Description of the eggs and nest, with notes on the breeding ecology of Hellmayr's Pipit Anthus hellmayri dabbenei in Chile

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Source: Bulletin of the British Ornithologists' Club, 143(4) : 479-484

Published By: British Ornithologists' Club

URL: https://doi.org/10.25226/bboc.v143i4.2023.a5

Description of the eggs and nest, with notes on the breeding ecology of Hellmayr's Pipit *Anthus hellmayri dabbenei* in Chile

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Received 13 April 2023; revised 2 September 2023; published 4 December 2023

http://zoobank.org/urn:lsid:zoobank.org:pub:A29E7BF6-4AA4-4C6E-9C5A-0049AAA2501B

Summary.—We report new ecological data for the poorly known migratory subspecies of Hellmayr's Pipit *Anthus hellmayri dabbenei* in Chile, describing four nests, eggs and some other aspects of the breeding biology. One nest was found in Bulnes, Ñuble region, in late October 2013, with three additional nests discovered between December 2019 and January 2020 on a grass-covered hill in Los Sauces, Araucanía region, in a previously harvested field. Eggs were oval, white to cream-white, with olive-brown speckling forming a 'cap'. Adults fed the nestlings almost entirely on grasshoppers (Orthoptera: Acrididae), averaging 0.8 deliveries per minute (range 0–3 deliveries per minute). The max. gap between deliveries was 31 minutes.

Hellmayr's Pipit *Anthus hellmayri*, which is represented in Chile by the subspecies *dabbenei* (Hellmayr 1932, Goodall *et al*. 1946), is one of three species of *Anthus* in the country. Peruvian Pipit *A. peruvianus* (monotypic) occurs in Arica, in the far north of Chile (del Hoyo *et al.* 2020) and Correndera Pipit *A. correndera* is represented by *A. c. calcaratus* in eastern Antofagasta and *A. c. correndera* from Atacama southwards (Tyler 2020, Norambuena *et al*. 2021). Previous observations suggested that *A. h. dabbenei* prefers tall dry grassland with scattered bushes (Raimilla *et al*. 2012), whereas a Brazilian study showed that a population of *A. h. hellmayri* selected grassland that had experienced wildfire within a year, but was much less abundant in grassland affected by fire longer ago, suggesting that they tended to avoid tall, dense grasses (Chiarani *et al*. 2020). In the austral summer *A. h. dabbenei* is patchily distributed between 37°S to 46°S in Chile (Hellmayr 1932, Raimilla *et al*. 2012, 2013) and at 36–50°S in Argentina (Ridgely & Tudor 1989, Tyler 2004), being present in southern Bolivia and northern Argentina (probably at least as far as Córdoba and Entre Ríos) in May (Hellmayr 1932, Ridgely & Tudor 1989, Pearman & Areta 2020. The migration routes and site fidelity of migrants still need to be assessed using modern techniques such as geolocators. Basic natural history information is still lacking for many Neotropical *Anthus*; for example, the nests of Peruvian Pipit *A. peruvianus* and Paramo Pipit *A. bogotensis* have been described only recently (Arcco *et al*. 2020, van Els *et al*. 2022). Despite its broad distribution, until now just one nest of *A. hellmayri* had been reported in Chile (Norambuena 2018).

Temperate grasslands are among the most altered biomes on earth (Heidenreich 2009, Jacobson *et al*. 2019) with factors as diverse as afforestation and climate change impacting these ecosystems worldwide (Brennan 2005). Understanding the home range size and habitat preferences of a species is important when monitoring their populations (Strasser *et al*. 2019). Land use change on former grassland in central Chile might be a threat to local Hellmayr's Pipit populations, as is true elsewhere for several grassland birds that cannot persist in suitable but fragmented habitat (Herkert 1994, Vickery *et al*. 1994). Here, we describe the breeding habitat and some aspects of the breeding biology of *A. h. dabbenei* in Chile.

ISSN-2513-9894 (Online)

Field work and Methods

Nests were found in two areas: Bulnes in Ñuble region and Los Sauces in Araucanía region (Fig. 1). Bulnes was visited on 31 October 2013 and Los Sauces from 15 December 2019 through 15 January 2020. Bulnes was characterised by grassland habitat (height *c*.40–50 cm) with isolated shrubs. Vegetation in Los Sauces was characterised by grassland of variable height, with dry and low grasses (*c*.15–30 cm) dominating slopes and greenish, taller grasses (*c*.40–55 cm) the hollows. Sweet-briar *Rosa eglanteria* was sparsely distributed throughout the area. The site was rich in arthropods, mainly orthopterans (Acrididae) and some small Tettigoniidae (*Conocephalus* sp.). To locate nests, we conducted parallel transects with three observers spaced 5 m apart and checked the locations where birds flushed from the grass. All nest and egg measurements were taken using callipers precise to 0.1 mm.

To determine feeding rates by the adults, we deployed an autonomous recording unit (Audiomoth 1.0.0, Open Acoustic Devices, 2018) 10 cm from one of the nests for three days. The recording cycle was as follows: 24-hour/day, 0-second sleep duration and 60-second recording duration. The recorder uses the last two seconds of each one-minute cycle to write the file to the microSD card. To assess the presence of some insects we used a sample rate of 48 kHz. The gain setting was fixed between the 'Low' and 'Med' presets which avoids signal clipping when birds vocalise close to the recorder and minimises non-target sounds in the recordings. We inspected the recordings using Adobe Audition (Adobe CC 2017) in spectrogram view, then recorded the date and time for each begging call detected. To assess prey composition and test the association between deliveries and begging calls, we installed a trail camera (Campark T70) 30 cm from two of the nests (N2 and N4) for five hours each. When two or more begging calls were separated by ≥5 seconds in the same sound file, we

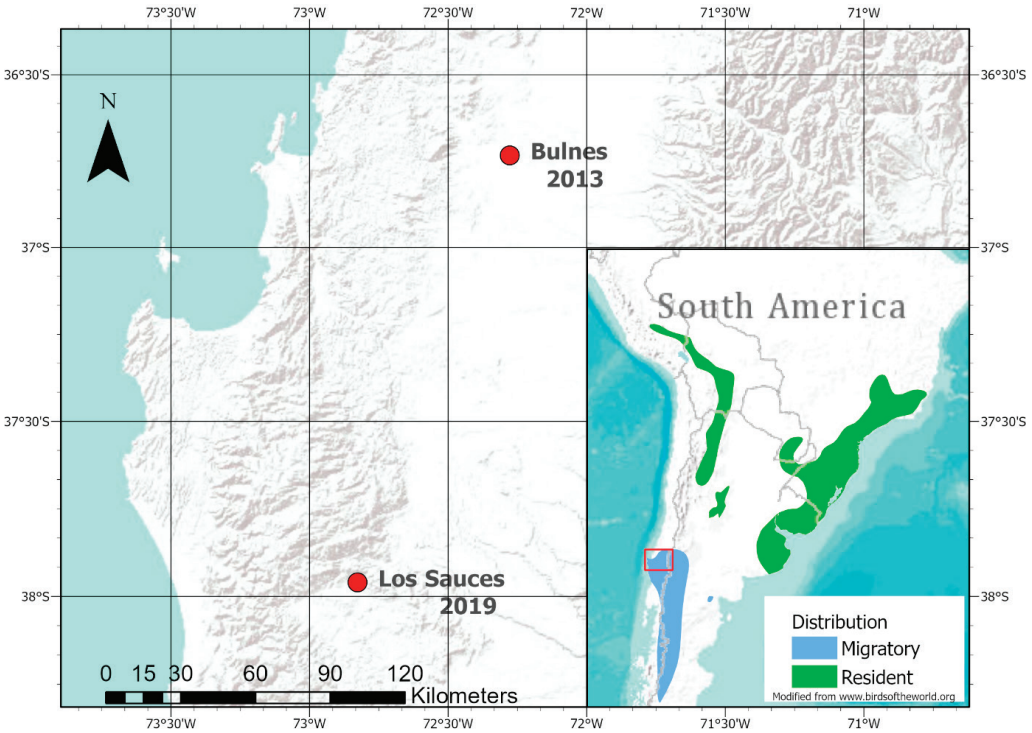

Figure 1. Location of the two nest sites of Hellmayr's Pipit *Anthus hellmayri dabbenei* in central Chile.

ISSN-2513-9894 (Online)

Figure 2. Nests of Hellmayr's Pipit *Anthus hellmayri dabbenei* in central Chile: (A) N1, Bulnes, with three nestlings *c*.8 days old; (B) N2, Los Sauces, with three nestlings *c*.10 days old; (C) N3, Los Sauces, with three eggs; (D) N4, Los Sauces, with four nestlings *c*.12 days old (A: Heraldo V. Norambuena, B–D: Francisco Rivas)

treated these as independent feeding events, whereas calls separated by <5 seconds were considered the same feeding event, as this was the min. interval between deliveries detected using the trail camera.

Results and Discussion

Like other subspecies, *A. h. dabbenei* constructs a cup of grass, but its dimensions are slightly smaller. In Argentina, Colombo (2020) described that the nests of *A. h. hellmayri* had a mean external diameter of 8.63 ± 0.09 cm (range 6.5–10.53 cm), mean internal diameter 6.39 ± 0.08 cm (range 4.88–8.05 cm) and mean depth 3.99 ± 0.07 cm (range 2.7–5.5 cm). In Brazil, a nest of *A. h. brasilianus* had an external diameter of 8 cm, internal diameter 6 cm, and depth 4 cm (Lombardi *et al*. 2010). The quantitative data of our findings are summarised in Table 1. The first nest (N1) was found on 31 October 2013, at Bulnes. It was hidden in the grass and held three nestlings (Fig. 2A). To ascertain the species involved, we waited for the adults to return to the nest. After a few minutes an adult approached with an insect and made territorial flights over the nest area; it was identified as *A. hellmayri* by its plumage.

On 15 December 2019 FR, CGD, SNS & EPB visited Los Sauces and observed 16 adults. On the same day, we found an active nest (N2) with five eggs (the surviving nestlings are shown in Fig. 2B). The number of eggs in this nest corresponds to the max. clutch size reported to date (Colombo 2022). The nest was cup-shaped but covered by a dome of dry

ISSN-2513-9894 (Online)

TABLE 1
Location, orientation and measurements of the four nests of Hellmayr's Pipit *Anthus hellmayri dabbenei* in central Chile described in this paper.

Nest	Location	Coordinates	Orientation	No. of eggs	No. hatched	Hatching date	Fledging date	Nest diameter	Nest depth
N1	Bulnes	36°44′09″S, 72°16′40″W	SW	-	3	24 Oct 2013	-	7.0 cm	3.5 cm
N2	Los Sauces	37°57′37″S, 72°49′42″W	ESE	5	3	26 Dec 2019	7–9 Jan 2020	6.0 cm	3.7 cm
N3	Los Sauces	37°57′37″S, 72°49′36″W	WNW	3	-	-	-	6.2 cm	4.1 cm
N4	Los Sauces	37°57′37″S, 72°49′35″W	ESE	-	4	1 Jan 2020	15 Jan 2020	6.0 cm	3.9 cm

grass stems, slightly inclined towards the entrance. These long stems were clustered by an agricultural machine during a previous harvest, as verified from satellite images taken the previous year (Google Earth, 14 February 2019). The eggs were photographed but no measurements were taken. They were creamy white speckled olive-brown throughout, but with a slight 'capped' effect, similar to those reported by Lombardi *et al*. (2010) in Brazil.

We visited the site again on 29 December 2019 and found another nest (N3), 45 m from N2, with three eggs: 20.55 ± 0.29 × 15.31 ± 0.2 mm (Fig. 2C). These measurements are slightly larger (by 0.44 × 0.58 mm) than the means reported by Salvador (2015) for *A. h. hellmayri* in north-west Argentina. The nest had an asymmetrical structure, with the lower edge facing the entrance and a reduced dome compared to N1 and N2. The same day we found three grey down-covered chicks in N2.

On 6 January 2020, we found the fourth nest (N4), 35 m from N3, with four nestlings (Fig. 2D) partially covered with grey down feathers. Their palate had yellowish choanal papillae. Again, the nest was cup-shaped and roofed with dry stems. To estimate the age of the nestlings we followed the guide for *A. spragueii* by Jongsomjit *et al*. (2007). Estimated hatching dates are shown in Table 1.

On 9 January 2020 N2 was empty. On 15 January 2020 N4 was empty and no eggs had hatched in N3, which had been abandoned by the adults; we confirmed this by watching the nest for five hours, during which time no adults approached it. We found a spider *Latrodectus thoracicus* using the nest to store prey and build a web across the cup. *L. thoracicus* was common in the grass mounds used by the pipits to nest.

Based on camera monitoring, we assessed that both members of the pair participated in provisioning food, confirming observations in Brazil (Sick 1997). All of the identified prey (n = 16) were grasshoppers (Orthoptera: Acrididae), although it is probable that they also feed the nestlings with *Conocephalus vitticollis* (Orthoptera: Tettigoniidae), a small conehead whose presence in the site was confirmed via Passive Acoustic Monitoring (PAM) analysis, and other small arthropods. After analysing the sonograms of our acoustic recordings, we noted a decrease in feeding rates at noon and during heavy winds. The largest interval between feeding events was 38 minutes, between 08.24 h and 09.02 h. The adults provided a mean 0.8 deliveries per minute.

In general terms, the breeding phenology of *A. h. dabbenei* is like that reported for Correndera Pipit in central Chile (Norambuena *et al*. 2017) but may show some variation depending on the arrival of pairs post-migration. For example, pairs incubating in late October is similar to the phenology of Correndera Pipit in Patagonia, which is also migratory to some extent, with the result that nesting can be delayed (Norambuena *et al*.

ISSN-2513-9894 (Online)

2017). In Aysén (43–49°S), territorial *A. h. dabbenei* have been reported in December and January (Raimilla *et al*. 2013). The seasonal difference between the nest found in 2013 and those in 2019 may indicate that some pairs are double-brooded. Another possibility is that egg laying occurs within a three-month window, as observed in Sprague's Pipit *A. spragueii* (Maher 1973, Sutter *et al*. 1996) and Ochre-breasted Pipit *A. nattereri* (Fraga 2001). We infer that the breeding season in south-central Chile starts in September–October with nest construction and egg laying, and ends around mid January when the last nestlings fledge.

Both of the two successful nests at this site were oriented east, consistent with findings for *A. spragueii* (Sutter 1997). The failed nest was the only one oriented west-southwest, in line with studies that have found a significant correlation between mean nest orientation and latitude in several ground-nesting passerines (Burton 2007). At middle latitudes nests facing east, rather than west, may warm more rapidly in the morning and are better protected from solar radiation in the afternoon (Nelson & Martin 1999). The coloration and size of the eggs are consistent with the observations of de la Peña (2013) and Lombardi *et al*. (2010), who reported nests in Argentina and Brazil, respectively.

The relatively short distance between the different nests found at Los Sauces and our failure to find more nests in nearby areas suggest that the species might possess a facultative semi-colonial breeding strategy, perhaps driven by agricultural pressure and limited habitat availability (Raimilla *et al*. 2012). Pairs left the nesting area in the first days after the young fledged the nest, probably to forage in long-grass areas, behaviour also observed in Argentine populations (J. I. Areta *in litt*. 2019). Diet was consistent with that described for *A. spragueii*, which feeds almost entirely on arthropods in the breeding season (Harris 1933b, Maher 1973).

More research is needed to better understand the breeding habitat requirements of *A. h. dabbenei* and how its populations respond to agricultural pressure. We recommend local stakeholders develop plans to protect its breeding habitat by designing harvest schedules that enable the birds to use remaining mounds for nesting.

Acknowledgements

We acknowledge the local farmers in Los Sauces for allowing us to enter their collective property and monitor the nests, and two referees for their comments on the submitted version of the manuscript.

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ISSN-2513-9894 (Online)