



FIRST RECORD OF TWIN FETUSES OF SOUTH AMERICAN SEA LION ON THE SOUTHERN BRAZILIAN COAST

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Abstract: We report the first known occurrence of South American sea lion (*Otaria flavescens*) twins on the South American coast. In January 2021 a female pregnant with dizygotic male and female fetuses was found dead in southern Brazil. The timing of the stranding event suggests that the pregnancy was near-term. However, the total body length and weight of fetuses suggested poor development and growth, which could be due to the advanced age of the mother and/or poor nutrition of the individual during pregnancy. The female fetus was larger and heavier than the male and could have been implanted and developed earlier.

Keywords: *Otaria flavescens*, otariids, pinnipeds, pregnancy, twinning.

In mammals, reproduction demands a very high energetic investment from females (Clutton-Brock 2019). This energy expenditure is high during gestation and even higher throughout the lactation period, considering that milk is typically rich in nutrients, hormones, vitamins, and immune compounds (Roulin 2002). Like other marine mammals, pinnipeds usually give birth to a single pup annually. The occurrence of twinning is rare, accounting for an average of less

than 1% of births (McMahon & Hindell 2003). It is considered a disadvantageous trait as it increases the demand for fetus development and milk production (Doidge 1987, Haase 2007), especially for species with extended lactation periods, such as otariids (Oftedal *et al.* 1987). During lactation, otariid females alternate periods on land (nursing their offspring) with periods at sea (during which pups remain on land fasting).

Many twinning reports rely on circumstantial

observational evidence, which might erroneously include cases of fostering and allo-suckling (Franco-Trecu *et al.* 2010). For otariids, confirmed cases of twinning, either from in utero observation, witnessing of births or genetic evidence, have been reported for the Australian (*Neophoca cinerea*), Steller (*Eutometopias jubatus*), and Californian (*Zalophus californianus*) sea lions; and for the New Zealand (*Arctocephalus forsteri*), Cape (*A. pusillus*) Subantarctic (*A. tropicalis*), Antarctic (*A. gazella*), South American (*A. australis*) and Northern (*Callorhinus ursinus*) fur seals (Spotte 1982, Ling 1986, Dowell *et al.* 2008, Hoffman & Forcada 2009, Maniscalco & Parker 2009, Gutiérrez *et al.* 2021). An anecdotal report from 1939 mentions dizygotic male twin fetuses of South American sea lion (*Otaria flavescens*, hereafter SASL) approximately 16.5 cm long from a female killed at the Falklands-Malvinas Islands (Hamilton 1939).

The SASL is widely distributed along the South American coast, from northern Peru to southern Brazil (Vaz-Ferreira 1982). There are no rookeries of the species on the Brazilian coast, but two haulout sites: Wildlife Refuge of Ilha dos Lobos, Torres (29°20'S) and Wildlife Refuge of Molhe Leste, São José do Norte (32°11'S), where males are seen year-round (Procksch *et al.* 2020). In the subtropical South Atlantic Ocean, the main breeding activity occurs at the Uruguayan coast (Figure 1), where a population of approximately 10,000 individuals is declining at an annual rate of 2% (Franco-Trecu 2015). Otariids in general represent the most dimorphic taxa among mammals (Weckerly 1998), where males are two to four times larger than females (Riedman 1990), and SASL is not the exception (Rosas *et al.* 1993). They are also highly polygynous; males attempt to mate with as many females as possible (Vaz-Ferreira 1982) in different mating systems (Franco-Trecu *et al.* 2015), while females must produce and rear a pup successfully. The breeding season of the species in Uruguay begins in late austral spring (mid-December), with males arriving at the rookery and setting up territories (Franco-Trecu *et al.* 2015). Most females arrive at the rookery around mid-January and give birth to a pup in the following days (Franco-Trecu *et al.* 2015). Pups are usually born between 75 and 86 cm long, with body masses from 12 to 15 kg (Cappozzo & Perrin 2009). Female SASLs nurse

their pups for 8-10 months (Campagna & Le Boeuf 1988). Male pups grow more slowly and demand extra energy investment from their mothers (Drago *et al.* 2021).

On January 26th, 2021 we found a dead 200 cm-long female SASL during a beach monitoring survey, 193 km south of Cassino Beach, Rio Grande, RS, southern Brazilian coast (33°29'26"S; 53°2'9"W) (Figure 1). The carcass had two dizygotic near-term fetuses in its womb (Figure 2): a female and male with 80 cm and 77 cm, and 5.010 kg and 4.054 kg, respectively (Figure 3). The advanced decomposition stage of the carcasses prevented more detailed body measurements. Due to the likely water loss associated with the decomposition process, body mass information should be considered approximate. We identified sex through an external examination of the genitalia region and internal organs.

The sea lion mother was around 17 years old when it died, as estimated by counting dentine growth layer groups in a longitudinally sectioned canine tooth (Payne 1978). The longevity of SASL females in the wild is around 20 years, and they are usually sexually mature at five years of age (Rosas *et al.* 1993, Grandi *et al.* 2010). Based on the mother's age, we can assume that it was probably reproductively experienced. It also seemed to be in a good nutritional condition, even though it had an empty stomach, indicating that the individual had not eaten recently before death.

The timing of the stranding event corresponds to the period when most SASL pups are born on the Uruguayan coast (Vaz-Ferreira 1982), suggesting that the pregnancy was indeed near-term. Along our study area, only 7.4% of all pregnant SASL stranding events occurred during summer, more specifically in January (S. Botta, personal communication). These events probably resulted from particularly late individuals for the breeding season. The arrival date at the rookery must be precise and pregnant females must compensate for possible delays. For instance, it has been shown that northern elephant seal (*Mirounga angustirostris*) females that are further away from the rookery travel faster than the others to arrive at the precise time window to give birth, and even cut their pre-birth interval shorter compared to early-arrivers (Condit *et al.* 2021).

Twin pups are often born with equivalent mass

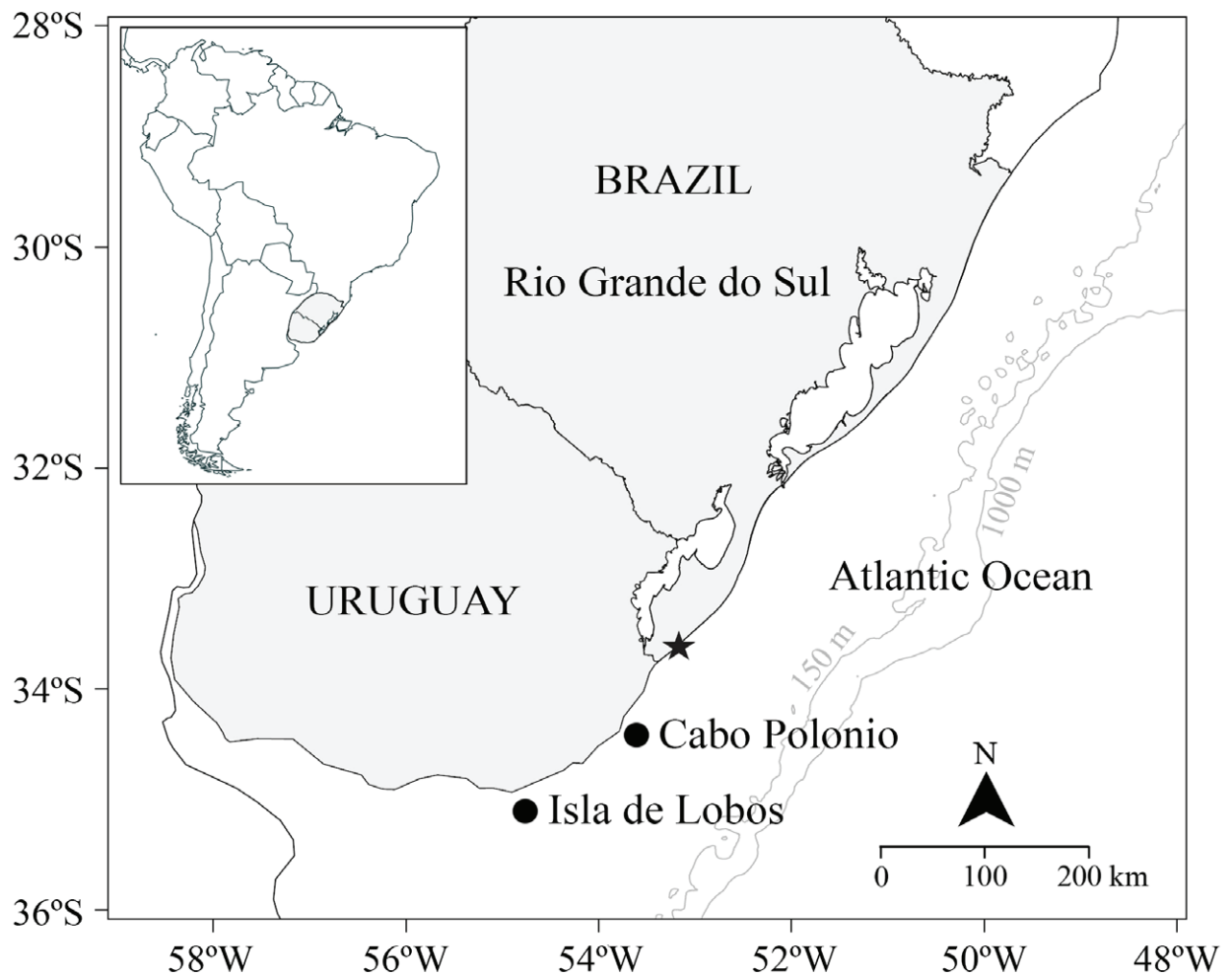


Figure 1. Map of the study area showing the stranding location of a pregnant female of South American sea lion (*Otaria flavescens*) with dizygotic twin fetuses (star symbol). The main and closest breeding colonies of the species are indicated by black dots.

and growth to single-born pups, as seen in *A. forsteri* (Dowell *et al.* 2008) and southern elephant seals (*M. leonina*, McMahon & Hindell 2003) but rather grow slower than other pups of the same sex during lactation. However, the fetuses reported here were way below the average body mass of a typical single-born SASL pup. Trites (1991) reports a positive relationship between the Northern fur seal female age and fetus size until the mother is 10-11 years old – that is when fetuses start to become progressively smaller. This could also be the case for SASL. Nevertheless, we also cannot rule out the possibility of poor nutrition of the mother and consequently slowed fetus growth. The female possibly sustained this pregnancy of twins and nursing of a pup from the previous breeding season at least until the late winter, which would have demanded an extremely high

energetic investment. The physical constraints of carrying two fetuses could have affected the mother's foraging abilities by the end of the pregnancy, making it less efficient, especially considering that SASL typically preys upon agile demersal fish on the southern Brazilian coast (Machado *et al.* 2018). Furthermore, consumption would have to be higher than normal, considering the doubled energetic demand.

What is most striking is the fact that the female fetus was considerably bigger than the male fetus, which contrasts with reports of male offspring becoming bigger due to higher energetic investment by the mother during pregnancy (Trites 1991). In Northern fur seals, smaller than average fetuses implanted much later than others also grew slower (Trites 1991). We hypothesize that the SASL female embryo was implanted and

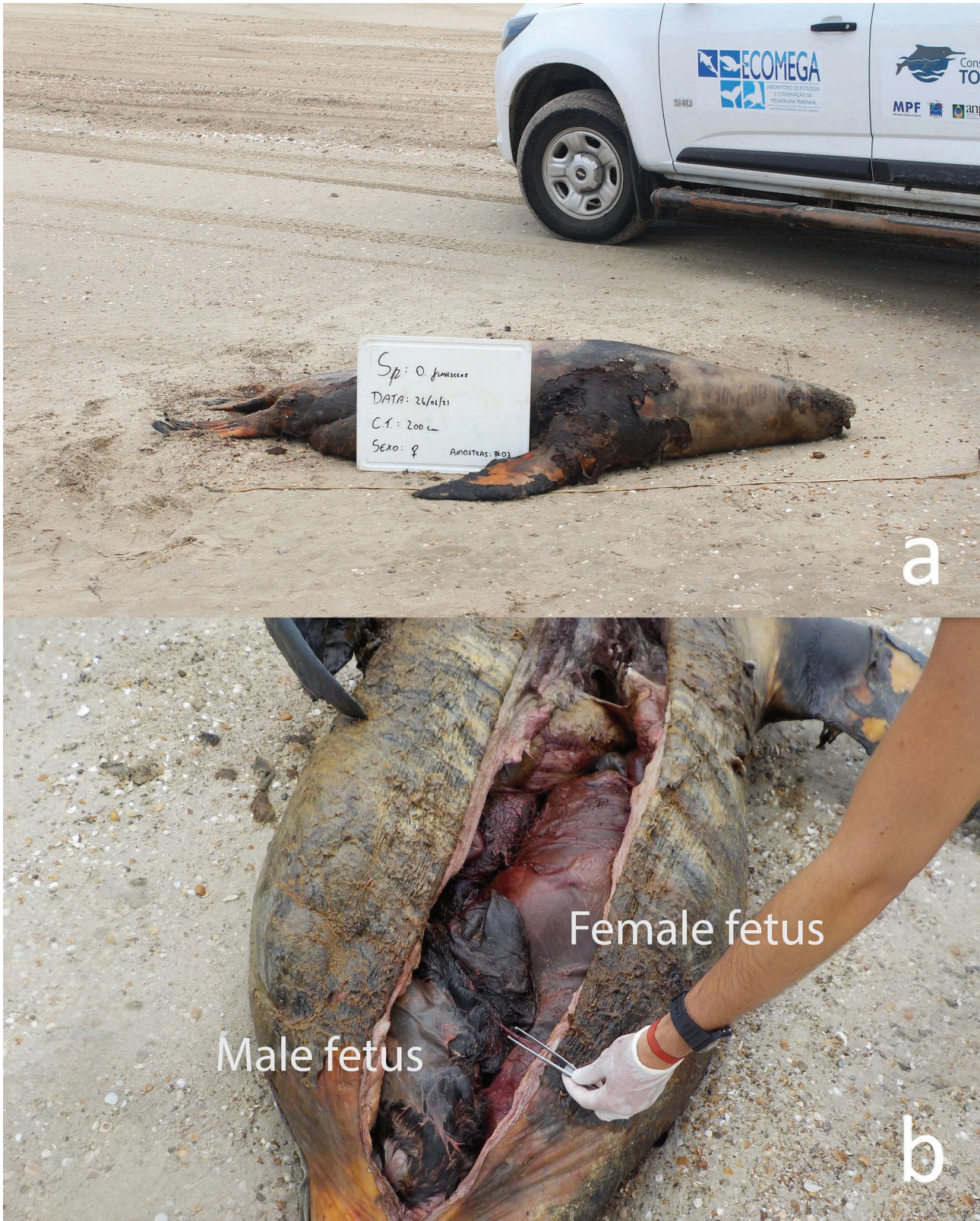


Figure 2. The female South American sea lion (*Otaria flavescens*) found with dizygotic twins in southern Brazil (a), male and female fetuses before being removed from the mother's carcass (b).

started developing earlier than the male one.

Chances of survival of both otariid twin pups are very low (Spotte 1982). There are only a few cases reported of potential twins surviving

to weaning (e.g. Bester & Kerley 1983, Doidge 1987, Dowell *et al.* 2008). Considering the higher energetic demands and possible inability of the female to successfully nurse two pups



Figure 3. Twin fetuses of South American sea lion (*Otaria flavescens*) after being removed from the carcass of a female stranded in southern Brazil. On top lies the male and smaller fetus, and below, the larger female one.

simultaneously, while maybe pregnant of a third pup, chances of offspring abandonment are high (Gelatt *et al.* 2001). There is also evidence of slowed growth rate and late weaning for pups sharing a mother, being twins or foster siblings (Doidge 1987, Haase 2007). A poor body condition at weaning is likely to reduce chances of offspring survival as well (Doidge 1987, Haase 2007). In this context, the consequences of twinning could directly reduce an individual's fitness, for both mother and pups.

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