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# Incidental pinnipeds at high latitudes of the Vestfold Hills, Prydz Bay, East Antarctica

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**Abstract:** Species distributions are predicted to change with future climate-associated ecosystem changes such that so-called 'vagrant' individuals may become established or re-establish in areas currently thought to be beyond their principle ranges. Survey data were collated for occurrences of pinniped (seal) species at very high latitudes of the Vestfold Hills, East Antarctica. Aside from Weddell seals (*Leptonychotes weddellii*) and southern elephant seals (*Mirounga leonina*), which aggregate annually at the Vestfold Hills to breed and/or moult, three other pinniped species were observed with the recession of the fast-ice edge. Leopard seal (*Hydrurga leptonyx*) occurrences increased with an increase in a seasonally abundant prey resource, and crabeater seals (*Lobodon carcinophaga*) were seen at a time that coincides with their moult period. Occurrences of sub-adult male Antarctic fur seals (*Arctocephalus gazella*) increase the known southward range for this species and may reflect population increases at source populations in the Kerguelen Plateau area. Although there were no direct sightings of Ross seals (*Ommatophoca rossii*), their presence close to the Vestfold Hills was detected by underwater passive acoustic monitoring. Sightings of obligate drift-ice species and sub-Antarctic fur seals may change at the Vestfold Hills with climate-mediated changes in sea-ice conditions.

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**Key words:** Marine mammal, seal, vagrant

## Introduction

Five Phocidae (true seals) and one Otariidae (eared seals) species comprise the pinniped biodiversity of the Southern Ocean marine ecosystem south of 60° S; the phocids are Weddell seals (*Leptonychotes weddellii*), crabeater seals (*Lobodon carcinophaga*), leopard seals (*Hydrurga leptonyx*), Ross seals (*Ommatophoca rossii*) and southern elephant seals (*Mirounga leonina*), and the otariid is the Antarctic fur seal (*Arctocephalus gazella*). Ross, leopard and crabeater seals are found for most of the year within the drift-ice zone, whereas Weddell seals are primarily south of it within the fast-ice zone (Bengtson *et al.* 2011). With the summer sea-ice recession, the habitat of the drift-ice species contracts south to remnant ice floes, the land-fast ice and the land at coastal ice-free areas (Bester *et al.* 2006, Bengtson *et al.* 2011, Staniland *et al.* 2018). For the more sub-Antarctic species (the southern elephant seal and the Antarctic fur seal), the summer retreat of the drift-ice zone opens up high-latitude foraging areas and allows access to haul-out areas on the Antarctic coastline that are not usually occupied by those species (van den Hoff *et al.* 2003, Malpress *et al.* 2017, Salton *et al.* 2022). From long-term observations we know that each Antarctic pinniped species has a secondary distributional range that often extends north into low latitudes along the coasts of Southern Hemisphere continents and islands, and these individuals are often termed 'vagrants' (Acevedo *et al.* 2011, Shaughnessy *et al.* 2012, Miskelly 2015).

Prydz Bay (73.5° E, 69° S) is a large embayment of the Lars Christensen and Ingrid Christensen coasts that not only extends the East Antarctic continental shelf southward from a typically narrow latitudinal range of 62–65° S to ~70° S (O'Brien *et al.* 2014), it also extends the limits of the drift-ice zone southward by ~300 km. From observations beginning during the 1950s and continuing to date, we know Weddell, crabeater, leopard and southern elephant seals were seasonally present in the Prydz Bay area (Ingham 1960, Johnstone *et al.* 1973, Rogers & Bryden 1997, Southwell *et al.* 2008a,b,c, Kumar & Johnston 2014, Heerah *et al.* 2017, Malpress *et al.* 2017), suggesting high-latitude habitats are part of their primary ranges. Both the Ross seal and the Antarctic fur seal have not yet been directly observed at very high latitudes in ice-free areas such as the Vestfold Hills.

From December 2017 to March 2022, observers surveyed the Vestfold Hills for presences of pinniped species. I collated those observations with previous studies, compared species occurrences and re-assessed the status of those species within the survey area.

## Materials and methods

The survey area for this study was the coastline of the Vestfold Hills, including the adjoining fast ice, the fjords

and the nearshore islands from the Wyatt Earp Islands to the north to Sørsdal Glacier at the southern extent (Fig. 1). Changes in the sea-ice conditions dictated choice of survey platform. Over-ice vehicles were preferred for surveying the broader area when conditions were favourable. When ice conditions were not suited to over-ice travel, aerial surveys were conducted from helicopters flying at speeds between 40 and 60 knots at an altitude of 750 m often, but not always, between 14h00 and 15h00 local time (Lake *et al.* 1997, Rogers & Bryden 1997). Flight paths were monitored by GPS, each seal sighting was plotted onto a 1:50 000 map and, where possible, an image of the sighting was captured using a variety of film and digital cameras fitted with telephoto lenses. In-flight estimates of seal numbers and species identifications were verified from those images.

Localized shore-based searches of the coast between Powell Point and Ellis Fjord (Fig. 1) were done on foot. During periods of open water, boat transport was used to access offshore islands and the coastline south of Ellis Fjord to Sørsdal Glacier. Those terrestrial areas were then surveyed on foot. As a minimum, the date, a count by species and the location were recorded for each sighting.

The term 'pseudo-vagrant' is applied here to describe species that occur repeatedly but whose migratory routes are not well understood (Gilroy & Lees 2003).

## Results

Twenty-seven individuals of three pinniped species, not including Weddell and southern elephant seals, were reported during surveys of the Vestfold Hills between December 2017 and March 2022. Three sightings were of an otariid (the Antarctic fur seal), and the remainder were of two phocid species (the crabeater and leopard seals).

### The crabeater seal *Lobodon carcinophaga (Hombron and Jacquinot, 1842)*

Five crabeater seals were observed: four were seen during January and one was seen in February. Two individuals were on land, whereas the remainder were on the fast ice within Long Fjord (Fig. 1). An individual seen in Heidemann Bay had extensive healed bite wounds to its flanks and tail region (Fig. 2a).

### The leopard seal *Hydrurga leptonyx (Gistel, 1848)*

Eighteen leopard seals were recorded on ice floes north of Long Fjord during aerial surveys (Figs 1 & 2b). As many as nine individuals were sighted during a single survey, and all were on separate floes. Leopard seals were seen hunting Adélie penguins (*Pygoscelis adeliae*) close to shore at their breeding colonies on Gardner and other islands (author's personal observation 2001).

### The Ross seal *Ommatophoca rossii (Gray, 1844)*

No Ross seals were seen ashore or on the sea ice at the Vestfold Hills during the study period. However, their under-ice presence was betrayed when siren calls were recorded by passive acoustic monitoring (AMAR G4) between 16 December 2021 and 3 January 2022 (Fig. 1; Australian Antarctic Division, unpublished data 2022).

### The Antarctic fur seal *Arctocephalus gazella (Peters, 1857)*

Three sub-adult male Antarctic fur seals were seen. The first was in Heidemann Bay on 21 February 2016 and the second on 23 February 2019 (Fig. 2c), and the third (Fig. 2d) was seen 1 year later on 7 March 2020 at Riviera Point, just 2 km from the location of the previous sighting.

### *Status*

Crabeater seals and leopard seals were seen during two observational periods (1957–1973 and 2017–2022), Antarctic fur seals were seen only during the second survey period and Ross seals have not been seen during either period, but their vocalizations were recorded in the later period. Changes in the status of those species are given in Table I. Since little is known of the migratory behaviours of Antarctic fur seals from the Kerguelen Plateau area, this species was given a pseudo-vagrant status (Table I).

## Discussion

For the first time in 65 years of written biological history has the presence of an Antarctic fur seal been reported at the Vestfold Hills (Fig. 2c,d). The three individuals observed there represent the most southerly occurrences for this species to date. All individuals appeared to be in reasonable body condition, suggesting that they had foraged successfully over the course of their ~1700 km ocean transit between Heard Island (53° S, 73.5° E), the nearest breeding location for the species, and the Vestfold Hills. Antarctic fur seals on the East Antarctic coast appear to be exceptional because they had travelled south of their primary range rather than north of it (Shaughnessy & Burton 1986, Bester & Reisinger 2010, Acevedo *et al.* 2011). Limited southward dispersal for male Antarctic fur seals from natal colonies is known, and it is thought to be representative of reduced overlap with female foraging grounds and increased population size at natal locations (Boyd *et al.* 1998, Convey & Hughes 2022, Salton *et al.* 2022). Perhaps the same logic may be applied to the individuals seen in East Antarctica

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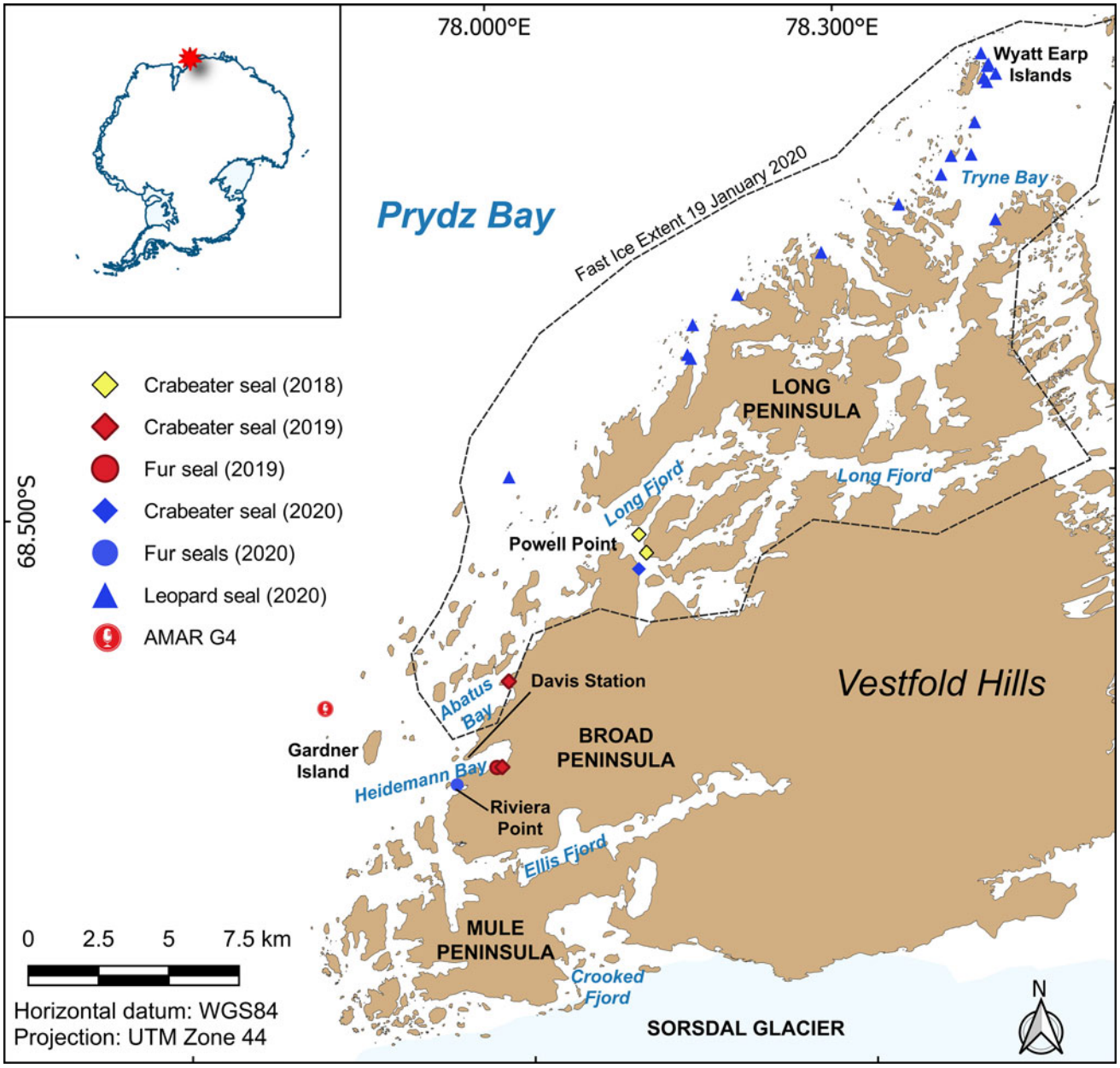


**Figure 1.** Map of the Vestfold Hills, East Antarctica, showing the locations of leopard seal (*Hydrurga leptonyx*; triangles), crabeater seal (*Lobodon carcinophaga*; diamonds) and Antarctic fur seal (*Arctocephalus gazella*; dots) sightings between 2017 and 2022. Light brown shading = ice-free land. AMAR = approximate location of an autonomous multichannel acoustic recorder.

but on a larger scale of dispersal. The Antarctic fur seal populations at Heard Island and Îles Kerguelen were increasing when last surveyed (Page *et al.* 2003, Jeanniard-du-Dot 2015), and some tracked juvenile males moved south from those islands (Raymond *et al.* 2015, Salton *et al.* 2022). The appearances of Antarctic fur seals at the Vestfold Hills therefore represent a consequence of population increases and avoidance of competition between the sexes. Our (human) current level of understanding of Antarctic fur seal migrations places that species firmly within the definition of a pseudo-vagrant (Gilroy & Lees 2003) to the Vestfold Hills.

Leopard seals are known to move south as the extent of their primary habitat - the drifting ice - recedes to the Antarctic coast during the summer (references in Hupman *et al.* 2020). Their regular occurrences at the Vestfold Hills appears to be a confluence of this seasonal recession in sea-ice extent, seasonal food availability in the form of Adélie penguins and the presence of remnant ice floes upon which individuals can haul out to rest (Johnstone *et al.* 1973). Adélie penguin remains

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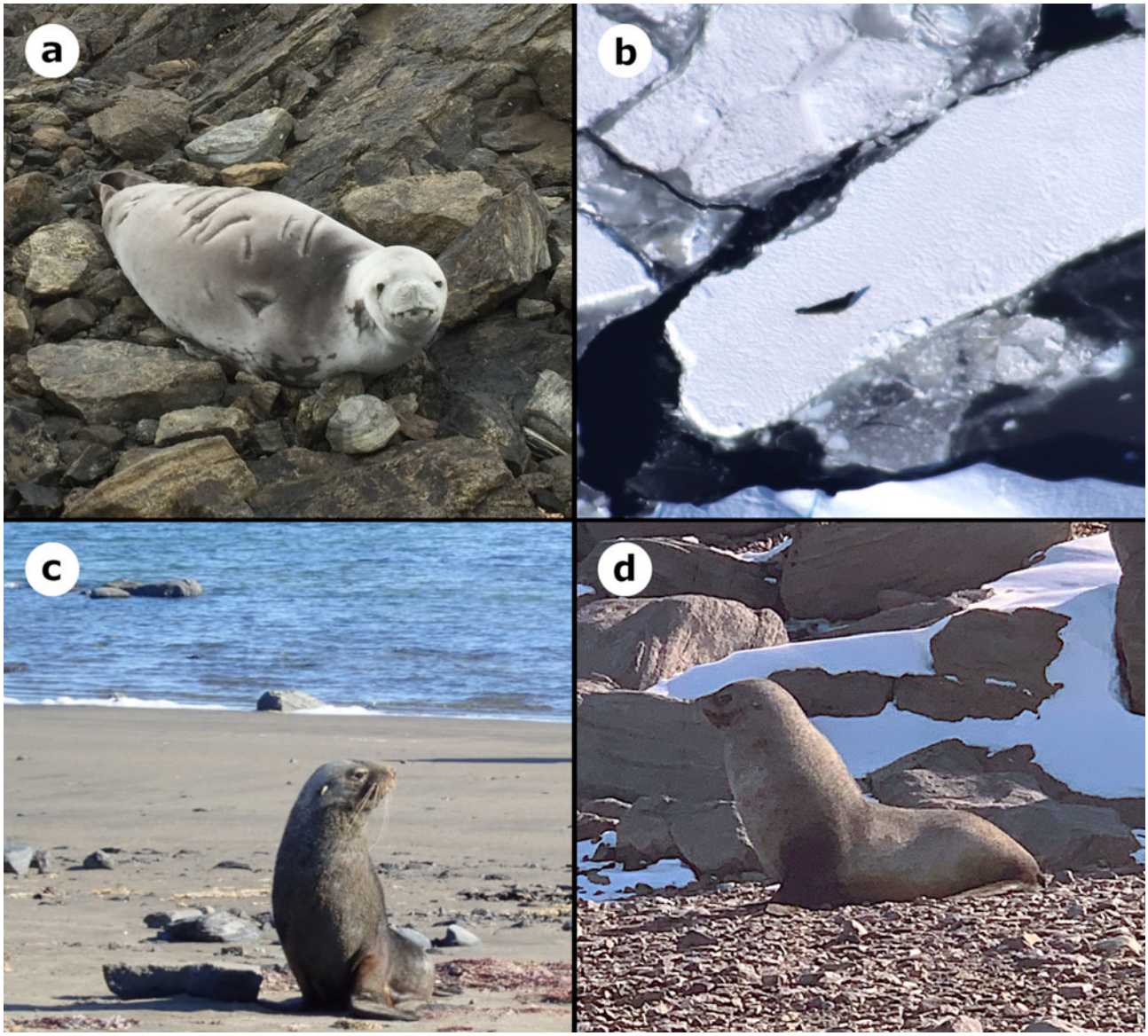


**Figure 2.** Incidental pinnipeds at the Vestfold Hills, East Antarctica. **a.** Crabeater seal (*Lobodon carcinophaga*) ashore at Heidemann Bay, 8 February 2019 (photograph: Kris Carlyon and Erica Adamson). Note the healed tooth rake marks indicating that this individual had escaped the jaws of a killer whale (*Orcinus orca*). **b.** Leopard seal (*Hydrurga leptonyx*) observed on an ice floe from an altitude of ~750 m on 18 February 2020 (photograph: Andrew Irvine). **c.** Sub-adult male Antarctic fur seal (*Arctocephalus gazella*) in Heidemann Bay on 23 February 2019 (photograph: Erica Adamson and Kris Carlyon). **d.** Another *A. gazella* ashore at Riviera Point on 7 March 2020 (photograph: Rachel McInerney).

were the most common prey items found in the diet of leopard seals at the ice edge in Prydz Bay (Rogers & Bryden 1995, McFarlane 1996, Hall-Aspland & Rogers 2004), and the individuals observed during this study were most often on remnant ice floes (Fig. 1b) at a time when Adélie penguins had aggregated in nearby areas for breeding. Although living leopard seals have not yet been reported ashore at the Vestfold Hills, their frozen carcasses have been found far inland in the Vestfold Hills and on the adjoining ice sheet (Johnstone *et al.* 1973), suggesting misadventure.

The progressive southward summer recession of the drift-ice zone probably also contributed to occurrences of crabeater seals close to the Larsemann Hills' coast (Kumar & Johnson 2014) and at the Vestfold Hills (Johnstone *et al.* 1973). Their occurrences at ice-free areas coincided with the moult period for this species (Kooyman 1981), and so it is plausible that the individuals seen at the Vestfold Hills were there to moult, but so far none have been reported doing so. Unfortunately for Southern Ocean ice-inhabiting marine mammal species, the retreating ice edge is a favoured

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**Table I.** Change in status of three pinniped species at the Vestfold Hills between two study periods.

| Species | 1957–1973[a] | 2017–2022 |
|---|---|---|
| Crabeater seal (*Lobodon carcinophaga*) | Occasional | Seasonal, long-term incidental |
| Leopard seal (*Hydrurga leptonyx*) | Occasional | Seasonal, long-term incidental |
| Ross seal (*Ommatophoca rossii*) | NR | Undetermined[b] |
| Antarctic fur seal (*Arctocephalus gazella*) | NR | Pseudo-vagrant |

[a]Johnstone *et al.* (1973).
[b]Vocalizations recorded in the area.
NR = not reported.

hunting habitat for large-form type B killer whales (*Orcinus orca*), and crabeater seals are on their list of vittles (Pitman & Ensor 2003). The tooth rake marks on the flank and tail regions of the crabeater seal seen in Heidemann Bay (Fig. 2a) are reminiscent of killer whale bite wounds observed on southern elephant seals (van den Hoff & Morrice 2008), and they suggest that this individual was fortunate to have escaped a 'butchering' by the killer whale (Pitman & Durban 2012).

The primary distribution of the Ross seal differs somewhat from other ice-inhabiting Southern Ocean pinnipeds. Studies suggest Ross seals typically forage north of the Antarctic drift ice for most of the year but return to it in October and January for breeding and moulting, respectively (Blix & Nordøy 2007, Southwell *et al.* 2008c, Arcalís-Planas *et al.* 2015). Indeed, more Ross seals have been seen ashore in Australia and New Zealand (Shaughnessy *et al.* 2012, Miskelly 2015) than have ever been seen at the Vestfold Hills. Although Ross seals were not observed in the study area, their distinct siren call vocalizations were recorded by autonomous acoustic monitoring (Fig. 1; Australian Antarctic Division, unpublished data 2022). Such an outcome serves to reiterate that no single survey method can be expected to provide all of the information required for a comprehensive survey of an area's biodiversity.

The literature contains numerous reports of living or indisposed individuals (or species) thought to have occurred beyond their natural ranges. Those individuals have been variously termed 'vagrants', 'biosecurity risks', 'accidental strays', 'transient visitors' and 'duds' (Davis & Watson 2018). However, they are also representative of increasing source populations, and in a dynamic world we might expect a change in the status of those purported climate refugees (Table I; Veit 2000, Lees & Gilroy 2014, Hupman *et al.* 2020). In this case, the regular or increasing occurrences of drift-ice seals at the Vestfold Hills suggest that the high latitudes have some secondary ecological importance to those species. None of the seals seen at the Vestfold Hills between 2017 and 2020 were individually marked, and no diet-related information was collected (e.g. scats). Therefore, at this stage, we can make no statements about potential new migratory patterns for those species, and we do not know how those individuals might interact with an ecosystem that is outside of their primary ranges.

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