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SHORT NOTE

Bird-damaged kauri snails (*Paryphanta b. busbyi*) and snail shell breakdown at Trounson Kauri Park, Northland, New Zealand

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Introduction

The kauri snail (*Paryphanta busbyi busbyi*) is a large endemic carnivorous snail that lives within kauri (*Agathis australis*) and mixed broadleaf forests. The Trounson Kauri Park was established as a "mainland island" in 1993 with rodent and possum numbers systematically controlled in order to protect native birds and other native flora and fauna, including snails (Gillies *et al.* 2003). Coad (1998) collected snail shells along the newly established bait lines within Trounson Kauri Park in order to estimate the effects of predation on snail populations (Fig. 1). The snail shells had accumulated over an unknown number of years before and during the 1st years of predator control and it was found that only 31.5% (n = 368) of shells were undamaged. In contrast, 28.9% of kauri snail shells showed damage by rats while 26.6% had an indeterminate cause of damage. At least 4 snail shells exhibited damage attributable to predation by birds (Coad 1998).

Bird predation on kauri snails has also been observed in the Waitakere Ranges. Between Jul 1993 and Feb 1995, Montefiore (1995) found that 8 (n = 613) kauri snail shells collected in the Little Huia region had damage attributable to birds. The identity of the predatory birds on kauri snails is unknown but is likely due to the 2 introduced thrush species from Europe. The song thrush (*Turdus philomelos*) was introduced to New Zealand in 1862 (Long 1981) and frequently preys upon introduced garden snails (*Helix aspersa*). Blackbirds (*T. merula*) were introduced at approximately the same time and also eat terrestrial snails (Higgens *et al.* 2006). Both thrush species are predators of snails in their European ranges and potential predators of native snails in New Zealand.

Although the rates of bird predation on large kauri snails appear low, the overall impact of birds on kauri snail populations is not known as bird-inflicted damage to shells is generally only detectable on snails > 3 years old (Coad 1998; Stringer *et al.* 2003). Levels of predation on smaller snails are likely to occur during foraging by predators in the leaf litter, yet such predation would be difficult to assess. Live snails in the smallest cohort size are difficult to detect as they live under ground (Coad 1998), or are associated with rotten logs (*pers. obs.*). Any shell remains due to bird predation are thus likely to be missed in surveys.

The objective of this paper is to further report on bird damage to kauri snail shells at Trounson Kauri Park. I also conducted repeated surveys of kauri shells to estimate the time that snail shells persist

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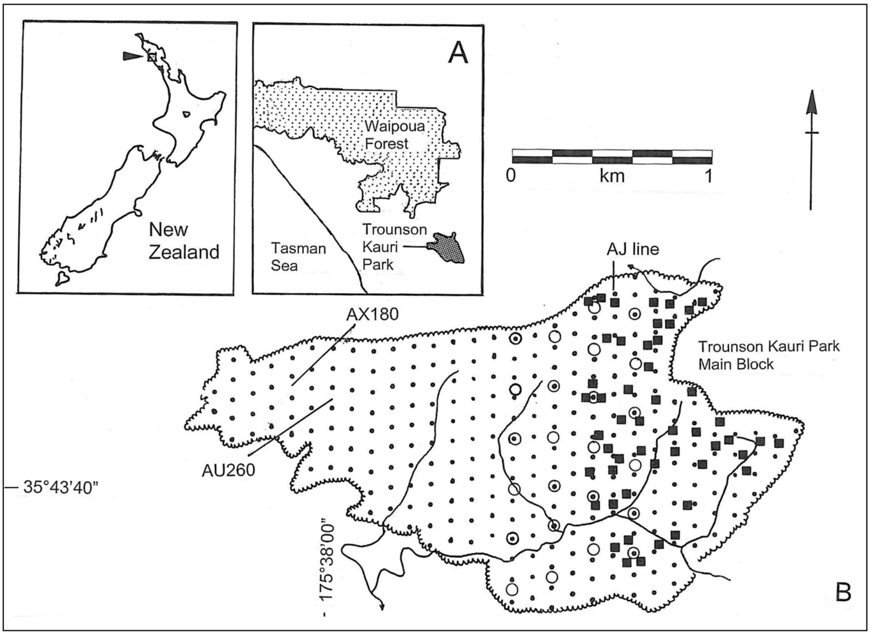

Fig. 1. Trounson Kauri Park Mainland Island main management block, Northland, New Zealand. (A) Location relative to Waipoua forest. (B) main management block; •, management lines; ■, systematic random plots and; **O,** bird count locations.

in the environment. Knowing both the extent of bird predation on kauri snails and the persistence of their shells in the environment are needed to provide better guidelines for interpreting counts of damaged shells.

Trounson Kauri Park is located in Northland, in the far north of the North I (Fig. 1). Predator control lines were walked at least monthly since they were established in 1993 by Department of Conservation staff and volunteers. During each walk, the *Paryphanta* snails seen were inspected for predator damage. The locations of accumulations of damaged *Paryphanta* shells were also recorded. To identify the potential avian predators of snails in the area, 5 minute bird counts were conducted 2 to 4 times at each of 20 sites in Nov each year by Mark Leach.

In 2006, 51 plots were established along the AA - AK lines in the eastern region of the Trounson Kauri Park main block (Fig. 1). Each plot measured 2 x 6 m and was systematically searched for *Paryphanta* shells and live snail presence on 5 occasions between 19 Apr 2006 and 27 Jul 2006. All live and dead snails were measured and the live snails returned to the site of detection. The 51 plots were searched again twice in Nov 2009 to measure the snail shells that were present from earlier searches.

Bird damaged accumulations of snail shells were first reported in Mar 2006 at site AX 180 (Fig. 1; Coad 2005); and subsequently at site AU260 in May 2006 and on the AJ line in Feb 2008 (S. Tweedle, *pers. comm.*). Shells in the 2 former locations were placed in exposed piles on moist free-draining sites at the areas where they were detected. These sites were subsequently inspected for more snail shells and the piles re-examined to assess shell breakdown. As snail shells degrade, they change from a shiny periostraca and fully connected whorl, to a dull periostraca with tan blotches and unraveled whorls within 2.5 – 4 years. By 5 years, they are almost completely disintegrated (Table 1).

The snails found at the 3 sites were predominantly late sub-adults and differed significantly in length (one way ANOVA, $F_{2,55}$ = 10.68, $P < 0.0005$) with those at site AX180 averaging 39.9 mm (se = 0.82, range 32.5 - 45.7, n = 14), those at site AU260 averaging 42.0 mm (se = 0.66, range 35.0 – 56.4, n = 31) and those on AJ line averaging 34.0 mm (se = 2.2, range 27.0 – 42.0, n = 6). Birds appeared to be eating or damaging different sizes of sub-adult snails at each site, and targeting shells that either lacked or had limited calcium build-up on their inner shells. Other undamaged but empty shells near sites AX180 and AU260 had a thin ostracum and averaged 52.7 mm (se = 2.72, range 41.2 – 70.0, n = 9), which was significantly longer than the damaged snail shells at this site (unequal variances t = -3.37, df = 9, P = 0.0049).

In 2006, a systematic search of plots along the AA - AK lines recorded a total of 26 live snails and 26 snail shells (Beauchamp & Wallace 2007). Once a shell was detected in a plot its probability of redetection during a subsequent search was 92%, indicating that movement of shells due to environmental factors during the 4 intervening months was not substantial. The empty kauri snail shells averaged 56.8 mm (se = 1.86, range 38.0 – 66.0, n = 26). Only 2 snail shells found on the forest margin

Table 1. Detection and breakdown of bird-damaged and whole *Paryphanta* shells at 2 sites in Trounson Kauri Park, Northland.

Month	AX180		AU260	
	Shells in pile	New shells found	Shells in pile	New shells found
Mar 2006	14 damaged; 7 undamaged in pile	-	-	-
May 2006	All 21 shells present; 12 with tan blotches	Nil	31 bird-damaged shells placed in a pile	-
Jun 2007	-	-	4 shells added to pile	3 bird-damaged; 1 undamaged
Sep 2007	All 21 shells degraded; 1 undamaged shell added to pile	1 undamaged	35 shells in the pile	Nil
Jan 2010	All 22 completely degraded	Nil	10 intact, tan blotched with uncoiled outer whorl; 8 in fragments; 16 degraded	Nil
Jun 2011	-	1 undamaged recent, 1 tan blotched bird-damaged shell	Fragments of 1 shell	Nil

Table 2. Size of individual kauri snail shells detected on 2x6 m plots at Trounson Kauri Park, Northland.

Plot number	Year	Snail length (mm)	Snail width (mm)	Snail max height (mm)
AI 700	2009	64	52	26
	2006	61	49	27
	2006	64	50	27
	2006	66	53	25
AH 500	2009	57	45	24
	2006	48	41	23
	2006	42	36	20
	2006	38	32	19
	2006	61	48	24
AH 400	2009	damaged	-	-
	2006	68	52	25
AG 200	2009	66	50	26
	2006	54	46	26

of lines AH and AK had any predator damage (both 48 mm long) but the cause was not established.

In Nov 2009, 50 of the plots on the AB-AK lines were searched twice again. Nine shells were recovered from 9 plots. Snail shells were present in 4 plots where shells were detected in 2006, but measurements of shells differed from those taken in 2006, and were clearly different individuals (Table 2). Snail shells were not found in 9 of the other plots where they were detected in 2006. Most of the plots were on almost level ground so movement due to water (Montefiore 1994, 1995) was unlikely. It was more likely that the 2006 sample of snail shells had degraded by Nov 2009.

Both thrush species inhabit Trounson Kauri Park and 5 minute bird counts during Nov along lines AI, AK, AM and AO (Fig. 1) between 1994 and 2003 (n = 32 counts) detected song thrush at half of the regularly counted stations (n = 20 stations). Blackbirds were detected 7 times more frequently than song thrushes, and were present at all 5 minute count sites (M. Leach, *pers. comm.*). The 14 damaged kauri snail shells found in 2006 at site AX 180 were located beside a protruding kahikatea (*Dacrycarpus* *dacrydioides*) root and is more consistent with the foraging activities of song thrush than blackbirds (Higgens *et al.* 2006). However, the snails found at site AX180 in 2009 had a smaller outer whorl holes and may have been damaged by a blackbird.

The impact of birds on adult kauri snails is likely to differ between kauri snail populations. At Trounson Kauri Park the kauri snails appear to secrete a minimal calcareous obstraca even when their periostraca are full formed. This may be because the soils are poor in calcium (N. Coad, *pers. comm*.). The ostracum layer from dead snail shells is consumed by other snails and radular marks were seen on 4 of the snail shells in the random plots (range 40-72 mm long, *n* = 26). Other kauri snail populations, including those found in the Mareretu Range and Puketi Forest, deposit substantial ostracum (< 1 mm thick, Powell 1979). Bird damage has not been detected on snails at Mareretu (*n* = 23 sub-adult shells in 2008-2009). On dry sites, snail presence can be detected by ostracum presence well beyond periostraca break down (*unpubl. data*).

Despite evidence of bird predation that I found in this study, kauri snails are well distributed at Trounson Kauri Park, and the dead snails recovered in random plots indicate that many late sub-adult and adult snails die without any obvious sign of mammalian or avian predation. The reduced number and deteriorated state of the remaining shells at site AU260, and the lack of recovery of any of the shells seen between 2006 and 2010 in the 13 random plots indicates that shell break-down within the moist leaf litter at Trounson Kauri Park is less than 3.5 years. The intact shiny periostraca of the bird-damaged shells detected at the 3 sites between 2006 and 2008, and the dull tan-brown brittle nature of those shells in 2010, indicates that bird damage seen in 2006 was recent. The subsequent lack of detection of further newly predated snails at sites AX180 and AU260 suggests that the impact of birds at each site was < 3.5 years old and potentially was the actions of only 1 bird at each site.

These data suggest that surveys of kauri snail shells could be a useful indicator of recent predator impacts, if collected in a systematic way. The breakdown rates of both the piles of bird-damaged and undamaged snail shells and the systematic random plots indicate that any *Paryphanta* snail shells found at Trounson Kauri Park are likely to be < 5 years old. No shells are likely to have survived since 1996-97 when Trounson Kauri Park was established as a mainland island and when predator damage was assessed at a level of 68% (*n* = 236, Coad 1998). By 2006, the rate of predator-damaged shells decreased to only 7.6% (*n* = 26), and a similar rate was observed in 2009 (6.3%; *n* = 16). This indicates that predation on sub-adult and adult *Paryphanta* snails during the preceding 5 years is substantially lower, despite some bird predation, than when the mainland island and mammalian predator management was established.

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LITERATURE CITED

Beauchamp, A.J.; Wallace, L. 2007. Kauri snail – Pupurangi (*Paryphanta busbyi*) occupancy kauri snail trail. Pp. 40-43. *In*: *Trounson Kauri Park Annual Report 2006/2007.* Dargaville: Department of Conservation.

Coad, N. 1998. *The kauri snail (Paryphanta busbyi busbyi): its ecology and impacts of introduced predators*. M.Sc. thesis, University of Auckland.

Coad, N. 2005. Bird preyed on kauri snails *Paryphanta busbyi* at Trounson Park Pp 34-35. in *Trounson Kauri Park Mainland Island - combined two year summary & background report 2004/5 and 2005/6.* Dargaville: Kauri Coast Area Office, Department of Conservation.

Gillies, C.A.; Leach, M.R.; Coad, N.B.; Theobald, S.W.; Campbell, J.; Herbert, T.; Graham, P.J.; Pierce, R.J. 2003. Six years of intensive pest management control at Trounson Kauri Park, a Department of Conservation "mainland island", June 1996-July 2002. *New Zealand Journal of Zoology 30*: 399-420.

Gillies, C.A.; Strche, A.; Bradfield, P.; Chalmers, K.; Leach, M.; Murphy, E.; Ward-Smith, T.; Warne, R. 2006. *Diphacinone bait for ground control of rats on mainland conservation land*. Wellington: Department of Conservation.

Higgens, P.J.; Peter, J.M.; Cowling, S.J. (eds). 2006. *Handbook of Australian, New Zealand and Antarctic birds. Volume 7 Part B. Boatbill to starlings*. Melbourne: Oxford University Press.

Long, J.L. 1981. *Introduced birds of the world*. Wellington: A.H. & A.W. Reed.

Meads, M.; Walker, K.J.; Elliott, G.P. 1984. Status, conservation and management of the land snails of the genus *Powelliphanta* (Mollusca: Pulmonata). *New Zealand Journal of Ecology 11*: 277-306.

Montefiore, R. 1994. *Progress report on Kauri snails (Paryphanta busbi busbi) in the Waitakere Ranges, as at 31 May 1994*. Wellington: Department of Conservation.

Montefiore, R. 1995. *2nd progress report on Kauri snails (Paryphanta busbi busbi) in the Waitakere Ranges, as at 31 May 1995*. Wellington: Department of Conservation.

Powell, A.W.B. 1979. *New Zealand mollusca. Marine land and freshwater snails*. Auckland: Collins.

Stringer, I.A.N.; Bassett, S.M.; McLean, M.J.; McCartney, J.; Parrish, G.R. 2003. Biology and conservation of the rare New Zealand land snail *Paryphanta busbyi watti* (Mollusca, Pulmonata). *Invertebrate Biology 122* : 241-251.

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