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A harness trial for radio-tracking threatened birds inhabiting dense vegetation

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Abstract. The 2019–2020 Black Summer bushfires resulted in the conservation status listing and uplisting of many species because of the significant loss of species' habitat, while also highlighting the lack of basic empirical data available for many of our threatened taxa. The Kangaroo Island Western Whipbird *Psophodes nigrogularis lashmari* and Western Bassian Thrush *Zoothera lunulata halmaturina* were two such taxa uplisted to Endangered. Both species are extremely cryptic, making monitoring their post-fire recovery particularly difficult. We trialled a small rubber-band backpack harness designed specifically to attach radio-transmitters to ground-foraging species inhabiting dense vegetation to assess its usefulness in future studies. The harness design was very quick and easy to attach in the field, with retention times of *c.* 14–22 days achieved. The rubber band's natural 'weak link' makes it a useful and simple harness technique in studies where entanglement is a potential issue and short-term deployment is desirable.

Introduction

The catastrophic wildfires that swept across eastern Australia during the Black Summer of 2019–2020 were unprecedented in their size and impact on both communities and the environment (Filkov *et al.* 2020; Ward *et al.* 2020). Although the scale of the South Australian fires was not as extensive as those experienced on the eastern coast of Australia, their proximity to populated areas and regions of conservation importance made their impact just as severe. The Kangaroo Island fires burnt >210,000 hectares, just under half of the island, with most of the western region completely burnt, including Ravine des Casoars Wilderness Protection Area and Flinders Chase National Park (Filkov *et al.* 2020; Rumpff *et al.* 2023). The western half of the island is ecologically important for the island's unique biota, retaining relatively high coverage and quality of native vegetation and home to 16 endemic bird subspecies, plus several species faring considerably better than their mainland counterparts (Robinson 2020).

With such large areas of critical habitat destroyed, numerous taxa were listed or uplisted under the *Environment Protection and Biodiversity Conservation Act 1999* (Garnett *et al.* 2023), including the now Endangered Kangaroo Island (KI) Western Whipbird *Psophodes nigrogularis lashmari* (DCCEEW 2023a) and Western Bassian Thrush *Zoothera lunulata halmaturina* (DCCEEW 2023b). Research and monitoring into how these taxa responded and recovered after fire were therefore identified as important for their future management (Garnett *et al.* 2023). However, both taxa are notoriously cryptic and difficult to observe, with no data on key habitat characteristics or size of home range (Boulton *et al*. 2021; Paton *et al*. 2021), which makes it difficult to accurately monitor or estimate their population sizes and recovery post-fire. Understanding how animals move throughout the landscape to access food, shelter, and breeding resources is critical when managing wildlife, even more so for threatened species impacted by fire. Biotelemetry has the potential to provide some of this information for such cryptic species (Cooke 2008), but neither species has been subjected to radio-tracking before. Additionally, their habitat preference for dense vegetation and predominantly ground-based behaviour makes suitable harness design critical and challenging, given the higher risk of negative welfare outcomes.

The continued development of radio-telemetry and production of new devices, often with prolonged battery life, lighter weights, and smaller sizes, has led to an increasing number of avian studies using the technology (Barron *et al.* 2010; Geen *et al.* 2019), gaining valuable information on species' biology. The importance of radio-telemetry as an effective tool for conservation practitioners is obvious (Cooke 2008). However, researchers need to be mindful of the trade-off between the benefits and the potential negative consequences such studies pose (Barron *et al.* 2010; Bodey *et al.* 2018), particularly when working with endangered species. Hill & Elphick (2011) found that ground-foraging passerines were more likely to experience transmitter loss, entanglement, and non-entanglement injuries than other passerines, but their survey also revealed under-reporting of negative effects in the literature. This highlights the importance of publishing any new telemetry development, to prevent future researchers spending unnecessary time on protocols that are proven to be ineffective or reinventing practical solutions, and to reduce possible negative welfare outcomes.

Here, we trialled a small rubber-band 'backpack'-style harness designed specifically for ground-foraging species inhabiting dense vegetation (Woinarski *et al.* 2016; Hamilton *et al.* 2017). Our aim was to assess the feasibility of radio-tracking KI Western Whipbirds and Bassian Thrushes for

future studies, and particularly after significant fire events. Similar transmitters and rubber-band harnesses have been trialled successfully in south-western Australia for Noisy Scrub-birds *Atrichornis clamosus* in very dense vegetation (S. Comer & A. Berryman pers. comm.) and for Western Ground Parrots *Pezoporus wallicus flaviventris* in dense heaths (A. Thomas & A.H. Burbidge pers. comm.) but their details are yet to be published. The potential benefits of rubber-band harnesses compared with more traditional methods include: (i) ease and quickness of attachment, (ii) no sticky glue near the bird, (iii) soft and smooth material, (iv) stretchiness may allow bird to pull itself free if entangled, and (v) rubber deteriorates in the environment creating a natural 'weak link' without complicated additions to the harness.

Methods

Study area

Kangaroo Island (35°50′S, 137°15′E) lies off the southern coast of Australia and is the country's third-largest island, covering 4405 km^2. Capture sites were situated on the western third of the island in Flinders Chase National Park (KI Western Whipbird) and the Western River Refuge (Bassian Thrush), a 13.8-ha feral-predator-proof refuge established by Australian Wildlife Conservancy, Kangaroo Island Land for Wildlife, and private landholders after the Black Summer bushfires to protect the endangered Kangaroo Island Dunnart S*minthopsis aitkeni*.

The climate is temperate, with most rain falling during the cooler winter months. Vegetation is dominated by mallee eucalypt species, low open shrubland, taller Dryland Tea-tree *Melaleuca lanceolata* open shrubland, and low coastal shrubland with typical heath species such as Beaked Hakea *Hakea rostrata*, Small Bull Oak *Allocasuarina striata*, Kangaroo Island Sheoak *A. muellerana notocolipica*, correas *Correa* spp., acacias *Acacia* spp. and banksias *Banksia* spp.

Western Bassian Thrush

The Western Bassian Thrush is a large-bodied ground-dwelling bird weighing 98–118 g (Higgins *et al.* 2006). The male and female are indistinguishable, with subtle brown-and-cream plumage. They possess scalloped black crescent-shaped bars down the back, rump and head, offering them perfect camouflage in thick leaf litter, and making them notoriously difficult to observe in the dense vegetation on Kangaroo Island.

Because of the bird's reluctance to respond to call playback (RLB pers. obs.), it was necessary to locate breeding pairs that were predictably and regularly using an area, ideally with birds nesting, to increase the chances of capture. On 20 August 2022, a female was found incubating in a nest high above the ground in the Western River Refuge, and three low mist nets were set up in a perpendicular configuration within this area. The first bird caught on 20 August was flushed into the net and identified as a juvenile from its feathering and it was later observed being fed by the adult birds. The male from the nest was caught shortly after the juvenile was released. Each bird caught was banded with a numbered metal band (Australian Bird and Bat Banding Scheme) and a unique combination of three coloured bands on the tarsus for subsequent identification.

Kangaroo Island Western Whipbird

The KI Western Whipbird is a medium-sized ground-dwelling bird weighing 43–47 g. Although the male and female are alike, with a black throat, white submoustachial stripe, and short triangular erectile crest, they each have their own distinctive song, with pairs partaking in antiphonal song (Higgins & Peter 2002).

Observations of Whipbirds over several weeks in late September 2022 revealed an area in burnt vegetation in the Flinders Chase National Park that appeared to have a high density of these birds, and this area was targeted for capture attempts. Over 5 days only two birds, a breeding pair, were caught (on 8 October 2022), because of variable response to call playback on any given day. Again, a mist-net configuration of perpendicular nets was successful with a combination of playback and flushing birds towards the net area.

Radio-telemetry

Rubber bands come in several standard sizes and widths, with both study species falling in the likely range of size 12 (40 × 1.5 mm), 14 (50 × 1.5 mm) or 16 (60 × 1.5 mm). The fit and method of handling and attachment of the rubber-band harness was trialled on a small number (n = 2) of Common Blackbirds *Turdus merula* before field trials commencing on the study species. Field trials of sizing of rubber bands and attachment methods were then conducted on a small number of KI Western Whipbirds (n = 2, 11 October 2021) and Western Bassian Thrushes (n = 3, 30 June 2022) using a dummy transmitter to select correct sizes of rubber bands; size 12 for Whipbirds and size 14 for Thrushes were identified as suitable. During fitting it was observed that the Alliance Pale Crepe Gold® bands, with their higher rubber content, were easier to stretch over the bird's wing compared with other brands (e.g. Officeworks J. Burrows).

Harnesses were made by carefully supergluing (Selleys® QuickFIX non-drip gel superglue) a size 14 rubber band to the top of a 1.8-g transmitter (model BD-2; Holohil, Carp Ontario, Canada) for the Western Bassian Thrush, and a size 12 rubber band to a 1.2-g transmitter (model BD-2) for the KI Western Whipbird (Figure 1). These were constructed before catching the birds to ensure that the superglue was fully dry. Care was needed when stretching the harness over wings as the point where the superglue met the rubber band created a natural, more brittle weak link. This weak link increased the speed at which the rubber band would naturally degrade, ensuring that the harness would eventually fall off the bird.

Results

Harness attachment was quick and easy, only requiring a single person (RLB). The technique of stretching the rubber band over the wings was not dissimilar to extracting

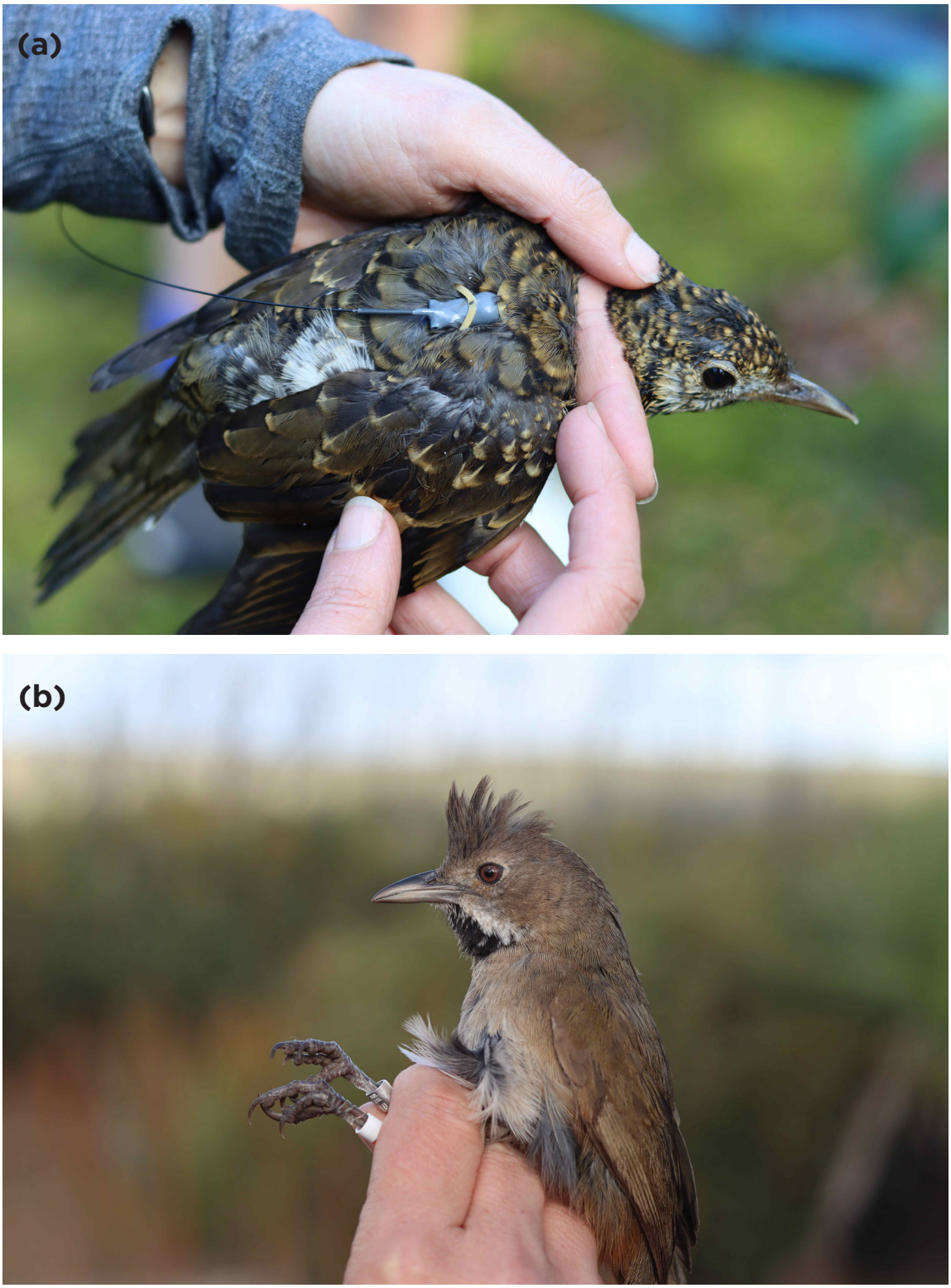

Figure 1. (a) Western Bassian Thrush juvenile showing transmitter BD-2 with rubber-band harness. (b) Kangaroo Island Western Whipbird female. Photos: Darcy A. Whittaker

bird's wings from mist nets. When released, the Bassian Thrush half-ran, half-flew into dense vegetation. Both the male and juvenile were tracked daily for the first 5 days. Given the nature of the vegetation, it was difficult to visually assess the harness and birds' behaviour, even when telemetry showed the bird to be only a few metres away. The male was seen flying unhindered 4 days after harness attachment, when he was found feeding the unbanded female. On most occasions, the juvenile was very difficult to observe, as it remained highly concealed. On 25 August, 5 days after harness attachment, the partial remains of the juvenile were found in the gully with the fully intact harness still attached. A motion-sensor camera was set up on the remains and within minutes (after personnel left the area) a Brown Goshawk *Accipiter fasciatus* returned to the carcass. We found no evidence that the juvenile had been entangled, and we were unable to assess the remains for potential injuries from the harness because the carcass had been almost fully consumed. The male Bassian Thrush remained in the gully feeding the female, which started incubating at the new nest. He was last successfully radio-tracked on 2 September (14 days after

capture). During the next visit, on 7 September, the tracker was found on the ground, the rubber band having broken at the superglue 'weak' point.

Previous captures of KI Western Whipbirds had shown them to be relatively agitated when being handled, struggling, and vocalising the whole time while in the bird bag and when in the hand (RLB pers. obs.). Harness attachment was simpler with the Whipbird (which has very short, rounded wings) than the Thrush. The two individuals captured for this study, although somewhat feisty while being handled, appeared unhindered when released, running off into the dense vegetation. Approximately 1 hour after attaching the tracker to the male (less-defined brood patch) he was radio-tracked to a nest where he was found incubating two eggs. At the time of capture and during pre-capture surveys there was no sign that the pair was nesting, and they had been observed feeding two juveniles 12 days before capture on 26 September. The nest was ~60 cm off the ground in the centre of a Beaked Hakea shrub in an area completely burnt in the summer of 2019–2020. The female, identified from an obvious brood patch, was caught 50 minutes after the male. Over the next 14 days both the male and female were radio-tracked every day or every second day to assess how long the harness would remain on. During this time, we recorded both birds sharing incubating duties, with the male foraging up to 310 m from the nest (~30-ha area) and the female tending to stay a little closer, foraging up to 170 m from the nest (~9-ha area). The male was seen with another Whipbird (potentially one of the juveniles) on the day of capture. Radio-tracking was reduced to every 4 days after 2 weeks, with adults seen carrying food to the nest on 26 October, and both birds successfully radio-tracked for the last time on 30 October (22 days after capture). When we visited on 3 November, the female's intact harness and tracker were found hanging from the ridged grass-like stem of a Yacca *Xanthorrhoea semiplana tateana* (225 m from nest), and the male was presumed deceased through predation (440 m from nest), with only a small pile of feathers and tracker found on the ground. The nest contained one healthy nestling at this stage, but this was gone by 7 November.

Discussion

Despite the small scale of these trials, we believe that it is important to make available such results for the telemetry community to continue improving and resolving harness methodology issues. In our study, it was difficult to directly relate welfare issues to the harness as we could not recapture the birds to check for abrasions, mortality events were not directly observed, and we were unable to assess any harness impacts from the carcasses. Further investigation into the cause and rates of predation for these two species is warranted given our results. Currently it is unclear whether high predation rates recorded here relate to some impact of the harnesses or are an artefact of increased predator–prey interactions in a burnt landscape (Doherty *et al.* 2022). Encouragingly, neither species immediately removed the harness, and the rapid attachment method significantly reduced handling duration and therefore stress to the birds. Although we would have preferred longer retention of the transmitters, the dense vegetation and large size of the study species may preclude longer retention using a rubber-band harness. The advantages of the harness' simple construction, deployment, and low cost may make it suitable for studies requiring shorter retention times (i.e. short battery life) or working with species in challenging environments where entanglement risk is high and where glueing techniques are known to initiate more of a pecking response, reducing retention times (Woolnough *et al*. 2004).

The design and construction of a weak link in a harness can be challenging, but their value in harness design is pertinent with respect to satisfying ethics and permit conditions, particularly when working with threatened species. With the increasing awareness and regulation around animal welfare in research, most studies are required to design telemetry equipment not to be worn long-term, either through recapture and removal or natural degradation, causing the device to drop from the animal. Innovative modifications of the Rappole & Tipton (1991) leg-loop harness have used weak links created with small sections of rubber band (Kesler 2011), dissolvable suture harness material (Doerr & Doerr 2002; Woolnough *et al.* 2004), and degradable elastic sewing thread (Streby *et al.* 2015). Backpack-style harnesses tend to be used on larger birds or in studies requiring longer retention of transmitters, often with no weak links (Nelson *et al.* 2016), but others have used cotton-strand (Hill *et al.* 1999) or cotton stitching weak links (García *et al.* 2021). The rubber-band design in this study demonstrates a simple and effective weak link harness for small to medium-sized birds.

Although the aim of the study was to test harness retention rates and attachment style, we were able to collect valuable information for two endangered and understudied Kangaroo Island species. Notably, we observed high predation for both species and obtained invaluable data on the breeding biology for the KI Western Whipbird which to date has been limited (Higgins & Peter 2002). Published effects of telemetry studies, both positive and negative, are not always widely accessible to other investigators (Hill & Elphick 2011). This reluctance to publish is likely for several reasons but in part because of researchers' inability to conclusively resolve issues around both animal mortality and welfare. Although we know of a few studies using the same rubber-band harness as we used (Woinarski *et al.* 2016; Nugent *et al.* 2022) and others using them with great success (A. Thomas & A.H. Burbidge pers. comm.), no detailed description has been published yet. Therefore, we hope that by publishing our methodology in more detail others will learn from our findings, improve the approach or consider publishing their own work, even with small sample sizes.

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