of special concern as they may have an impact on dotteral eggs and nestlings (R. Brockie pers. comm.).

The original surveys suggested that hedgehogs shied away from native or plantation forest habitat and preferred suburban and grassland habitat (Brockie 1975; Morris & Morris 1988), but this may not always be the case. Studies at Boundary Creek Reserve (Hawkes Bay) show that animals preferred nesting in the forest and also spent most of their time foraging in the bush when compared to the surrounding pasture (C. Berry, Victoria University, pers. comm.). Hedgehogs do on occasion move into developed pasture but never for an extended period. It is possible that rodent control within this reserve has caused a subsequent increase in the invertebrate abundance thereby turning the reserve into a better hedgehog habitat.

2.1 OTAGO DISTRIBUTION

Within New Zealand, hedgehogs are abundant in most habitats below 800 m, where the mean annual temperature minimum is between 4 °C-8 °C, the mean mid-winter temperature (July) is at least 2 °C, there are < 250 frost days per year and the rainfall is < 250 cm/year.

Coastal areas of Otago are generally below 800 m and, in Central Otago, the major suburban areas and a large part of the major river catchments (e.g. Taieri, Manuherikia and Clutha) are also below 800 m. Therefore, large areas of Otago can be classed as lowlands and as such are available as hedgehog habitat. The climate of Otago is relatively mild especially in these lowland regions. Otago is relatively dry with annual rainfall ranging between 800 mm in Dunedin to <360 mm in Alexandra. The average monthly mid-winter (July) temperature rarely drops below 2 °C in areas below 1000 m. Similarly, in coastal regions of Otago and lowland regions of Central Otago, ground frost days per year are well below the >250 frost days limit on hedgehog distribution. For example, at Manorburn Dam (746 m) there are on average 154.9 frost days per year and in Ophir (305 m), the area with the most frost days, this rises to 176.6 frost days (NZ Meteorological Service, 1983). Obviously, the greater the altitude the more frosts there are. In Otago the freezing level is above 1300 m in July and 2700 m in January.

Otago's relatively mild climate and dry winters suggest that hedgehog distribution will be only limited by altitude. Therefore, most of Otago below 800 m, where sufficient food is available, could support viable hedgehog populations.

3. Impacts on native species

Hedgehogs are generally insectivorous and therefore, pose a serious threat to native invertebrate species. While the main part of a New Zealand hedgehog's diet includes lepidopteran larvae, earwigs, beetles, spiders, grass grub beetles, millipedes, slugs, snails and earthworms (Campbell 1973; Brockie 1959), there are variations in their diet composition resulting from local prey abundance. R. Brockie (unpublished data) found that hedgehogs in the Orongorongo Valley (Wellington) fed mainly on weta, millipede and surprisingly, the large centipede (*Homocephalus* sp). At Boundary Creek, a mainland island in the Hawkes Bay, large tree weta and again the large centipedes were relatively common in hedgehog's diet (C. Berry pers. comm.). While weta and the large centipedes were relatively common in this area, *Homocephalus* sp. and other species of weta are of limited abundance in other parts of New Zealand. Hedgehogs are also known to eat the native snail *Wainuia urnula*, and the native slug *Athoracophorus bitentaculatus* (R. Brockie pers. comm.).

Hedgehogs are potentially a major threat to New Zealand invertebrates. They have the ability to eat large amounts of invertebrate biomass during a single meal and they can be present in high densities. For example, Campbell (1973) found 424 adult grass grub beetles in one hedgehog's stomach. Recent studies at the Boundary Creek Reserve found that hedgehogs can eat up to 160 g of invertebrates per night (C. Berry pers. comm.). With densities of 8/ha not being uncommon, over 1 kg of invertebrates can be eaten per hectare per night. Therefore, where threatened populations are localised, or numbers limited, hedgehogs could be a serious threat to the population's viability.

4. Otago invertebrates

Otago is the home to several regionally endemic invertebrate species (Patrick 1994), including species that have a highly restricted range or are known only from single locations. The Cromwell chafer beetle *Prodontria lewisi*, for example, is endangered and is now restricted within a reserve of 89 ha. Two other species of *Prodontria* (*P. bicolorata* and *P. modesta*) are recognised as being threatened (Sherley 1989; Molloy & Davis, 1992). Both of these species are restricted near the vicinity of the Central Otago town of Alexandra. Patrick (1994) also recognises two new species of *Peripatus* that are apparently restricted to the Dunedin area. The grasshopper (*Sigaus minutus*) is locally restricted to a lowland area between Alexandra and Galloway in Central Otago and is only known from one other location in New Zealand, i.e. Mackenzie Basin. Three new weta species (*Deinacrida* n.sp. 1,2 and *Hemiandrus* n.sp.) are also confined to the Otago region.

Only one of the species mentioned above, a *Deinacrida* n.sp., lives above 800 m. The remaining species all reside in lowland habitats and therefore are potentially threatened by hedgehogs. While the Cromwell chafer beetle and

the *Hemiandrus* species are protected within a fenced reserve, they are still under threat from hedgehog predation. Hedgehogs are present in areas surrounding the Chafer Beetle Reserve (Brignall-Theyer, 1998; Hamilton & Alterio 1998) and have also been found within the reserve itself (B. McKinlay DOC pers. comm.). Contrary to popular myth, hedgehogs are adept climbers and can scale chickenwire fences, rock wall, small trees and shrubs with relative ease, and the fencing around the chafer reserve is unlikely to exclude them.

5. Conclusions

Evidence suggests that hedgehogs will be common in areas below 800 m alt in the Otago region, and several at-risk species with restricted ranges fall within this altitudinal gradient. Accordingly, hedgehogs have the potential to impact negatively on these invertebrate populations, but as yet, such impacts have not been adequately assessed.

6. Recommendations

- Develop standardised methodology and monitoring techniques to assess the impacts of hedgehogs on native invertebrates.
- Using these standardised techniques, instigate research programmes to evaluate the threat of hedgehog predation to native invertebrate species with restricted ranges both in the Otago region and on a national basis.

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