Occurrence and group size of seals in the Western Antarctica: Results from the 2023 VII Turkish Antarctic Research Expedition

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Abstract

Antarctica offers a unique opportunity to study climate-related changes and ecological responses due to its remoteness and relatively undisturbed ecosystems. Pinnipeds, which are among the top predators in the Southern Ocean, are important bioindicators of environmental conditions. This study presents data on the distribution, species composition, and group sizes of pinnipeds observed during the VII Turkish Antarctic Research Expedition along the Western Antarctic Peninsula (WAP) in January–February 2023. The observations were conducted both from the research vessel BIO Hespérides and during land-based surveys at nine sites located in the islands off the Danco and Graham Coasts, at the north side of Marguerite Bay, in South Shetland Islands and Trinity Peninsula. A total of 70 sightings were recorded, including five pinniped species from the Phocidae and Otariidae families: southern elephant seals (*Mirounga leonina*), Weddell seals (*Leptonychotes weddellii*), leopard seals (*Hydrurga leptonyx*), crabeater seals (*Lobodon carcinophaga*), and Antarctic fur seals (*Arctocephalus gazella*). No Ross seals (*Ommatophoca rossii*) were sighted. Southern elephant seals sightings (n = 40) were the most frequently recorded, especially in the northern part of the study area, with one group comprising up to 250 individuals. Weddell seals (n = 16) were mostly sighted on the sea ice near Adelaide Island, while Antarctic fur seals (n = 8) were observed both on land and at sea, with one unusually large aggregation (approximately 1,000 individuals). Leopard seals (n = 3) and crabeater seals (n = 2) were observed in small numbers, mostly as solitary individuals or in small groups. These results contribute to the baseline knowledge of pinniped distribution patterns along the WAP and provide insights into regional population structures during the austral summer. The data are important for future ecological monitoring and understanding of species-specific responses to environmental changes in Antarctic ecosystems.

Key words: Antarctica, Phocidae, Otariidae, Southern Ocean, seal

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Introduction

Antarctica is an optimal location for studying global climate change, environmental shifts and the responses of living organisms to anthropogenic influences (Yin et al. 2007) due to its remoteness from human activity and uniqueness of its ecosystem. In the western Antarctica, seals play an important role in the marine ecosystem of the Southern Ocean. As the top predators of the region, they are directly dependent on the availability of food resources (Croxall et al. 1999, Negri et al. 2023) and are affected by abiotic factors (Mangel and Nicol 2000). Their high sensitivity to environmental changes makes them important indicators of the condition and dynamics of Southern Ocean ecosystems (Sun et al. 2004, Learmonth et al. 2006, Curtis et al. 2009). Thus, the data collected on seals from this region are highly valuable for various ecological and climatic studies, as evidenced by a recent long-term study (Dunn et al. 2025).

Six seal species occur in the marine ecosystem of the Southern Ocean below 60° S: the southern elephant seal (*Mirounga leonina*), the Weddell seal (*Leptonychotes weddellii*), the crabeater seal (*Lobodon carcinophaga*), the leopard seal (*Hydrurga leptonyx*), the Ross seal (*Ommatophoca rossii*) and the Antarctic fur seal (*Arctocephalus gazella*) (Jefferson et al. 2015).

Studies of pinnipeds in Antarctica cover such topics as their population size, spatial distribution, dietary preferences, behavioral responses, and physiological characteristics (Bengtson and Stewart 1997, Burns et al. 2004, Ciaputa and Siciński 2006, Padman et al. 2010, Krause et al. 2021). The Antarctic fur seal is a common species in the region, and its populations have been mostly studied on King George Island (Daneri 1996, Daneri and Carlini 1999, Daneri et al. 2005, Ciaputa and Siciński 2006). Santora (2013) investigated the population dynamics of this species, recording 2,261 individuals during 14 summer expeditions conducted between 2003 and 2011. Grebieniow et al. (2020) conducted a population survey of Antarctic fur seals, recording 43,919 individuals, including 47 leucistic animals. Weddell seals were studied mostly in summer period in different regions of the Antarctica (Bengtson et al. 2011, Gurarie et al. 2017, LaRue et al. 2021). Research covering such aspects as their diving physiology, foraging behaviour and reproductive biology has been conducted only during the summer and in a few regions of Antarctica (Lake et al. 2005, Hadley et al. 2006, Nachtsheim et al. 2019). Recent studies have shown that the summer diet of Weddell seals is dominated by the Antarctic silverfish (*Pleuragramma antarctica*) and its interannual variation in the ability can affect seal foraging pattern, as well as the distribution along the Antarctic coast (Negri et al. 2023). Estimates suggest that several hundred thousand individuals (Erickson and Hanson 1990, LaRue et al. 2021) occur around the Antarctic coastline, primarily inhabiting stable fast-ice areas attached to the coastline (Gurarie et al. 2017). It was reported by LaRue et al. (2021) that Weddell seals are spatially associated with two Antarctic penguin species, that might indicate shared ecological needs in the coastal Antarctic ecosystem. While southern elephant seals are primarily concentrated at the sub-Antarctic islands (Jefferson et al. 2015), they are also found in Antarctica, but their colonies here are less numerous than those located north of the Antarctic Polar Front (Le Boeuf and Laws 1994, SCAR 2002[1]). Crabeater seals are the year-round residents in the Antarctica and are among the most abundant species, with an estimated population up to 7 millions (Erickson and Hanson 1990). These seals appear to be highly mobile travelling long distances in most seasons, yet remain associated with pack ice (Burns et al. 2004). Leopard seals primarily inhabit the Antarctic pack ice and remain there throughout the year (Bester et

al. 2002, Meade et al. 2015). However, there have been rare sightings of these seals far from their usual range, including along the coasts of Australia, New Zealand, South America, and South Africa (Markham 1971, Horning and Fenwick 1978, Rounsevell and Pemberton 1994, Vinding et al. 2013). Leopard seals usually spend most of their lives as solitary individuals (Hückstädt 2015), except for mothers with their newborn pups (Southwell et al. 2003). The Ross seal is the least abundant of the Antarctic phocids, with an estimated population of around 130,000 individuals (Erickson and Hanson 1990). It is mostly found in the pack ice of Antarctica during winter (Blix and Nordøy 2007).

This study provides information on the number of sightings, distribution, and group size of pinniped species from the Phocidae and Otariidae families encountered along the cruise track of the BIO Hespérides (A-33) off the coast of the Antarctic Peninsula during the austral summer of 2023. These observations, conducted in areas previously surveyed for pinnipeds, were compared with earlier studies on species occurrence and contributed to expanding the existing knowledge base.

Material and Methods

The seal study took place in Antarctic Management Area I (*see* Fig. 1) within the multidisciplinary VII Turkish Antarctic Research Expedition in January and February 2023. The study area extends along the coastline of the Western Antarctic Peninsula (WAP) and includes the nearshore islands from King George Island in the South Shetlands (north) to Adelaide Island in the south (Fig. 1).

Vessel-based observations of seals were conducted on board the BIO Hespérides (A-33), an 82-metre-long Spanish polar research and survey vessel. A total of 98 hours of observation effort occurred during one month of the expedition. Seal sightings were recorded by a trained biologist standing on the ship's observation bridge (7 m above sea level). The vessel's track was determined by other scientific objectives of the research cruise; thus, seal sightings were recorded as the vessel was moving between 62°S and 68°S and back. Seal sightings periods were determined by departure/arrival time of the vessel and major changes in weather conditions. The observations were usually conducted during daylight hours from 07:00 to 20:00. Each observation period lasted from 30 minutes to two hours, depending on the weather conditions. A break of 15-30 minutes was taken between two consecutive observations to give the observer time to recover. The ship's position, time, sea state (0-3 on the Beaufort scale) and visibility were recorded every 30 minutes. Localised land-based observations of the coast including Ronge, Amsler, Avian, Adelaide, Yalour, Livingston, and King George Islands, as well as the sites located nearby the British Antarctic Survey Base, Spanish Gabriel De Castilla Base in Deception Island and Esperanza Base, were conducted on foot.

Once a single animal or a group of seals was sighted, the date and time of the sighting, group size (minimum, maximum and optimal of the count) and the general behaviour were recorded. A group was defined based on spatial criteria (individuals less than 10 meters apart), following Southwell et al. (2003). Seal species were identified based on systematic characteristics, such as body size and shape, presence or absence of external ears, flipper morphology, fur coloration and patterns, and other distinctive features (Laws 1993, Shirihai 2003).

QGIS (version 3.34.1, QGIS project, available at [2]) was used to map the route of the vessel and seal species sightings.

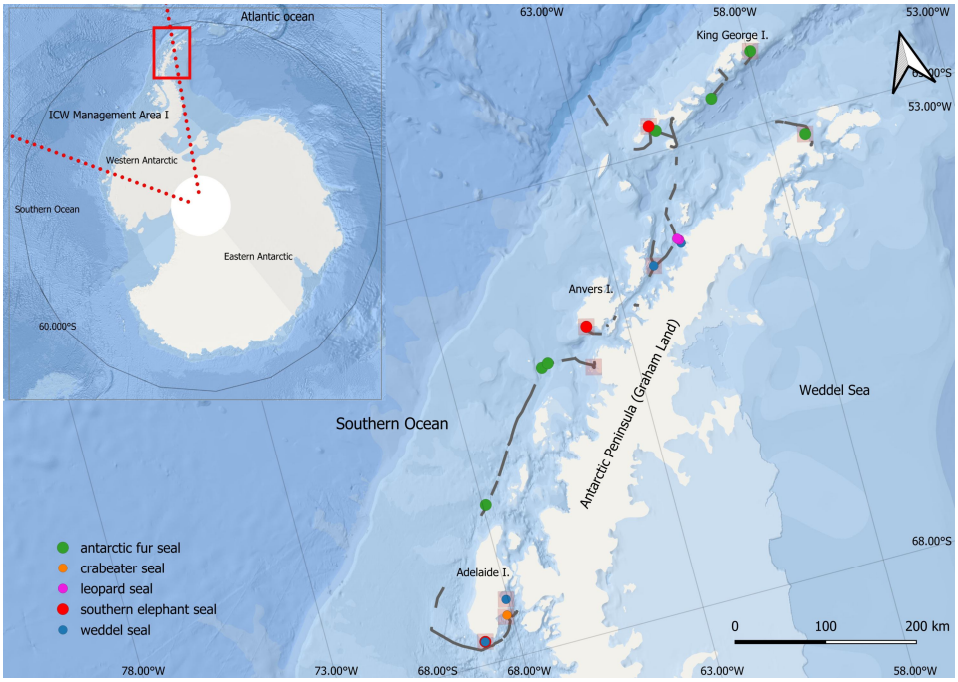

Fig. 1. Sightings of pinnipeds in the Antarctic Region on the route (grey line) of the cruise taken by BIO *Hespérides* (A-33) in January and February, 2023. Transparent squares indicate the observations from land.

Results

The survey, including 17 days of observations in January and February 2023, provided details on pinniped sightings along the Western Antarctic Peninsula. Of 70 sightings, four species from the Phocidae family, one species from the Otariidae family, and one unidentified seal were recorded.

Elephant seals (*Mirounga leonina*). Southern elephant seals were observed in three locations with all the animal sightings (40 sightings, 57%): Amsler Island, Avian Island, and Livingston Island. The majority of the animals were observed on land of the islands, and a few individuals were sighted on ice floes. Although the animals were counted along the same cost within those islands, they did not form a single aggregation but were distributed as separate groups consisting of 1-90 individuals. A group sighted on the Livingston Island consisted of around 250 individuals (Table 1). The median group size of southern elephant seals was six individuals.

Species	No. sightings	No. individuals	Mean group size	Max. group size
Southern elephant seal	40	772	19.3	250
Weddel seal	16	45	2.8	11
Leopard seal	3	4	1.3	2
Crabeater seal	2	4	1.5	2
Fur seal	8	1081	135	1000

Table 1. Number of sightings and group characteristics of pinnipeds recorded along the WAP in January-February, 2023.

Fig. 2. Examples of pinnipeds, (**A**) southern elephant seal; (**B**) crabeater seal; (**C**) Weddel seal; (**D**) leopard seal; (**E**) Antarctic fur seal, which were sighted during the study period in the Antarctic region.

Weddel seals (*Leptonychotes weddellii*). There were 16 sightings (23%) of Weddel seals during the study period (Table 1). The majority of encounters with this species were recorded near the Adelaide Island, where the animals were primarily resting on the ice. Weddel seals were typically found in groups ranging from one to 11 individuals, with an average group size of 2.8 (Table 1) and a median of 1. Along the Adelaide Island there also were large congregations of penguins (Adelie and Gentoo).

Antarctic fur seals (*Arctocephalus gazella*). Eight sightings (11%) of fur seals were recorded in the present study. They were distributed along the King George Island, in the northern Antarctic Peninsula, as well as near Renaud and Adelaide Islands. Four of these sightings were recorded in the water at a distance of 10–15 km from the nearest shoreline, with individuals observed either alone or in pairs. The other sightings were recorded on land within the Avian Island, in the vicinity of the Esperanza Base, as well as on the northern and southern coasts of the King George Island (Fig. 1). The animals were observed hauling out either on beaches or on coastal rocks in the water. The median size of fur seal groups was two individuals. However, two much larger groups were recorded: one consisted of approximately 70 individuals and the other included approximately 1,000 animals (Table 1). In these large aggregations, the animals were evenly distributed across the area.

Leopard seals (*Hydrurga leptonyx*). Only four leopard seals in three sightings (4%) were recorded (Table 1). On 29 January, a solitary individual and a pair of seals were observed resting on separate ice floes. Next day, another individual was seen on the ice near Primavera Cape (Fig. 2).

Crabeater seals (*Lobodon carcinophaga*). In January 2023, two sightings (3%) of crabeater seals were recorded on the eastern coast of the Adelaide Island (Fig. 2, Table 1). A pair was resting further inland, while another individual was sighted at the edge of the ice zone.

Ross seals (*Ommatophoca rossii*). No Ross seals were observed during both land-based and vessel-based observations in the study period.

Discussion

This study provides information on sightings, group sizes, and the distribution of pinniped species observed in the Antarctic region during the 2023 VII Turkish Antarctic Research Expedition in the summer. Our findings show that during the January-February period, seals were encountered along the WAP, with more frequent counts of large aggregations in the northern part of the peninsula.

The sightings of southern elephant seals on the islands along the Antarctic Peninsula are in line with the previously described patterns of their distribution and grouping on land (Le Boeuf and Laws 1994, Hindell 2018). According to Le Boeuf and Laws (1994), the main breeding colonies of elephant seals in South America, particularly in Argentina and Chile, are larger than the colonies in Antarctica. We also observed large groups in the northern sections of the route, while moving to the south the groups became much smaller. Higher temperatures could create better conditions in the northern regions, while the elephant seals on the Antarctic continent and its surroundings are more restricted by physical barriers such as ice. Our sightings of elephant seals in January corresponded to the moulting season when these animals are on land, which also confirms earlier studies (Le Boeuf and Laws 1994, Salwicka and Sierakowski 1998). One of the elephant seal colonies is located in the South Georgia, from where individuals regularly enter

the Antarctica, especially during periods of minimal sea ice (Bornemann et al. 2000, Muelbert et al. 2004). In response to the increase of ice-free areas along the western Antarctic coast, dispersal between subpopulations and latitudinal expansion of southern elephant seals may occur (Negrete et al. 2022). This is consistent with our observations where seals have been seen in more southerly and remote areas of Antarctica during the summer. It is also known that the elephant seals of this colony utilise Antarctic waters more and for longer periods than any other region, despite the presence of ice even in winter (Hindell et al. 2016). Our main encounters took place on the Livingston Island, which could be related to the fact that the seal population there continues to increase (Negrete et al. 2022) despite its relatively small size in the region; they can even stay here in winter without having to search for shelf areas (Muelbert et al. 2013, Hindell et al. 2016).

Most encounters with Weddell seals took place on land, where they rested at some distance from the edge. The results of our encounters with Weddell seals are consistent with previous studies showing that they favour fast ice and adjacent pack ice areas (Hussain and Saxena 2008, Southwell et al. 2012, LaRue et al. 2019). While adult individuals generally remain loyal to stable ice, young seals may move along the coast into pack ice (Nachtsheim et al. 2019). The distribution of Weddel seals also depends on dietary composition that can vary in response to interannual oceanographic changes. Negri et al. (2023) reported that proportion of *P. antarcica,* a key pelagic fish in the diet of Weddell seals, increased in years associated with warm El Niño-Southern Oscillation and negative phases of the Southern Annular Mode. This indicates that large-scale climate variability may influence prey availability and affect the foraging strategies and spatial use of Weddell seals. Such foraging plasticity may contribute to the observed patterns of seal occurrence during the cruise. Seal abundance is also linked to ice conditions when it increases during periods of extended fast-ice cover and declines with warming and sea ice loss as was shown during long-term observations in the Northern Weddell Sea (Dunn et al. 2025). In addition, the probability of encountering seals may be related to the presence and size of penguin colonies. LaRue et al. (2019) hypothesises that seals and emperor penguins, which require stable fast ice (Barbraud and Weimerskirch 2001, Gurarie et al. 2017), can coexist to some extent in the same area as their population density (Yirmibesoglu and Ozsoy 2023, and references therein) and consequently competition is low. At the same time, large colonies of Adélie penguins can displace Weddell seals from their foraging areas (LaRue et al. 2019). The distribution of seals in our study could be influenced by the impact of large Adélie penguin colonies on the probability of their presence. The relatively small group sizes observed in our study also confirm the data on the predominantly small group size of Weddell seals (Gurarie et al. 2017).

Eight sightings of Antarctic fur seals were recorded in this study. Although 97% of the Antarctic fur seal population is concentrated on South Georgia (Forcada and Staniland 2008, Hoffman et al. 2018), the South Shetland Islands also serve as important breeding and moulting sites for this species (Salwicka and Sierakowski 1998, Reid et al. 2006, Korczak-Abshire et al. 2019). Our findings are in line with these reports, as we recorded the animals mostly distributed along King George Island and Deception Island, with some sightings also recorded near Renaud and Adelaide Islands. Although Adelaide Island is relatively distant site for this sub-Antarctic species, fur seals were also recorded at Riviera Point at Prydz Bay (van den Hoff 2024), one of the southernmost documented records of the species. The number of Antarctic fur seals can vary considerably

depending on the season and environmental conditions (Bengtson et al. 1990, Salwicka and Sierakowski 1998, Salwicka and Rakusa-Suszczewski 2002), with peak numbers occurring between February and March. Grebieniow et al. (2020) suggested that the increase in the number of fur seals on King George Island from December to March may be related to the end of the breeding season of *Pygoscelis* penguins (Trivelpiece et al. 2007, Sierakowski et al. 2017) and the subsequent increase in prey availability. The sporadic encounters with fur seals in the southern part of the Antarctic Peninsula suggest that their local presence at this time of year was stable. However, Dunn et al. (2025) documented a decline in numbers since 1990s, indicating that long-term population trends may differ from short-term local observations. Despite their primary distribution on South Georgia and the South Shetland Islands, the fur seals presence in the southernmost region may be important for male migration or resting and for potential new breeding and moulting sites.

Only a few leopard seals were sighted during the cruise. All animals were observed lying on small ice floes surrounded by a large amount of open water, which is a typical habitat for this species in the Antarctic (Bester et al. 2002, Meade et al. 2015). This environment is more suitable for leopard seals as they can effectively hunt seals and penguins in such conditions, as opposed to regions with thicker ice (Bengtson et al. 2011, Andreasen et al. 2022). The limited sightings of leopard seals can be explained by their behaviour, particularly in terms of probability of haul-out. These animals generally move onto the ice around midday (Krause et al. 2016), which reduces the chances of sighting them at other times of the day. In addition, leopard seals spend a considerable portion of their time diving and foraging. In summer, leopard seals show increased diving activity, while in winter this probability drops to 20 % of summer values (Nordøy and Blix 2009), which may also contribute to the low encounter rate. As this species is not the most abundant in the region (Erickson and Hanson 1990), this fact probably also plays a role in the low number of sightings compared to more frequently observed species, such as Weddel seals or Antarctic fur seals.

Our sightings of crabeater seals near Adelaide Island, although limited in number, correspond to previous studies indicating the WAP as a region of high density for this species relative to other areas (Forcada et al. 2012, Joiris and D'Hert 2016). The Western Antarctic is known for its abundant krill populations (Montú et al. 1994, Atkinson et al. 2004); thus, crabeater seals can easily access to the Antarctic krill, their primary food source (Hückstädt 2015). The ice-covered zones of the region play a crucial role in the life cycle of these seals, which prefer pack-ice zones within the continental shelf area (Burns et al. 2004, 2008; Costa et al. 2010). However, in recent decades, there has been a marked reduction in the sea ice (Stammerjohn et al. 2008, Dinniman et al. 2011) along with the shift in the spatial distribution of krill in this region (Moline et al. 2004), both of which may influence crabeater seal density and distribution patterns (Forcada et al. 2012, Wege et al. 2021b).

There were no encounters with Ross seals during our cruise, possibly because this species is among the rarest and most elusive Antarctic seals (Hückstädt 2018). Ross seals are typically solitary and do not form large aggregations at haul-out sites; instead, they prefer to hide in dense pack ice (Skinner and Klages 1994). Even in the austral summer, when these seals return from the open ocean where they spend most of their time foraging (Southwell et al. 2008, Wege et al. 2021a), the probability of capture remains low.

Conclusions

This study provides information on the distribution, number of sightings and group sizes of pinniped species observed during the VII Turkish Antarctic Research Expedition in 2023. The data confirm previously described patterns for seals and indicates environmental influences along the Western Antarctic Peninsula. Southern elephant seals, Weddell seals, and Antarctic fur seals were frequently observed reflecting known habitat preferences. Leopard seals were rarely observed, probably due to fluctuations in haul-out and diving activity. Crabeater seals were also sighted in limited numbers that may be related to krill availability and sea ice conditions. The absence of Ross seal sightings is consistent with their known rarity, solitary nature, and preference for dense pack ice. The results of our study support the idea of continuous monitoring of pinniped populations in the WAP region, especially in the context of climate-driven changes in sea ice and prey availability.

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