A case study on the distribution of native land snails in the Abel Tasman National Park

Background

The Abel Tasman National Park is home to two endangered carnivorous land snail species: *Powelliphanta hochstetteri hochstetteri* (yellow based, fig. 1) and *Rhytida oconneri.* Northwest Nelson and Westland are national strongholds for Powelliphanta snails, which are endemic to New Zealand and in gradual decline (Hitchmough et al. 2007*). R. oconnori* is critically endangered (Mahlfeld et al. 2012), which puts them on a level with species like kakapo, Maui´s dolphins and New Zealand sea lions. The distribution of *R. oconneri* is limited to upland areas in the Abel Tasman and a few adjacent places in Golden Bay. Snails are most vulnerable to predators like rats and possums, but also to pigs, which additionally destroy the habitat through intensive rooting. Hedgehogs, thrushes and weka are also known to predate on snails.

Both snail species are known to be present in the area around Canaan Downs and Harwoods Hole, and previous monitoring of the snails using diurnal subsurface plots indicates that populations in these areas are declining (Ogle 2017). Predation is the most likely cause for this development. A dense network of stoat traps is containing mustelids over the entire park, but possums and rats are believed to be the main predators for snails. The Canaan area is outside the area where Project Janszoon is undertaking intensive control of possums and rats. In order to develop a strategy to protect the snails, we needed to learn more about their distribution. The objective was to investigate if alternative strongholds for both snail species existed within the area where rats and possums are managed by Project Janszoon.

The Department of Conservation conducted a survey across wide areas of the park and the presence of shells and live snails was mapped (Ogle 2016). High numbers of shells were found at Waterfall Creek, Wainui Valley, Jenkins Creek, Evans Creek and Glennies Clearing.

As both snail species are nocturnal and hide during the day, the surveys for these promising areas were repeated at night to see if the distribution of shells corresponded with the abundance of live snails (see Lloyd 2018 for full details on results presented in this article).

Fig.1: A yellow based Powelliphanta hochstetteri hochstetteri

(photo credit Ruth Bollongino, fernphotos.com)

Nocturnal surveys

Nocturnal snail surveys along six transects were carried out at Waterfall Creek, Glennies Clearing, Evans and Jenkins Creeks, Wainui Valley and along the Pisgah ridge in November 2017 and January 2018 (fig. 2). To determine the variation in numbers of active and detectable snails, the survey in the Wainui Valley was replicated three times. All surveys were undertaken during humid, warm nights (≥ 8°C, rel. humidity ≥ 90%). The number of live snails and empty snail shells was recorded for each transect.

We used the replication of the Wainui survey to test the applicability of distance sampling and mark-recapture along transects. Positions of snails were recorded with a GPS, their distance to the centre of the track measured, and all snails larger than 15mm in diameter were marked with individual tags.

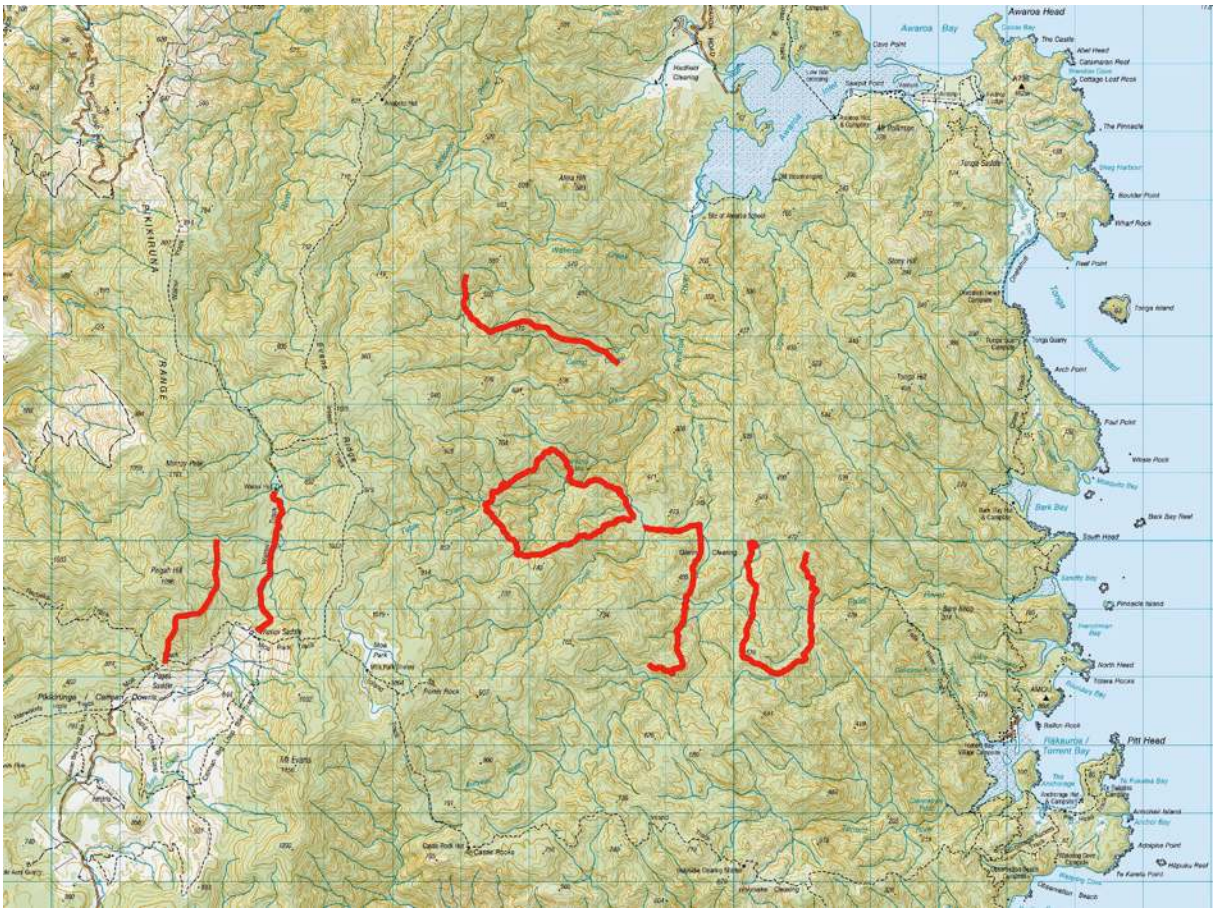

Fig. 2: Transects of nocturnal snail surveys

Results

In total, 25km of transects were surveyed. Overall, 191 live *P. hochstetteri* 37 live *R. oconneri* were detected (fig 3), as well as 208 *P. hochstetteri* shells (fig 4. No *R. oconneri* shells were found on any transect. Both snail species are more widely distributed than previously thought. *P. hochstetteri* and *R. oconnori* are most abundant in mixed beech forest, the latter also seems abundant in higher elevation kaikawaka and mountain beech habitat (fig. 3).

Table 1 shows that in spite of high numbers of shells, few live snails were encountered in low elevation rimu/hard beech habitat at Waterfall, Evans and Jenkins Creeks and Glennies Clearing. In contrast, high numbers of live snails and fewer shells were encountered at Pisgah and in the Wainui Valley. The ratio of live snails vs. shells varies considerably – thus shells are no reliable indicator for the abundance of live snails. Total snail numbers have to be interpreted with caution, as the repeated counts along the Wainui Valley show that snail numbers also vary between nights (Tab. 1).

The pattern of snail distribution corresponds with the topography of the landscape, showing higher numbers of snails at higher elevations and lower snail numbers at lower elevations.

There appears to be a negative correlation between snail numbers and high rat numbers, with snail numbers being lowest where rat tracking rates are highest. That rats are the cause of the decline is supported by the observation that shells at lower elevations (where rat densities are high) often show signs of predation, whereas the majority of shells at higher elevations are not damaged. The high numbers of shells at lower elevation suggests that the snail populations have experienced a rather recent decline. Alternatively, a source-sink dynamic where snails are constantly moving into the area and experiencing high predation rate could explain this pattern.

Table 1: Encounter rates of live snails and shells per 100m. Wainui survey replications 1-3 are truncated to overlapping sections, except for Wainui 2 (long) where shell distribution has been included along the entire survey length.

Survey site	Encounter rate (N/100m)		
	P.h.	R.o.	P.h. shells
Waterfall Creek	0.26	0.11	2.66
Evans Creek	0.03	0.00	0.10
Glennies	0.02	0.00	0.16
Jenkins	0.14	0.00	1.29
Pisgah	0.51	0.42	n.a.
Wainui 2 (long)	7.15	1.45	4.02
Wainui 1	4.52	0.17	n.a.
Wainui 2	4.52	0.67	n.a
Wainui 3	7.04	1.01	n.a

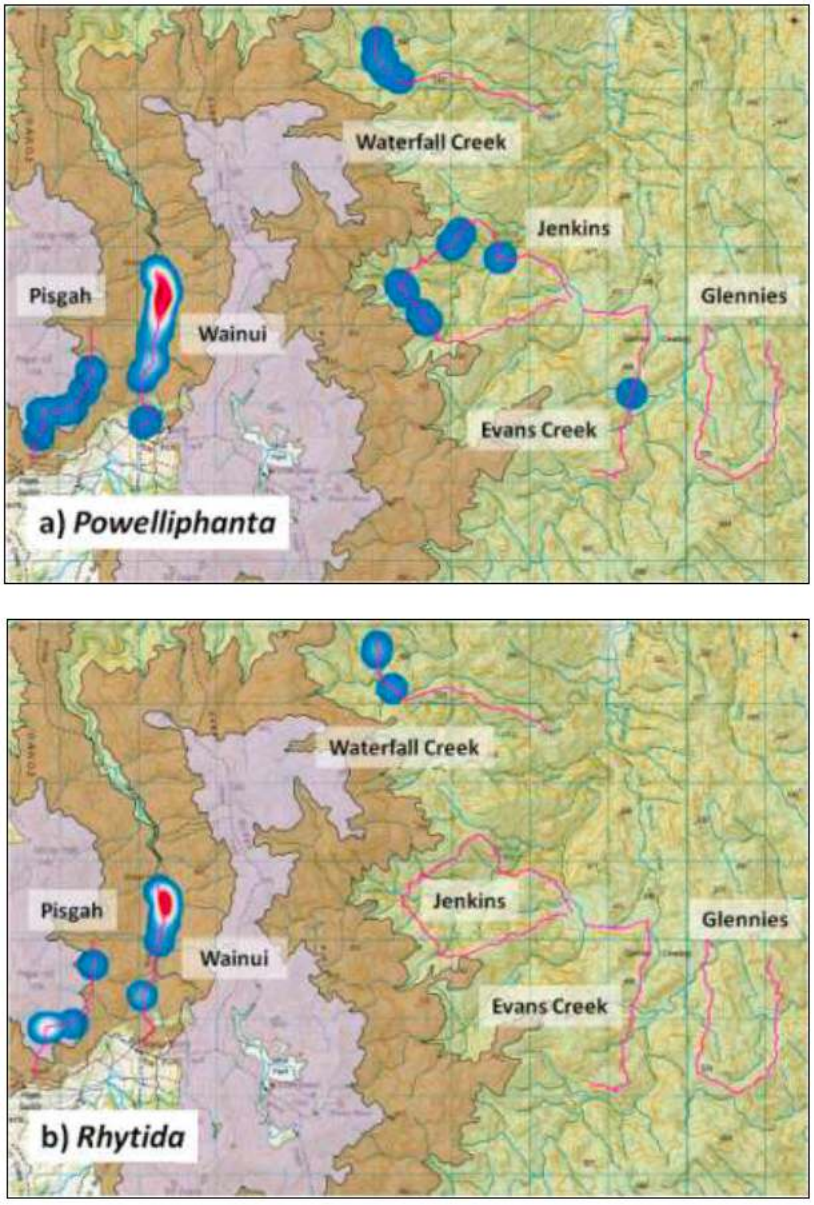

Fig. 3: Heat map of densities of live snails (maps adopted from Lloyd 2018). Areas of mixed beech and kaikawaka mountain beech forests are shaded brown and grey-purple respectively.

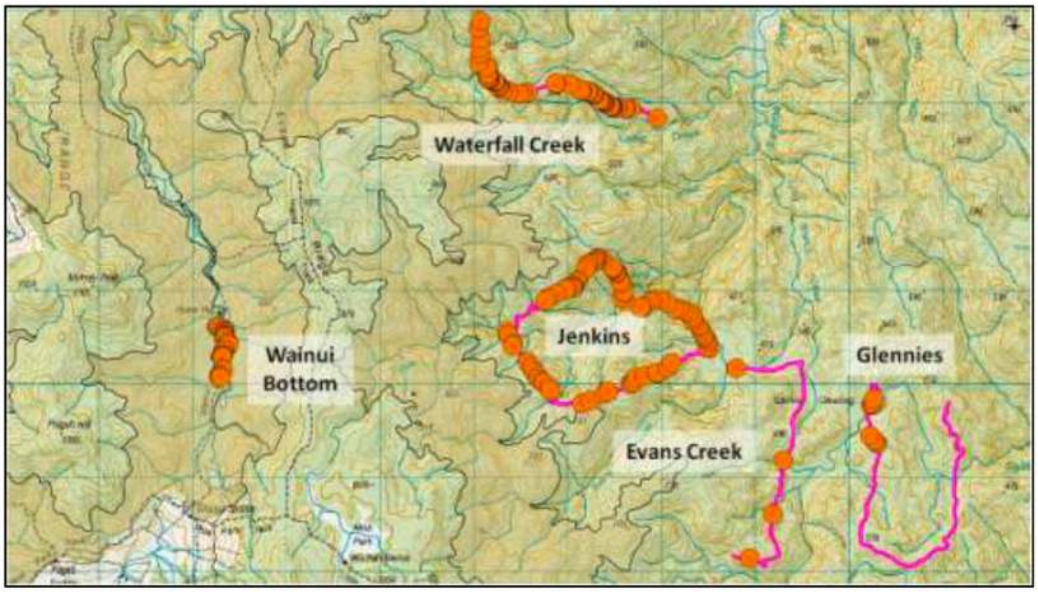

Fig. 4: Distribution of *P. hochstetteri* shells along transects (map adopted from Lloyd 2018).

Snails are slow – they are therefore well suited for distance sampling. However, the population density estimates derived from distance sampling only reflect the density of snails that are active on the surface. This measure is of limited value, as ratios of snails that are hidden or active on the surface vary substantially with environmental conditions.

Mark-recapture monitoring showed that of 47 tagged *P. hochstetteri* only four were found a week later, whereas 61 untagged snails were caught. This means that we mostly caught different individuals during each survey, and that the actual density of snails is much higher than the number of snails on the surface

We also made some curious observations about snail behaviour. Both species were seen climbing up trees, in some cases more than a meter up a tree trunk (fig. 5). During one survey in the Wainui Valley, four little *Rhytida* were found in *P. hochstetteri* shells. No remains of soft tissue of the *Powelliphanta* snail could be seen, so these *Rhytida* were not feeding on them. We believe the shells were used as shelter or as a source of calcium. We therefore recommend shells be left in place as they have a functional role in the ecosystem and might contain young *Rhytida*.

Fig. 5: A Rhytida snail 70 cm up on a tree trunk

(photo credit Fred Overmars)

Synopsis

- Snails are best monitored during warm, humid nights (≥ 8°C, rel. humidity ≥ 90%) after rainfall, especially for R. oconnori, which seem to avoid heavy rain.
- P. hochstetteri prefer mixed beech habitat. They are also found in low elevation rimu/hard beech habitat where mortality is high.
- R. oconnori are abundant in mixed beech but also kaikawaka (mountain cedar) and mountain beech habitat.
- R. oconnori are regularly encountered in Powelliphanta shells, which might be used as shelter or a source of calcium. Thus shells should not be collected.
- Snails can also be found up on trees.
- The distribution of shells is not a suitable indicator for the abundance of live snails.
- Between night variation of detectable snails is substantial, especially for Rhytida.
- Distance sampling only gives a density estimate of snails on the surface at a given time.
- The low recapture rate of marked snails showed that different snails were active during the repeated surveys, leading to an underestimation of snail densities when individuals are not being marked.
- Densities of live snails correlate negatively with high rat densities.
- Snails can be tagged on the go, which reduces effort, workforce and impact on habitat for mark-recapture monitoring.

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