

Note on the first modern record of a southern elephant seal (*Mirounga leonina* Linnaeus, 1758) in Los Ríos Region, southern Chile

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The distribution of southern elephant seals (*Mirounga leonina* Linnaeus, 1758) in the southeastern Pacific has been subject to revision in recent years (Acevedo et al., 2016, 2019; Cárcamo et al., 2019). Southern elephant seals were hunted close to extinction by humans (Hindell & Perrin, 2009; Acevedo et al., 2016, 2019). However, since the late 20th century they have been re-colonizing breeding sites in southernmost Chile's Magallanes Region (e.g. Cáceres, 2013; Acevedo et al., 2016; Capella et al., 2017). The recent documentation of pups and a birth event at different latitudes of the southeastern Pacific coast as far north as 38°22' S suggests that the species is extending its southeastern Pacific distribution back to its historical continental range of up to 37° S (Acevedo et al., 2019; Cárcamo et al., 2019). A fossil record from the colder than recent Pleistocene indicates that elephant seals (*Mirounga* sp. Gray, 1827) in the southeastern Pacific prehistorically ranged as far north as northern Chile's Antofagasta Region (around 23° S; Valenzuela-Toro et al., 2015). Southern elephant seals are known to undertake extensive travels of up to several

thousand kilometers and to show site fidelity to foraging regions as well as to breeding and molting haul-out sites (e.g., Campagna et al., 1999; Bradshaw et al., 2004; McIntyre et al., 2017). In the southeastern Pacific, intra-annual shifts in food resource availability related to coastal upwelling cycles, and the occurrence of La Niña phenomena have been discussed as possible explanations for the repeated appearance of individuals farther north in Chile (Sepúlveda et al., 2007; Pacheco et al., 2011), Ecuador (Páez-Rosas et al., 2018), Colombia (Ávila et al., 2021), and Panama (Redwood & Félix, 2018). Like in southern Chile (Acevedo et al., 2019; Cárcamo et al., 2019), increasing numbers of anecdotal southern elephant seal sightings in the Eastern Tropical Pacific have been recently hypothesized to result from two causes that would hence outweigh ENSO (El Niño-Southern Oscillation) cycling as sole possible contributor: 1) a possible density-dependent extralimital growth of the three Atlantic populations, and 2) global climate change-related large-scale regime shifts in the Southern Ocean (Alava et al., 2022). An observed prevalence of often immature or subadult males in all of these northerly anecdotal sighting reports – at their time often considered to be linked to vagrancy (Páez-Rosas et al., 2018) – has been attributed to sex-based differences in southern elephant seal foraging behavior/dietary niches and to age-dependent experience in the selection of haul-out sites (Mulaudzi et al., 2008; Acevedo et al., 2016; Sepúlveda et al., 2018). On a global scale, extra-distributional coastal sightings include male adults in the southeastern Atlantic (Bester et al., 2022) and, among others, infants in the southwestern Atlantic (Siciliano et al., 2020), encouraging comparative studies concerning (re-)colonization and range extension processes.

As research on the ecology and behavior of southern elephant seals in their re-colonized historic southeastern Pacific range is only beginning, detailed observations of single sightings might help to further develop working hypotheses. Therefore, details of the first modern record of a southern elephant seal in Los Ríos Region, near 40° S in southern Chile (Fig. 1A), are described here. Cárcamo et al. (2019) had already collected census data to reassess the distribution of southern elephant seals in the southeastern Pacific. They included southern elephant seal

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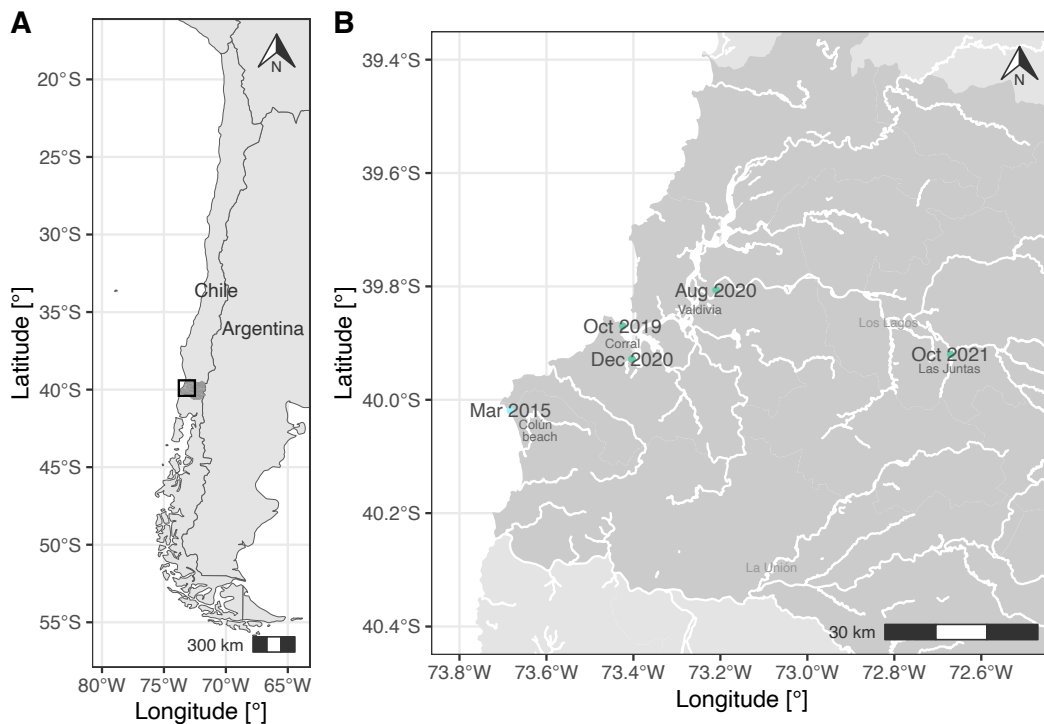


Figure 1. A) Map of continental Chile within South America's southern cone with Los Ríos Region (dark gray shading) and location of the enlarged area (black rectangle) represented in the map in B. B) Approximate location where the southern elephant seal (*Mirounga leonina*) was found on 03 March 2015 (light blue dot), and locations of SERNAPESCA (2022) records of southern elephant seals after 2015 (greenish dots) along the major inland bodies of water (white lines). Dates of records are abbreviated as the first three letters of the corresponding month and the year. Relevant places are indicated for orientation.

sighting records from authorities (Servicio Nacional de Pesca y Acuicultura/Chile - National Fishery and Aquaculture Service of Chile – SERNAPESCA); records from 2009 to 2016) and social media (from 2007 to 2017) in their analysis. The record described here in detail appears in Fig. 1 (a) of Cárcamo et al. (2019) as a 'Sernapesca Record,' roughly at 39° S, recorded by SERNAPESCA. The note at hand, besides providing detailed insight, aims to put the first record into a regional context in order to further discard earlier hypotheses of vagrancy and/or of the effects of the individual's condition. Therefore, southern elephant seal stranding data collected by SERNAPESCA were obtained through a more recent (October 2022) request. These data, covering the entire Chilean coast until July 2022, were filtered for Los Ríos Region and are henceforth referred to as SERNAPESCA (2022).

Anecdotal observations in coastal southern Los Ríos Region from 2012 to 2015 revealed no pinnipeds other than South American sea lions (*Otaria flavescens* Shaw, 1800). In early March 2015, HN was informed by staff of the local coastal reserve Reserva Costera Valdiviana (The Nature Conservancy) about the presence of a reportedly rather weak, large seal near the locality of Chunquey on the beach of Colún (Fig. 1B; Comuna de La Unión). SERNAPESCA (2022) named the beach erroneously 'Cohuin' and specified the coordinates (for 26 February 2015) as 39°51'13.32" [39.8537°] S, 73°41'0.48" [73.6835°] W. The latitude datum, however, cannot be correct since it is located offshore (cf. Fig. 1B). Except for a mild number of visitors during midsummer months, the vast sandy

beach of Colún is rarely visited by people. The seal had been observed by local conservationists and residents for several days since late February, despite the longitudinal extension of the beach of ca. 9 km, reportedly always at approximately the same spot. Field observations were carried out around noon of 03 March 2015 under conditions of strong insolation and low air humidity, a few days before the seal reportedly disappeared from the beach, presumably into the sea. Observer distance to the seal was kept at ≥ 15 m. Photographs and video footage were taken (Canon PowerShot SX130 IS); filmed behaviors are available on request. Maps were created with R (version 4.3.0; R Core Team, 2023) in Rkward (version 0.7.5; Friedrichsmeier & the Rkward Team, 2022), using the package 'chilemapas' as a basis. Data of continental bodies of water were extracted from OpenStreetMap® (2023).

Given the pronounced proboscis (Fig. 2A) and the total body length of an estimated 4 m, the seal was identified as a male southern elephant seal (Laws, 1956a) of adult size (Hindell & Perrin, 2009). In addition to the southern latitude, the lack of a reddish, scarred chest shield (Fig. 2B) and the seal's head shape/proboscis' relative length indicated that it was a southern, rather than a northern (*M. angustirostris* Gill, 1866) elephant seal (Hindell & Perrin, 2009). In the recent data from SERNAPESCA (2022), this southern elephant seal is recorded as a subadult male. According to Laws (1956a), male southern elephant seals reach sexual maturity at five to six years of age, but do not reproduce before their seventh year and may therefore be called subadults. However, classification by means of exterior physical appearance

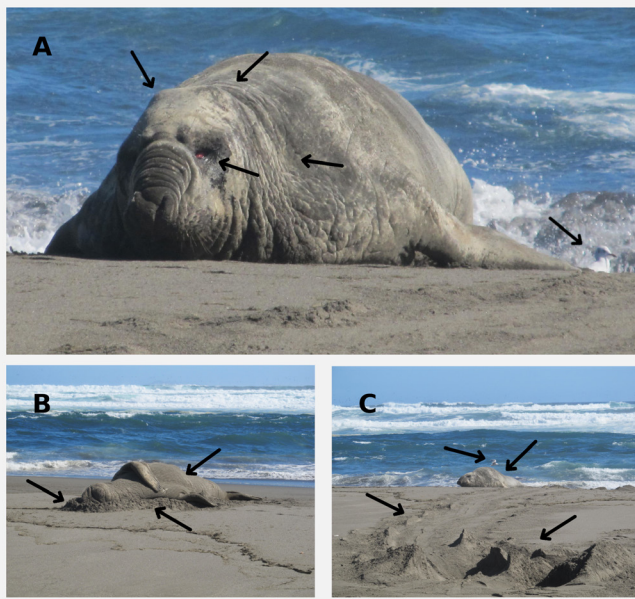


Figure 2. A) The southern elephant seal encountered on the beach of Colón on 03 March 2015 was a male of adult size. The left of his scarlet, presumably infected, eye sockets is visible in the photograph. Note the area of his neck and shoulders and the outline of his skull bones that indicate a weak body condition. No interaction with the brown-hooded gull visible in the background was observed. B) The southern elephant seal male also lay on his right side and back, hiding these body parts in the sand within a small sand parapet. Note the lack of a thick blubber layer on thorax and abdomen. Also, scars foremost on the chest, that would be expected in fully adult, sexually active males, are missing. (C) The southern elephant seal had presumably moved with tide over the vertical extension of the beach, thereby leaving visible marks in the sand. Again note the seal's lean condition and the brown-hooded gull flying nearby.

is nearly impossible for these age classes (Laws, 1956a). In the individual at Colón, despite an otherwise adult, or even old-aged, appearance, subadulthood was corroborated by a complete lack of scars on neck and chest (Fig. 2B), that in sexually reproducing males are the product of intra-sexual aggression (Laws, 1956a). The specimen was visibly emaciated (Fig. 2A – C). According to the aforementioned reports by locals and the observations of 3 March 2015 (behaviors displayed: mostly lying still, short head-lifting, short mouth-gaping (Murphy, 1914), occasional body rotation (Fig. 2B), and sand-throwing (Laws, 1956b)), it can be assumed that a low, however not necessarily unhealthy, activity level prevailed. The distribution of sand parapets and locomotion marks (Fig. 2C) indicated that the seal had moved along the beach transect, presumably with tide. No interactions with the only other vertebrate animal present, a brown-hooded gull (*Chroicocephalus maculipennis* Lichtenstein, 1823; Fig. 2A, C), were discerned during the hour of observation. This is worthwhile to mention given the documentation of (sea-) birds feeding on marine mammals (Azizeh et al., 2021), including pinnipeds (Gallagher et al., 2015), also in Chile (Pavés et al., 2008). Furthermore, there is evidence from Chilean Patagonia of predation by dogs (*Canis lupus familiaris* Linnaeus, 1758) on southern elephant seal pups (Acevedo et al., 2019; SERNAPESCA, 2022). Footprints of terrestrial carnivores, presumably of (de-) domesticated dogs, were found in the upper parts of the beach of Colón.

Because of the Humboldt Current System's summerly extension to 42° S (Thiel et al., 2007), there is no reason to presume that a general lack of food resources could have led to the seal's weak state. Considering his likely age of ≥ 6 years (Laws, 1956a; also see Pacheco et al., 2011), possibly a first try to socially establish himself for reproduction, an energetically demanding endeavor due to intra-sexual competition at breeding sites, might have led to weight loss (Laws, 1956a). The lack of scars however renders other reasons, foremost, extensive traveling, more likely. Furthermore, both his eye sockets showed signs of infection (Fig. 2A). SERNAPESCA (2022) called this a "blepharal conjunctivitis." It was not possible to determine whether his vision was affected by this infection. Neither could his eyeballs be discerned in field or in photographs (Fig. 2A). Thus, it remains unknown if they were intact, affected by the infection, or even missing (e.g., from a genetic defect, an accident, an interspecific interaction, and/or the infection). But if his vision was hampered, his abilities of prey detection might have been restricted, which could have led to starvation. southern elephant seals rely mainly on their vibrissae to sense when foraging, but vision still accounts for at least 20% of their sensing while they forage (Vacquién-García et al., 2012; Adachi et al., 2022).

The recent data from SERNAPESCA (2022) reveal that this has not remained the only southern elephant seal sighting in Los Ríos Region. By July 2022, four more single individuals had been recorded: one in late winter (August 2020), two in spring (October 2019 and 2021), and one in early summer (December 2020; Fig. 1B). All but a juvenile whose sex could not be determined (December 2020) were males: one juvenile (October 2019), one subadult (August 2020), and one adult (October 2021). The subadult southern elephant seal corresponds to the one recorded in winter. In the sub-Antarctic Indian Ocean (Marion Island), for so far unknown reasons, immature male southern elephant seals haul out in winter – compared to females much more regularly and, in contrast to females, throughout subadulthood (Kirkman et al., 2004). The subadult in Los Ríos Region from August 2020 might indicate that such patterns are starting to occur here, too. Both the subadult and the adult in Los Ríos Region were found $\gg 10$ kilometers upstream the regional river system (Fig. 1B). The adult, with a scar on his back likely stemming from a marine propeller (for a similar observation in northern Chile, see Sepúlveda et al., 2007), was noted down to possibly have spent several weeks or even months in the area – according to citizens, including the Region's capital, Valdivia. When documented by SERNAPESCA (2022) in October 2021, the animal had hauled out to a meadow at about 160 m from the river. The haul-out of male adults initiates the breeding season of southern elephant seals in spring (Hindell & Perrin, 2009). The adult male recorded by SERNAPESCA (2022) could hence be an early sign of intents to locally establish new breeding sites, as it has been hypothesized for similar cases, e.g., in Ecuador (Félix, 2018) – in Los Ríos Region however likely on historic grounds. Furthermore, March 2015, when the first record of a southern elephant seal in Los Ríos Region was made, was the onset of the strong El Niño of 2015/2016 (Chen et al., 2016; Santoso et al., 2017). It is therefore unlikely that ENSO, especially La Niña – before 2015 last recorded for 2010-2012 (Luo et al.,

2017) and after 2015 in 2020/2021 (Li et al., 2022) –, alone is driving the recent cases of southern elephant seal appearances in Los Ríos Region. Back in 2015 it could still be hypothesized that the southern elephant seal found on the beach of Colún was a vagrant individual, possibly affected by weight loss and/or the eye infection. But all recent records together further corroborate the observations of a current re-colonization process by southern elephant seals in the mid-latitude southeastern Pacific, with increasing occurrence also in Los Ríos Region and, like elsewhere (e.g., Sepúlveda et al., 2018), including riverine haul-out sites. Concurrently, the records underscore the need for further monitoring. Viewing the 2015 seal's physical condition and eye infection, veterinary surveillance is necessary, as is attention to interspecific interactions potentially hampering conservation, and to threats imposed by boats. Most urgent, however, is regional monitoring in light of potential spatial conflict with humans. Therefore, future research should focus on the habitat types used during the different phases of the southern elephant seal annual cycle. The practice of SERNAPESCA to include notes on the localities' habitat characteristics in their records is hence very useful. For instance, southern elephant seals elsewhere prefer dense inshore vegetation during early, tightly shared muddy wallows during mid, and sandy beaches during late stages of molt (Paterson et al., 2022). The latter coincides with the first modern sighting in Los Ríos Region described here. The beach of Colún offers southern elephant seals the advantage of little to no anthropogenic disturbance. It is therefore strongly recommended that the maintenance and, if necessary, amplification of the local conservation management be implemented by Reserva Costera Valdiviana in conjunction with the local communities.

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