

Ross Sea Ecosystem IMMA

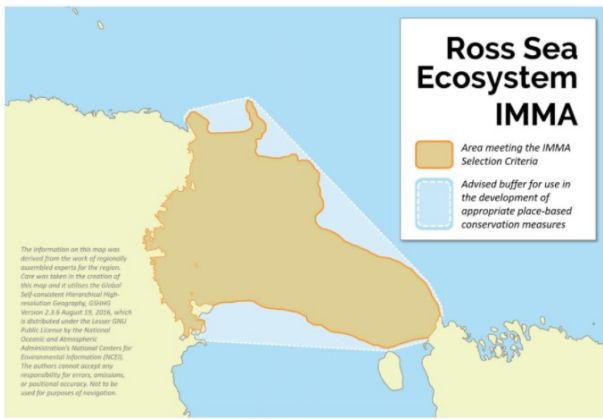
Summary

The Ross Sea is covered by pack ice for 9 months of the year, yet it is viewed as one of the most pristine natural regions in the world, as well as one of the most productive regions of the Southern Ocean. Occupying a large, high-latitude embayment in the Antarctic continental shelf, it has an average depth of 500 m and a shelf break at 700 m. This area represents the southernmost range for any mammal. It hosts what is likely the largest concentration of Weddell seals (*Leptonychotes weddellii*) anywhere in the Antarctic, providing year-round habitat and breeding grounds for the species, including a small isolated population on White Island and two much larger colonies in Terra Nova Bay. Leopard seals (*Hydrurga leptonyx*), crabeater seals (*Lobodon carcinophaga*) and Ross seals (*Ommatophoca rossii*) also feed in the Ross Sea's highly productive waters, and are often associated with pack ice and penguin colonies.

The Ross Sea's continental slope is a hotspot for Arnoux's beaked whales (*Berardius arnuxii*). Killer whales (*Orcinus orca*) are also abundant, with both the dwarf or C-type and B1 morphotypes observed regularly in the McMurdo Sound. Antarctic minke whales (*Balaenoptera bonaerensis*) appear seasonally, and are commonly seen foraging in the leads that develop in the fast/pack ice as it breaks up.

Description

We define the Ross Sea ecosystem as follows: the area extending from Cape Adare following the continental slope across to the east (beyond Roosevelt Island) along the Ross Ice Shelf to Ross Island and following the western extension of the Ross Island to the Ross Ice Shelf, including White Island, then along the Victoria Land coast to Cape Adare. The Ross Sea is one of the most productive regions of the Southern Ocean, having been estimated to contribute 28% of the total primary



Area Size

1,860,969 km²

Qualifying Species and Criteria

Weddell Seal – *Leptonychotes weddellii*

Criteria B1, B2, C1, C2, D1

Crabeater seal – *Lobodon carcinophaga*

Criteria B2, C2

Leopard seal – *Hydrurga leptonyx*

Criteria B2, C2

Ross seal – *Ommatophoca rossii*

Criteria B2, C2

Killer whale – *Orcinus orca*

Criteria B2, C2, C3

Antarctic Minke whale – *Balaenoptera bonaerensis*

Criteria B2, C2

Arnoux's beaked whale – *Berardius arnuxii*

Criteria B2, C2

Marine Mammal Diversity

Balaenoptera acutorostrata, *Balaenoptera bonaerensis*, *Balaenoptera musculus intermedia*, *Balaenoptera physalus*, *Berardius arnuxii*, *Hydrurga leptonyx*, *Leptonychotes weddellii*, *Lobodon carcinophaga*, *Megaptera novaeangliae*, *Ommatophoca rossii*

production south of 50°S (Ballard et al., 2012). The Ross Sea is a large, high-latitude (72–78° S) embayment in the Antarctic continental shelf with an average depth of 500 m and a shelf break at 700 m. The area is covered by pack ice for 9 months of the year and has been acknowledged as among the most nearly-pristine natural regions in the world. Ainley and colleagues (2010) stated:

"...the Ross Sea is the most productive stretch of the Southern Ocean and contains habitat for 32% and 26%, respectively, of the world populations of Adélie and emperor penguins (summer, moulting, portion of wintering habitat); 30% of the world population of Antarctic petrels, 6% of Antarctic minke whale and perhaps 50% of Ross Sea killer whale (summer foraging); and 50–72% of the South Pacific sector Weddell seal population (year round habitat)" and "...on the basis of projections made from current models in the Intergovernmental Panel on Climate Change array, is likely to be the last stretch of ocean on Earth, perhaps within the current century, that will support a sea-ice associated community of organisms".



Figure 1: Type-C killer whales in the Ross Sea. Photo: Giancarlo Lauriano

Given the wealth of information available on the western Ross Sea, a biological hotspot was identified in the Joides Basin as having particular significance as an IMMA. The whole coastal area is characterized by the presence of warm and saline waters and upwelling processes due to the katabatic winds. These characteristics are also responsible for the unusually high primary production and the coexistence of large numbers of marine mammals and seabirds. The area is the site of a diverse and abundant upper trophic level fauna. Aerial surveys

conducted along the coastline of Terra Nova Bay highlighted a high marine mammal concentration. The high diversity of upper trophic level predators appears to be a natural consequence of the polynya, as well as high local productivity, in terms of phyto- and zooplankton and pelagic fish abundances.

Criterion B: Distribution and Abundance

Sub-criterion B1: Small and Resident Populations

A small distinct population of Weddell Seals exists at White Island. The presence of this small isolated population led to the designation of White Island as an ASPA (Antarctic Specially Protected Area)(Testa and Scotton, 1999). The Weddell seal colony appears unable to relocate to another area because of its distance from the open ocean of McMurdo Sound, and as such it is highly vulnerable to any human impacts that might occur in the vicinity. The colony is not thought to have been present in the early 1900s, as there is no mention of seals by naturalists who visited White Island many times during Scott's 1902, 1903 and 1910 expeditions. An ice breakout occurred in the region between 1947 and 1956, and the first two seals were observed near the north-eastern end of the island in 1958 (R. Garrott, pers. comm). Year-round studies have detected no evidence of immigration or emigration of seals from the population, which appears to have grown to around 25 to 30 animals from a population of around 11 in the 1960s. The seals do not have the breathing capacity needed to dive the 20km required to reach the open ocean, and there is only one record of a seal from the colony making the journey over the ice shelf surface.

Criterion B: Distribution and Abundance

Sub-criterion B2: Aggregations

Arnoux's beaked whales, killer whales and Antarctic minke whales are seasonally abundant in the Ross Sea, taking advantage of the highly productive waters and associated prey that becomes available as the ice breaks up (Kasamatsu et al., 1993; Ponganis et al., 1995; Hobson and Martin, 1996; Murase et al., 2013). The Ross Sea continental slope is a hotspot for Arnoux's beaked whales that are regularly seen in the area between McMurdo Sound and Terra Nova Bay

where they may be summer residents (Smith et al., 2007). Antarctic minke whales occur in large numbers feeding throughout the Ross Sea (Ballard, et al., 2012) and have been estimated to consist of some 14,000 individuals in this region (Ainley, 1985). Among cetaceans, killer whales are seasonally prevalent in the Ross Sea (Lauriano et al., 2011). The dwarf killer whale form (C type) is found in McMurdo Sound (Pitman et al., 2007; 2018). Here, two population clusters have been identified: 'regulars' with strong inter- and intra-annual site fidelity and an average annual abundance of 73 individuals, and a larger population estimated at 397 individuals, which were less frequently encountered. In McMurdo Sound type C killer whales have been recently assessed after 14 years of study (Pitman et al., 2018). A high degree of individual turnover in the area has been described. Less regular data are available from the Terra Nova Bay area, where type C and B1 killer whales were studied in the austral summers 2003-4 and 2014-15; C type individuals were re-sighted between the two periods in the same location along the ice shelf (Lauriano and Panigada, 2015).

High site fidelity of Weddell seals population is based on two colonies occurring in Terra Nova Bay that have persisted for long periods of time in the same area. Weddell seals are concentrated during the summer on coastal fast ice. The unique and outstanding ecological and scientific value of the region has consistently attracted international scientific interest and led to the establishment of the Ross Sea Region Marine Protected Area (MPA) by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) in October 2016. The extensive continental shelf, combined with considerable shore-fast and pack ice habitat, creates ideal habitat for Weddell seals. These seals inhabit cracks in the fast ice formed along the shoreline, ice tongues and islands resulting from tidal fluctuations (Hückstädt 2018b). They favour cracks that are far away from open water, close to the shoreline. The abundance of this habitat has enabled what appears to be the highest density (and thus population) of Weddell seals anywhere in Antarctica (M. Le Rue, pers comm). Recent tracking revealed that Weddell seals (Goetz 2015) move throughout the western reaches of the



Figure 2: A killer whale patrolling the ice-edge in the Ross Sea. Photo: Giancarlo Lauriano

Ross Sea throughout the year; the movement patterns of the other seal species are not as well documented but they are considered to be resident (Meade et al., 2015; Krause et al., 2016).

Leopard seals remain near the coastal zone when the ice is offshore, but move with the ice when it is closer to land (Meade et al., 2015). They are most commonly observed near penguin colonies during the spring and summer months (Krause, et al., 2016; Pinkerton et al., 2010). Crabeater and Ross seals are associated with the pack ice (Southwell et al., 2012; Bengtson and Stewart, 2018). While Ross seals are known to occur in the Ross Sea, their abundance, distribution and general biology are poorly known (Arcalis-Planas, et al., 2015, Hückstädt, 2018a). Given their abundance and their broad diet (krill, fish, seals, and penguins) the four species of seals represent a significant means of energy transfer between trophic levels within the Ross Sea food web (Pinkerton et al., 2010).

Criterion C: Key Life Cycle Activities Sub-criterion C1: Reproductive Areas

There are numerous breeding aggregations of Weddell seals along the Victoria Land Coast that are associated with the coastal tidal cracks in the shore-fast ice. Another significant breeding aggregation is associated with Cape Colbeck in the eastern Ross Sea (Davis et al., 2008). The breeding colony at White Island is composed of some 84 Weddell seals that were known to have existed between 1990 and 2000 (Testa and Scotton, 1999; Gelatt et al., 2009). Between 2003 and 2007, 11 females have been sighted at White Island, but only six of these individuals have produced pups. Between two and four live pups were recorded in 1963-1968, 1981, and 1991. Annual censuses since 1991 recorded between four and ten pups from 1991 to 2000, but lower numbers (between two and four pups each year) from 2000 to 2007. Pup mortality is high, possibly due to inbreeding, and pup production is low in comparison to the population in Erebus Bay.

Criterion C: Key Life Cycle Activities Sub-criterion C2: Feeding Areas

The area is an important summer feeding habitat for the three whale species and is a year-round feeding

habitat for the four seal species. Minke whales feed on krill, while killer whales feed on penguins, crabeater and Weddell seals, as well as Antarctic toothfish (*Dissostichus mawsonii*). The B1 type killer whales prey primarily on ice seals and occur commonly along to the ice shelf in austral summer to take advantage of both the seals and the Adelie and emperor penguin colonies (Cape Washington, Edmonson point, Adelie Cove, Inexpressive Island) in the Ross Sea coastal area. Extensive movements from McMurdo Sound and Terra Nova Bay by B1 type killer whales have been described for this killer whale ecotype (Andrews et al., 2008; Lauriano et al., 2007).

Satellite studies conducted in both McMurdo Sound and Terra Nova Bay show areas along the western Ross Sea coastline where type C killer whales, which feed only on fish, have been engaged in feeding activities and long-distance travel beyond the coast, outside the polar front (Pitman et al, in prep.; Lauriano & Panigada, 2015; Eisert et al., 2015). The most important component in their diet is the Antarctic toothfish, which is by far the largest species of fish in Antarctic waters. Moreover, other species have been considered in type C killer whales' diet and these all belong to the Nototheniidae, a suborder that includes pelagic and semi pelagic species which dominate the fish fauna at > 90% levels of abundance and biomass in the Ross Sea and in the IMMA. The Antarctic silverfish (*Pleurogramma antarcticum*) is one of the most abundant fish in the suborder and a prey of the toothfish; a nursery area has been described in the Terra Nova Bay where type C killer whales feed regularly along the ice shelf (Lauriano and Panigada, 2015). Satellite tracking studies conducted in both McMurdo Sound and Terra Nova Bay show that type C killer whales engage in feeding activities (Area Restricted Search – ARS and diving activities) in both Terra Nova Bay and Lady Newnes Bay, and they travel long distances away from the coast, outside the polar front (Fig. 3) (Lauriano et al., 2020; Lauriano and Panigada, 2015; Eisert et al., 2015).

Antarctic minke whales feed in large numbers in the whole Ross Sea area (Ainley et al., 1985; Ballard et al., 2012). They are commonly seen foraging in the leads that develop in the fast/pack ice (Friedlaender et al., 2014) as far south as Cape Armitage. The Arnoux's beaked whales are regularly seen, and presumably

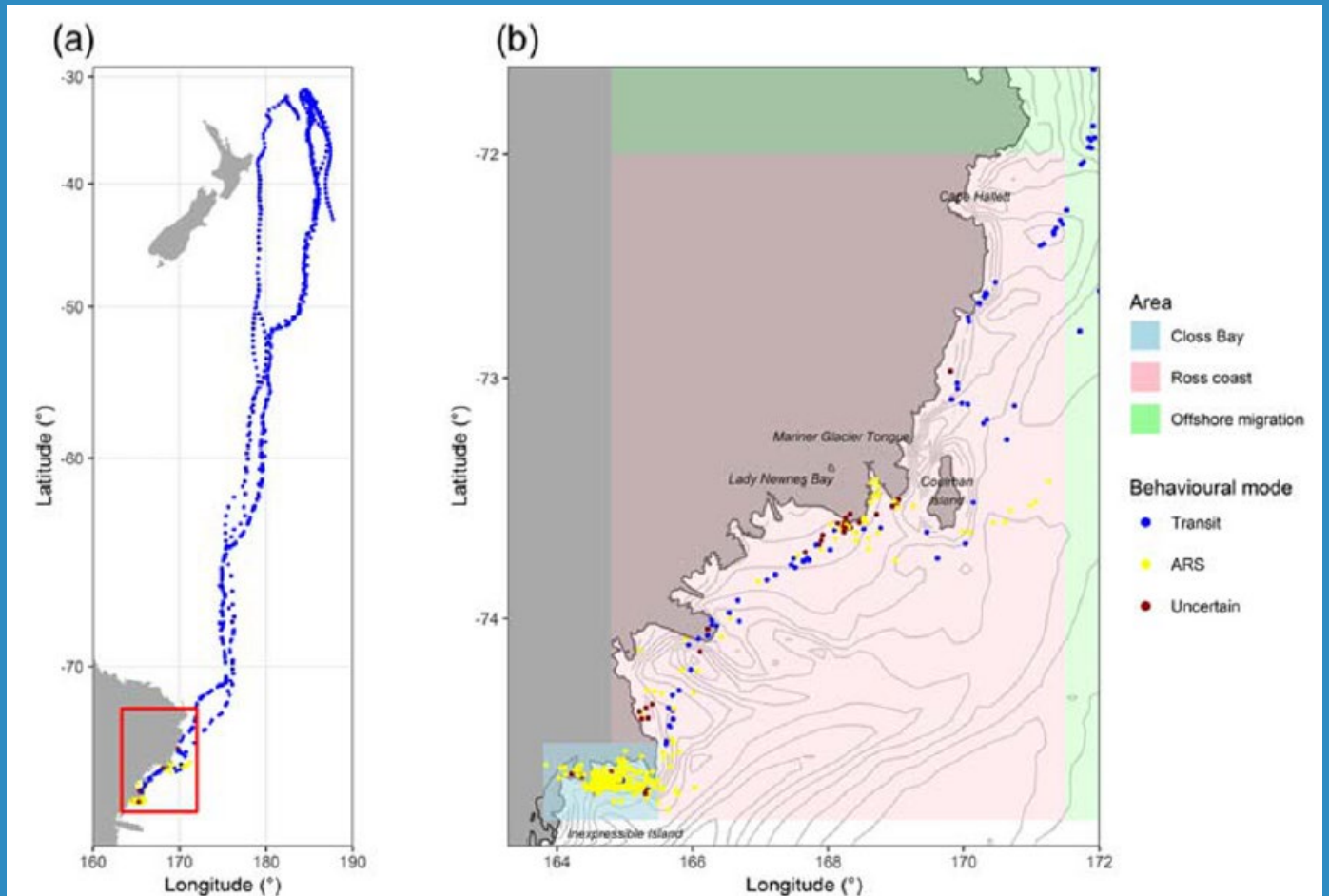


Figure 3: Tagged killer whale tracks (a), and the estimated behavioral state of the 10 killer whales in Closs Bay, along the Ross Sea coastline and offshore migration (b). From: Lauriano et al, 2020.

feed, in the area between McMurdo Sound and Terra Nova Bay (Lauriano et al., 2011) where the species has been considered as resident in summer (Smith et al., 2007). Leopard seals prey on Adélie penguins (*Pygoscelis adeliae*), crabeater seals, and Emperor penguins (*Aptenodytes forsteri*) when the ice is offshore, but move with the ice when it is closer to land (Meade et al., 2015). Recent tracking revealed that Weddell seals (Goetz, 2015) move throughout the western reaches of the Ross Sea throughout the year; the movement patterns of the other seal species are not as well documented but they are considered to be resident (Meade et al., 2015; Krause et al., 2016).

Criterion C: Key Life Cycle Activities Sub-criterion C3: Migration Routes

Migration routes for C Type killer whale along the Ross Sea coast were described in 2015 (Lauriano and Panigada, 2015; Eisert et al., 2015). Movements with high persistence and low turning angle along with

shallow diving activities, occurred alongside the coastal area between Terra Nova Bay and outside the polar front; this transiting behaviour show a migratory pattern beyond the polar front towards New Zealand sub-tropical waters (Lauriano and Panigada, 2015; Eisert et al., 2015).

Criterion D: Special Attributes Sub-criterion D1: Distinctiveness

This is the southernmost range extension for the whale and seals species and as such represents the southernmost natural habitat for any mammal. The breeding colony at White Island is composed of some 84 Weddell seals that were known to have existed between 1990 and 2000. This is an isolated breeding aggregation that was likely founded by a small group of individuals (three females and two males) that accessed the island during a brief break in the surrounding sea ice in the mid-1950s and is genetically isolated (Testa and Scotton, 1999; Gelatt et al., 2009).

Supporting Information

Ainley, D.G. 1985. 'Biomass of Birds and Mammals in the Ross Sea Antarctica'. In: W.R. Siegfried, P.R. Condy and R.M. Laws (eds.) Antarctic Nutrient Cycles and Food Webs; 4th SCAR (Scientific Committee on Antarctic Research) Symposium on Antarctic Biology, pp 498-515. New York, Berlin: Springer-Verlag

Ainley, D.G., Ballard, G. and Weller, J. 2010. 'Ross Sea Biodiversity Part I: Validation of the 2007 CCAMLR Bioregionalization Workshop Result Towards Including the Ross Sea in a Representative Network of Marine protected Areas in the Southern Ocean' CCAMLR Report, WG-EMM-10/11. Hobart, Tasmania.

Ainley, D.G. and Ballard, G. 2012. 'Trophic Interactions and Population Trends of Killer Whales (*Orcinus orca*) in the Southern Ross Sea'. Aquatic Mammals 38:153-160.

Ainley, D.G., Larue, M.A., Stirling, I., Stammerjohn, S. and Siniff, D. B. 2015. 'An apparent population decrease, or change in distribution, of Weddell seals along the Victoria Land coast.' Marine Mammal Science 31:1338-1361.

Andrews, R.D., Pitman, R.L. and Ballance L.T 2008. 'Satellite tracking reveals distinct movement patterns for Type B and Type C killer whales in the southern Ross Sea, Antarctica.' Polar Biology 31(12):1461-1468.

Arcalis-Planas, A., Sveegaard, S., Karlsson, O., Harding, K.C., Wahlin, A., Harkonen, T. and Teilmann, J. 2015. 'Limited use of sea ice by the Ross seal (*Ommatophoca rossii*), in Amundsen Sea, Antarctica, using telemetry and remote sensing data.' Polar Biology 38(4): 445-461.

Ballard, G., Jongsomjit, D., Veloz S.D., and Ainley D.G., 2012. 'Coexistence of mesopredators in an intact polar ocean ecosystem: The basis for defining a Ross Sea marine protected area.' Biological Conservation 156:72-82.

Bengtson, J.L. and Stewart, B.S. 2018. 'Crabeater seals' In: B. Wursig, J.G.M. Thewissen and K.M. Kovacs (eds), Encyclopedia of Marine Mammals. pp.230-232. San Diego, Academic Press.

Cameron, M.F. and Siniff, D.B. 2004. 'Age-specific survival, abundance, and immigration rates of a Weddell seal (*Leptonychotes weddellii*) population in McMurdo Sound, Antarctica.' Canadian Journal of Zoology 82:601-615.

Davis C.S, Stirling I., Strobeck C And Coltman D.W. Population structure of ice-breeding seals. 2008. Molecular Ecology (2008) 17, 3078–3094

Eisert R, Lauriano G, Panigada, S, et al. 2015. Activity, seasonal site fidelity, and movements of type-c killer whales between the Ross Sea, Antarctica and New Zealand. CCAMLR Working Group EMM 2015

Friedlaender, A.S., Goldbogen, J.A., Nowacek, D.P., Read, A.J., Johnston D. and Gales N. 2014. 'Feeding rates and under-ice foraging strategies of the smallest lunge filter feeder, the Antarctic minke whale (*Balaenoptera bonaerensis*).' Journal of Experimental Biology 217(16): 2851-2854.

Gelatt, T.S., Davis, C.S. Stirling, I. Siniff, D.B., Strobeck C. and Delisle I. 2009. 'History and fate of a small isolated population of Weddell seals at White Island, Antarctica.' Conservation Genetics 11(3):721-735.

Goetz, K. T. 2015. 'Movement, Habitat, and Foraging Behavior Of Weddell Seals (*Leptonychotes weddellii*) In The Western Ross Sea, Antarctica' Ph.D. Dissertation, University of California Santa Cruz.

Hobson, R.P. and Martin, A.R. 1996. 'Behaviour and dive times of Arnoux's beaked whales, *Berardius arnuxii*, at narrow leads in fast ice.' Canadian Journal of Zoology 74(2):388-393.

Hückstädt, L.A. 2018a. 'Ross Seal' In: B. Wursig, J.G.M. Thewissen and K.M. Kovacs (eds). Encyclopedia of Marine Mammals. pp. 835-837. San Diego, Academic Press.. 57:149-165.

Hückstädt, L.A. 2018b. 'Weddell Seal.' In: B. Wursig, J.G.M. Thewissen and K.M. Kovacs (eds). Encyclopedia of Marine Mammals. pp. 1048-1051. San Diego, Academic Press.

- Kasamatsu, F., Yamamoto, Y., Zenitani, R., Ishikawa, H., Ishibashi, T., Sato, H., Takashima K. and Tanifuji, S. 1993. 'Report of the 1990/91 southern minke whale research cruise under scientific permit in Area V.' Report of the International Whaling Commission 0(43):505-522.
- Krause, D.J., Goebel, M.E., Marshall G.J., and Abernathy, K. 2016. 'Summer diving and haul-out behavior of leopard seals (*Hydrurga leptonyx*) near mesopredator breeding colonies at Livingston Island, Antarctic Peninsula.' Marine Mammal Science 32(3):839-867.
- LaRue, M.A., Rotella, J.J. Garrott, R.A., Siniff, D.B., Ainley, D.G., Stauffer, G.E., Porter, C.C. and Morin, P.J. 2011. 'Satellite imagery can be used to detect variation in abundance of Weddell seals (*Leptonychotes weddellii*) in Erebus Bay, Antarctica.' Polar Biology 34:1727-1737.
- Lauriano, G., Vacchi, M., Ainley D. and Ballard, G. 2007. 'Observations of top predators foraging on fish in the pack ice of the southern Ross Sea.' Antarctic Science 19(4):439-440.
- Lauriano, G., Fortuna, C.M., and Vacchi, M. 2011. 'Occurrence of killer whales (*Orcinus orca*) and other cetaceans in Terra Nova Bay, Ross Sea, Antarctica.' Antarctic Science 23(2): 139-143.
- Lauriano, G, Panigada, S. 2015. 'Ross Sea killer whales activities from Terra Nova Bay (Ross Sea Antarctica) to New Zealand,' SC66a/Sm/11 San Diego
- Lauriano, Giancarlo, et al. "Movements, diving behaviour and diet of type-C killer whales (*Orcinus orca*) in the Ross Sea, Antarctica." Aquatic Conservation: Marine and Freshwater Ecosystems 30.12 (2020): 2428-2440.
- LeDuc, R.G., Robertson, K.M., Pitman R.L., 2008. 'Mitochondrial sequence divergence among Antarctic killer whale ecotypes is consistent with multiple species.' Biology Letters 4:426-429
- Meade, J., Ciaglia, M.B., Slip, D.J., Negrete, J., Marquez, M.E., Mennucci, J. and Rogers, T.L. 2015. 'Spatial patterns in activity of leopard seals *Hydrurga leptonyx* in relation to sea ice.' Marine Ecology Progress Series 521:265-275.
- Murase, H., Kitakado, T., Hakamada, T., Matsuoka, K., Nishiwaki, S. and Naganobu, M. 2013. Spatial distribution of Antarctic minke whales (*Balaenoptera bonaerensis*) in relation to spatial distributions of krill in the Ross Sea, Antarctica. 'Fisheries Oceanography' 22(3): 154-173.
- Pinkerton, M.H., Bradford-Grieve, J.M., Hanchet, S.M. 2010. 'A Balanced Model of the Food Web of the Ross Sea, Antarctica.' CCAMLR Science 17:1-31.
- Pitman, R.L., Perryman, W.L., LeRoi, D, Eilers, E. 2007. 'A dwarf form of killer whale in Antarctica.' Journal of Mammalogy 88:43-48.
- Pitman, R.L., Fearnbach, H., Durban, J.W. 2018. 'Abundance and population status of Ross Sea killer whales (*Orcinus orca*, type C) in McMurdo Sound, Antarctica: evidence for impact by commercial fishing?' Polar Biology 41(4):781-792.
- Ponganis, P.J., Kooyman, G.L. and Castellini, M.A. 1995. 'Multiple Sightings of Arnoux Beaked Whales Along the Victoria Land Coast.' Marine Mammal Science 11(2):247-250.
- Rotella, J.J., Link, W.A., Nichols, J.D., Hadley, G.L., Garrott, R.A. and Proffitt, K.M. 2009. 'An evaluation of density-dependent and density-independent influences on population growth rates in Weddell seals.' Ecology 90:975-984.
- Southwell, C., Bengtson, J., Bester, M., Blix, A. S., Bornemann, H., Boveng, P., Cameron, M., Forcada, J., Laake, J., Nordoy, E., Plotz, J., Rogers, T., Southwell, D., Steinhage, D., Stewart, B.S., and Trathan, P. 2012. 'A Review of Data on Abundance, Trends in Abundance, Habitat Use and Diet of Ice- Breeding Seals in the Southern Ocean.' CCAMLR Science 19:49-74.
- Smith, W.O., Ainley D.G and Cattaneo-Vietti, R. 2007. 'Marine Ecosystems: the Ross Sea.' Philosophical Transactions of the Royal Society B 362:95-111.
- Testa, J.W. and Siniff, D.B. 1987. 'Population Dynamics of Weddell Seals (*Leptonychotes weddellii*) in McMurdo Sound, Antarctica.' Ecological Monographs 57:1-24.

Testa, J.W. and Scotton, B.D. 1999. 'Dynamics of an isolated population of Weddell seals (*Leptonychotes weddellii*) at White Island, Antarctica.' *Journal of Mammalogy* 80:82-90.

Younger, J.L., van den Hoff, J., Wienecke, B., Hindell, M., and Miller, K.J. 2016. 'Contrasting responses to a climate regime change by sympatric, ice-dependent predators.' *BMC Evolutionary Biology* 16.

Acknowledgements

We would like to thank the participants of the 2018 IMMA Regional Expert Workshop held in Brest, France for the identification of IMMAs in the Extended Southern Ocean. Funding for the workshop was provided by the French Biodiversity Agency, IUCN Global Marine and Polar Programme, the Fondation Prince Albert II de Monaco, OceanCare, Animal Welfare Institute (AWI) and the Natural Resources Defense Council (NRDC). Support was also provided by Whale and Dolphin Conservation and the Tethys Research Institute.



**MARINE MAMMAL
PROTECTED AREAS
TASK FORCE**

IUCN SSC WCPA IMMA

TETHYS since 1986

THE INTERNATIONAL COUNCIL FOR SCIENCE
SCAR
SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

WHALE AND DOLPHIN
CONSERVATION
WDC

OFB
OFFICE FRANÇAIS
DE LA BIODIVERSITÉ

PRINCE ALBERT II OF MONACO
FOUNDATION

ocean care

NRDC

Ministerio del Medio Ambiente
Gobierno de Chile

GOBI

Animal Welfare
Institute

Suggested Citation: IUCN-Marine Mammal Protected Areas Task Force, 2021. Ross Sea Ecosystem IMMA Factsheet. <https://www.marinemammalhabitat.org/wp-content/uploads/imma-factsheets/ExtendedSouthernOcean/ross-sea-ecosystem-ExtendedSouthernOcean.pdf>. Downloaded on (day month year).

PDF made available for download at <https://www.marinemammalhabitat.org/wp-content/uploads/imma-factsheets/ExtendedSouthernOcean/ross-sea-ecosystem-ExtendedSouthernOcean.pdf>