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SHORT NOTE

Riflemen (tītitipounamu, *Acanthisitta chloris*: Acanthisittidae) eating seeds of silver beech (tawhai, *Lophozonia menziesii*: Nothofagaceae)

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Rifleman (tītitipounamu, *Acanthisitta chloris*) is one of two surviving species in the family Acanthisittidae (New Zealand wrens), and is considered to be almost entirely insectivorous (Oliver 1955; O'Donnell & Dilks 1994; Higgins *et al.* 2001). The few observations of food items other than invertebrates consumed by riflemen include birds in South Westland feeding on fruit of *Raukaua edgerleyi* (raukawa) and *R. simplex* (haumakoroa: both Araliaceae) between April and July, with fruit comprising 2–4% of their diet in these months, but less than 1% when averaged throughout the year (O'Donnell & Dilks 1989, 1994). Riflemen have also been observed taking fruit of tutu (*Coriaria arborea*: Coriariaceae) (Greg Sherley *pers. comm*. to CMM, April 2023). We here report the first known observations of riflemen consuming seeds.

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All observations were by GAP on 28 March 2023, between 1030 & 1240 h, along river flats east of Routeburn Flats hut (*c.* 700 m above sea level, 44.72°S 168.29°E), on the Routeburn Track, Mt Aspiring National Park. The forest along this section of the Routeburn Track is mixed southern beech (Nothofagaceae), dominated by red beech (tawhairaunui, *Fuscospora fusca*). GAP observed numerous small flocks of riflemen foraging on the forest floor, and took many photographs of them. Identification of food items was based on high-resolution digital images, taken with a high shooting speed (20 frames per second) Canon R5 camera with a Canon RF 100–500 mm lens (f/4.5–7.1L IS USM) set at 500 mm focal length, allowing rapid autofocusing with image stabilisation. As this was his first encounter with the species, Glenn did not realise the significance of the foraging behaviour observed until he was able to share his observations and images with others.

The weather was cold, with occasional light rain and sleet. A cold front with strong winds the previous day had caused much fresh leaf fall (GAP, *pers. obs*). Groups of 2–6 riflemen were foraging along the track, focussing their effort on areas with less leaf litter, including the track itself, and footbridges (Fig. 1). At least 15 birds were seen on the track, with a further 8 or so on the ground to the side of the track. The birds were very focussed on foraging, and could be approached within a few metres before they moved away. When they did move, they generally hopped a little further along the track, rather than flying into the surrounding vegetation. The birds foraging on the ground included juveniles, and adults of both sexes.

The images revealed the birds to be foraging among fallen leaves of silver beech (tawhai, *Lophozonia menziesii*), rather than the locally more abundant red beech (Fig. 1). Several images revealed that the birds were holding silver beech seeds cross-wise in the distal half of their bills, and they appeared to be squeezing the amorphous seed contents out (Fig. 2). We suspect that it was this whitish paste that the birds were consuming, rather than swallowing the entire nut. Several images showed riflemen with small quantities of this paste adhering to their bills, and none of the 800+ images showed an entire nut in a bird's gape.

Figure 1. Adult female rifleman among silver beech leaves on a footbridge on the Routeburn Track, 28 March 2023. Image: Glenn Pure.

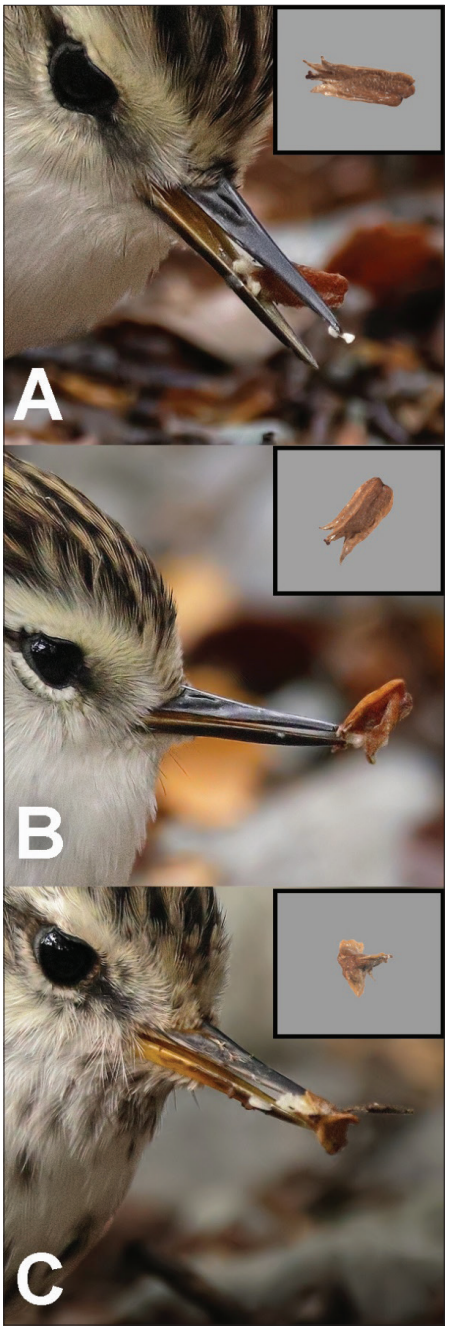

Figure 2. Riflemen extracting the contents of silver beech seeds from the hard nut, Routeburn Track, 28 March 2023. A & B: Adult females; C: Juvenile. Main images: Glenn Pure; insets of silver beech seeds at similar orientations: Jean-Claude Stahl, Te Papa. The birds were eating seeds that had likely fallen the previous day; the reference seeds (picked out of roadside gravel and leaf-litter collected by CMM at Kawatiri, Nelson, on 18 April 2023) were older and drier.

The caterpillars of at least 20 species of moths (Lepidoptera: Oecophoridae, Hepialidae, Psychidae, and Noctuidae) have been identified from beech forest litter (from under hard beech (*Fuscospora truncata*) near Wellington; Dugdale 1996). However, none of the Routeburn images revealed anything suggestive of insect larvae being held by riflemen.

Silver beech seeds are highly variable in size and shape. They average 5.4 x 3.5 mm (though can be as long as 7 mm and as slender as 2 mm), and have three (occasionally two) narrow wings along the length of the seed (Fig. 3; Wardle 1967; Webb & Simpson 2001; Ford *et al.* 2016). Seeds of Nothofagaceae lack endosperm; however, their cotyledons contain fat reserves (Webb & Simpson 2002; Ford *et al.* 2016), and this is likely to be the whitish paste that the birds were extracting.

Figure 3. Silver beech seeds (2 x life size). The scale bar is 15 mm, with tick marks at 5 mm. Riflemen have bills that are 11–15 mm long, and silver beech seeds average 5.4 mm long (Higgins *et al.* 2001 and Webb & Simpson 2001 respectively). Image: Jean-Claude Stahl, Te Papa.

With an average weight of 2.9 mg, each silver beech seed is about 35% the size of a red beech seed (mean weight 8.2 mg; Beggs 1999). Seeds of both species contain similar energy by weight (21.4–21.8 kJ/g; Beggs 1999), although red beech seeds contain proportionately more nitrogen, phosphorus, and potassium (Beggs 1999). The larger and more nutritious red beech seeds are favoured by introduced rodents, and endemic kākā (*Nestor meridionalis*) and yellow-crowned parakeets (*Cyanoramphus auriceps*) (Beggs 1999). We suggest that riflemen are limited to eating the much smaller silver beech seeds due to the birds' small body size and weak jaw muscles. The images of riflemen holding silver beech seeds suggest that they may have been selecting seeds that were more slender than average (Fig. 2 cf. Fig. 3), although no attempt was made to assess sizes and shapes of seeds available on the forest floor at the time.

Silver beech seeds are mainly shed from mid-March to early April, with highly variable quantities of seed produced and shed between years (Wardle 1967; Kelly *et al*. 2012). Autumn 2023 was observed and predicted to have moderate levels of beech seed fall in northern Fiordland and western Otago (Colin O'Donnell & Graeme Elliott, *pers. comms* to CMM, May 2023). We do not know if riflemen are able to eat silver beech seed before it is shed, and this would be difficult to observe in the forest canopy. However, foraging on the ground is unusual behaviour for riflemen (O'Donnell & Dilks 1994; Higgins *et al.* 2001). The number of birds observed feeding on the ground on 28 March 2023 suggests that they were seeking a resource that they couldn't get at their usual foraging heights. It is possible that silver beech nuts became softer and more pliable after prolonged contact with damp ground (suggestion by Colin O'Donnell, *pers. comm.* to CMM, April 2023). We suggest that foraging along the track and footbridges, which were kept relatively clear of leaves by human foot-traffic, facilitated searching for the tiny seeds, compared to nearby areas of deep leaf litter.

This first record of seed-eating by riflemen was facilitated by high-resolution, low light photography and high frame rates, allowing small food items to be photographed and identified before they were consumed. We do not know if this is rare foraging behaviour, or whether it has been overlooked previously. Riflemen occur widely in beech forests, and we note that black beech (*Fuscospora solandri*) and mountain beech (*F. cliffortioides*) have seeds which are similar in size to those of silver beech (Webb & Simpson 2001; Ford *et al.* 2016). Although beech seed fall is seasonal and is variable between years (Kelly *et al*. 2012; Ford *et al.* 2016), it can be abundant, and may provide an energy-rich food at a time of year (autumn) when beech-forest invertebrates become less available (Fitzgerald *et al.* 1996).

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