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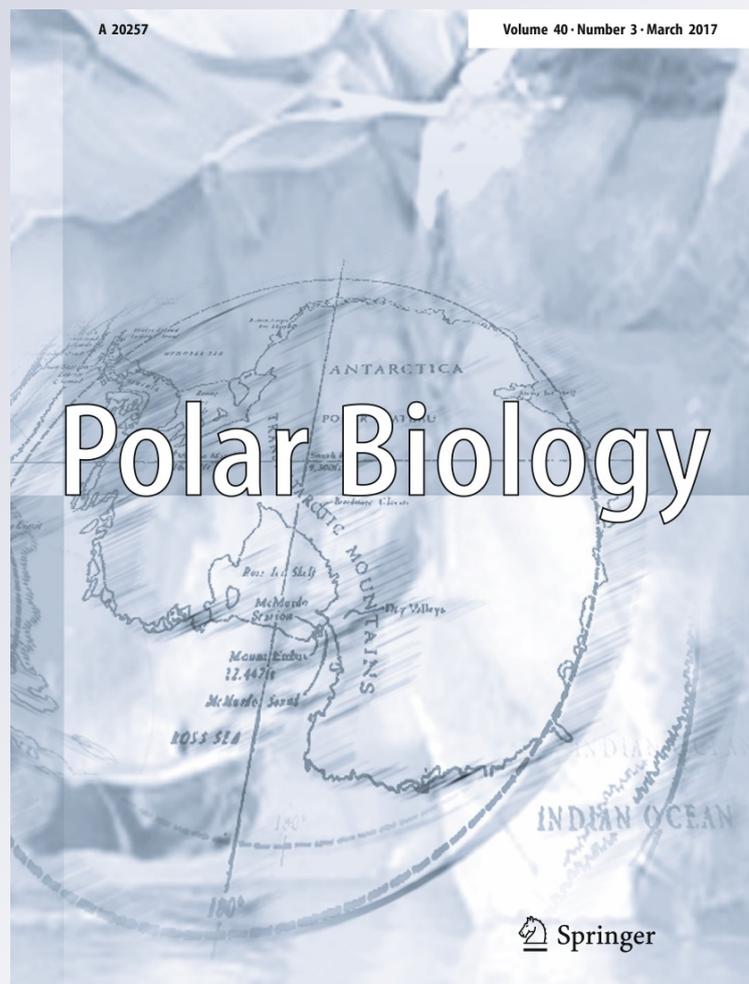
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Births of leopard seals *Hydrurga leptonyx* in southern Chile

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Abstract Leopard seals (*Hydrurga leptonyx*) are widely distributed within the Antarctic pack ice. Recently they have been reported further north, in the fjords of southern Chile, where individuals remain year-round, especially on Tierra del Fuego Island. Little is known of the leopard seals reproductive biology or breeding distribution, and more specifically, whether they use southern Chilean water to breed. Two recent opportunistic sightings of leopard seal adult–pup pairs were observed in Parry Fjord, Almirantazgo Sound, on 2 December 2012 and 6 October 2015. These are the first documented recordings of leopard seal pups in southern South America and the second and third records of leopard seal pups on the continents north of the Polar Front. Although the pups reported here were dead, these observations are important because they add new evidence that leopard seals pup asynchronously, unlike other ice-breeding seals. It provides further information regarding the leopard seals use of South American waters.

Keywords *Hydrurga leptonyx* · Pup · Birth · Chile · South America

Introduction

The leopard seal (*Hydrurga leptonyx* de Blainville 1820) is a true seal widely distributed to south of the Polar Front, inhabiting primarily on the circumpolar pack ice (Southwell et al. 2008; Rogers et al. 2005, 2013; Meade et al. 2015), with higher densities close to the pack-ice edge (Bester et al. 1995, 2002; Rice 1998; Rogers 2009). The distribution also includes small permanent concentrations in Antarctic and sub-Antarctic Islands such as Heard Island (Brown 1957), Auckland and Campbell Islands (King 1983) and Kerguelen Islands (Paulin 1952; Bester 1981; Bester and Roux 1986). Small seasonal groups have also been recorded in the Falkland Islands (Hamilton 1939), South Georgia Islands (Hamilton 1939; Walker et al. 1998), Macquarie Island (Gwynn 1953; Rounsevell and Eberhard 1980), and Marion Island (Bester et al. 2006).

Because leopard seals are solitary animals that live mainly in the Antarctic pack ice, little is known about their reproductive biology (Southwell et al. 2003). Individual breeding female leopard seals give birth to a single pup on the floating pack ice where most breeding occurs. Some exceptional births north of the pack ice have been reported at Heard Island (Gwynn 1953; Brown 1957), Bird Island (Walker et al. 1998) Falkland Islands (Gwynn 1953) and other on the snowy coast of Ardley Island, South Shetland Islands (Torres pers. comm.). Information on the timing of pupping is also limited by the paucity of sightings at this time of the year when the extent of pack ice is intermediate or close to maximal making the access very difficult (Rogers 2002, 2009; Southwell et al. 2003). Information regarding birth of pups comes from observations of near-term fetuses and sighting of pups accompanied by a respective adult (e.g., Siniff and Stone 1985; Southwell et al. 2003), as well as through acoustic behavior (Rogers et al. 1996). However, it

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is not known whether breeding females remain continuously on the ice for the duration of the lactation period, as do another Antarctic seals (Testa et al. 1989; Southwell 2004) and are only on the ice intermittently (Southwell et al. 2008). It is also unclear on the duration of lactation across the entire breeding season, because of asynchrony in pupping. It has been suggested to be short as 10–14 days (Brown 1957) to long as 8 weeks (Maxwell 1967). The most frequently cited period of 2–4 weeks (King 1983; Laws 1984; Reidman 1990; Southwell et al. 2003).

Along the coast of Chile, leopard seals have been reported from the nineteenth century to date (Aguayo-Lobo et al. 2011; Torrejón et al. 2013). Sightings have included immature and adult individuals of both sexes, especially in glacial areas such as in Laguna San Rafael National Park (46°41'S) (Torres et al. 1979; Boop 2014) and year-round in some fjords and channels in the southern tip of South America (south of 53°43'S) (Markham 1971; Aguayo-Lobo et al. 2011; Acevedo and Martinez 2013). Interestingly, one leopard seal pup was reported and filmed in Laguna San Rafael National Park on October 25, 2013 (<https://www.youtube.com/watch?v=kgksZV0vUa4>, Boop 2014), but no evidence of breeding activity or pups has been previously recorded in the southern tip of South America. Here, we present the first observations of births of leopard seal pups at Tierra del Fuego Island and add new evidence that leopard seals pup asynchronously, unlike other ice-breeding seals. It provides further information regarding the leopard seals use of South American waters.

Materials and methods

Records of leopard seal pups in this note were obtained opportunistically by two of us (AG and SG) aboard of L/M “Nueva Galicia” in 2012, and researchers of Fundación CEQUA (IG and RG) in 2015 during a sea-ice monitoring aboard of helicopter HH 65 “Dauphin” of the Chilean Navy. Both sightings were recorded in Parry Fjord, Tierra del Fuego Island, and the adult–pup pairs were observed on ice floes at glacial areas (Fig. 1). Photographs of each adult–pup pair were obtained with digital camera Nikon D200 and D300 equipped with lens of 80–200 mm for document the presence of those pups. Geographic position and short observations of the adult–pup pairs were taken in both cases.

Results and discussion

On December 2, 2012, a pup accompanied by an adult was observed in the eastern arm of Parry Fjord (54°04'25"S, 69°20'24"W) during a touristic voyage. Viewing

conditions were optimal (e.g., undisturbed sea surface) and sunny. During their short time in the sector (approximately 40 min), they noted that the pup was dead and in poor physical condition (Fig. 2a). No placenta was observed in the place suggesting that pup had been born days ago. Despite the pup's death, the adult individual always remained close to the pup.

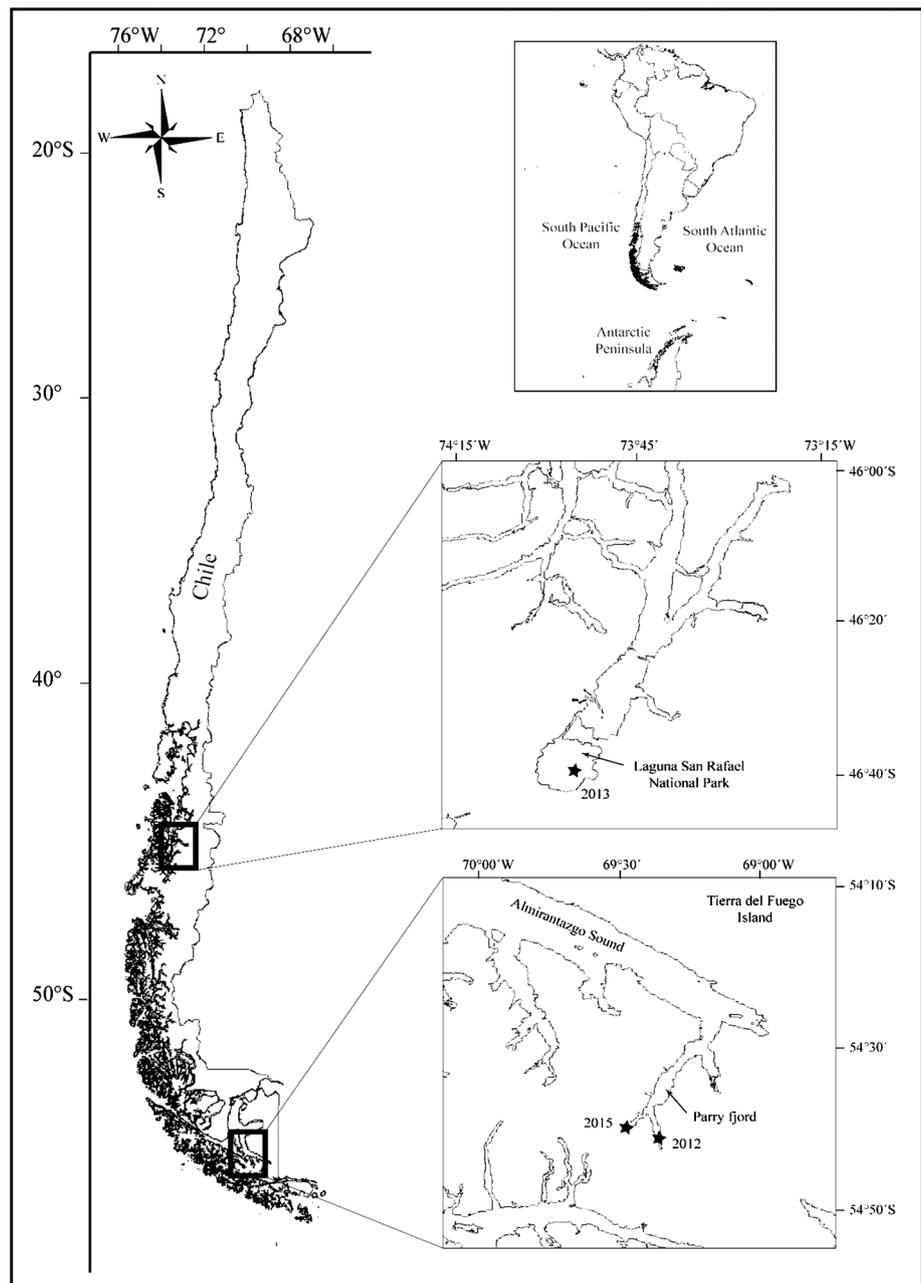
A second pup accompanied by an adult was photographed in the western arm of Parry Fjord (54°40'44"S, 69°30'40"W) on October 6, 2015 on a small piece of ice floes (Fig. 2b), and no placenta was observed in the place suggesting that pup had been born days ago. Like the first pup, this one was dead, presenting an obvious wound on its belly. During the approach, the adult seal repeatedly held the pup by the head trying to move toward the water. In October 13, two of the authors (JA and IG) visited Parry Fjord again, on board the Chilean Navy vessel “Ona”, and although one leopard seal was seen in the water, we did not reach the head of the fjord where the adult–pup pair was previously registered.

To our knowledge, the presence of at least two leopard seal pups reported here and the one born in Laguna San Rafael National Park (Boop 2014) are the first records of births on the continent to the north of the Polar Front. The only leopard seal births reported to north of their natural breeding range are at Heard Island (Brown 1957), Bird Island (Gwynn 1953; Walker et al. 1998) and another in an exceptional circumstance on the Falkland Islands (Gwynn 1953). Although the two pups reported here were observed dead, these observations are important because they add new circumstantial evidence that an unknown number of leopard seals remains year-round in the southern area of South America. If this is added that immature and adult individuals of both sexes are seen throughout the year (Aguayo-Lobo et al. 2011) and the long occupation by a identified leopard seal in the Fuegian Region (Acevedo and Martinez 2013), it reinforces the idea of a stable sub-Antarctic population in the southern area of South America as inferred by some previous sources as Torres et al. (1979) and Aguayo-Lobo et al. (2011).

It is also interesting to note that a small leopard seal (visually estimated at 180-cm long) observed by two of the authors (JA and AAL) unaccompanied by an adult was observed resting on a small ice floe in November 28, 2003 at Parry Fjord (Aguayo-Lobo et al. 2011). Considering that the length between birth and the first 6 months of this species is about 1.2–1.9 m (Valette 1906; Matthews 1929; Hamilton 1939; Jefferson et al. 2008), this small individual could possibly have also been a pup born at Parry Fjord, Almirantazgo Sound.

Leopard seals breed on the pack ice where they are solitary and sparsely distributed. In Antarctic, pack ice cover varies by the season, from a maximum between

Fig. 1 Locations where the leopard seal pups were observed (*star*) in Parry Fjord provided year of those records. The figure also includes reference of the location of the leopard seal pup born in Laguna San Rafael National Park in 2013



August and October to a minimum between February and March (Rogers 2002). Presence of one leopard seal pup in Laguna San Rafael and another two pups at Parry Fjord appear to be close enough to Antarctic environment, with low thermal characteristics in both water and air temperature and presence of floating ice from the glacier and/or pack ice, providing a favorable breeding habitat. Another potential fjord at Tierra del Fuego Island where low thermal with presence of floating ice from the glacier and/or pack ice and leopard seals are Hyatt Sound at D'Agostini Fjord and Brookes Bay at Ammirantazgo Sound, but scarce

surveys between September and December have been made.

The understanding of the timing of pupping on this species is extremely limited and even speculative in some reports. The observations of leopard seal pups in the wild suggest an asynchrony in the births caused by the loss in daily rhythmic activity under continuous lighting regimes of summer and winter at high latitudes (Southwell et al. 2003; Rogers et al. 2013), as seen in the Arctic reindeer (van Oort et al. 2005). The four births reported in Subantarctic Islands to north of Polar Front have been



Fig. 2 Leopard seal pups seen at Parry Fjord in 2012 (a) and 2015 (b)

reported from September to mid-November (Matthews 1929; Gwynn 1953; Brown 1957; Walker et al. 1998). Gwynn (1953) noted that R. Vallentin secured a skin from the Falkland Islands which is now in the British Museum. Unfortunately, he does not refer to the incident in any of his papers about the Falkland Islands, but the Museum label reads “Shallow bay, west Falkland”, “found on shore with mother by native”. South of Polar Front, the few observations note in September and November at the South Orkney Islands (Hamilton 1939) and November in the Antarctic Peninsula region (Siniff et al. 1978). From observations of near-term fetuses and nursing pups, Siniff and Stone (1985) inferred that births occur from October to mid-November, while Southwell et al. (2003) reported that adult-pup pairs were sighted between early-November and late-December in East Antarctica. From acoustic behavior and reproductive hormone studies, the leopard seal is believed to breed between November and first week of January (Rogers et al. 1996). Although the accounts are not sufficient to permit a full comparison, it is generally accepted that birthing occurs from October to December (e.g., Rogers 2002, 2009; Southwell et al. 2003; Jefferson et al. 2008).

The two pups reported at Parry Fjord and those reported in Laguna San Rafael National Park would be consistent

with the asynchrony suspected. The pup born in Laguna San Rafael National Park was observed on late October accompanied by an adult and the placenta was still in the place, suggesting that the pup had been born a few hours beforehand (Boop 2014). The same case would be for the pup sighting in early December at Parry Fjord, suggesting that pup was born days ago in late October. However, the second pup reported in 2015 at Parry Fjord was seen in early October without placenta, suggesting that pup was born days ago and even late-September. Although the later birth in September or earlier in October may be a premature birth, as noted Matthews (1929) for a very weak and feeble pup observed in Else Bay, South Georgia Islands, the pup photographed in early October of 2015 at Parry Fjord was in not emaciated condition, suggesting that the death would have been caused by other unknown factors than nutrition or lack of interest by the mother.

Although analysis of birthing period is beyond the scope of this paper, such analysis with more data could provide insights into the little-known timing of pupping of these pack-ice seals. Finally, although the observations presented here are limited only for two leopard seal pups, it is important to note the occurrence of births outside their natural breeding range (Antarctic) in the last three years, and we have a long-term interest into continue monitoring their status to improve our understanding of this species in the southern tip of South America. Observations of the presence or absence of pups with adults could facilitate the planning and design of population surveys as well as in the conservation effort of these areas in mainland coast.

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