Ross Sea region MPA Baseline data meta data

Data files and metadata were compiled by Adrian Dahood, United States. Please not that all files have been projected into the South Pole Lambert Azimuthal Equal Area projection. In some cases, files have been “clipped” to the extent of MPA Planning Domain 8

**Basemap**

**550m\_isobath**

This is the 550m iso bath. It was derived from a bathymetry raster downloaded from https://www.gmrt.org/GMRTMapTool/?

In ARCMap 10.6 the Spatial Analyst Contour tool was applied using 50m increments. The 550m isobath was isolated.

Full citation for the underlying bathymetry data is:

Ryan, W.B.F., S.M. Carbotte, J.O. Coplan, S. O'Hara, A. Melkonian, R. Arko, R.A. Weissel, V. Ferrini, A. Goodwillie, F. Nitsche, J. Bonczkowski, and R. Zemsky (2009), Global Multi-Resolution Topography synthesis, Geochem. Geophys. Geosyst., 10, Q03014, doi: 10.1029/2008GC002332

**Antarctica**

Low resolution Antarctic coastline as down loaded from

coastline\_low\_res\_polygon\_zip

https://www.add.scar.org/ and

<https://add.data.bas.ac.uk/repository/entry/show?entryid=synth%3Af477219b-9121-44d6-afa6-d8552762dc45%3AL2NvYXN0bGluZXMvc2hw>

**mgds\_bathy**

This is a bathymetry raster downloaded from https://www.gmrt.org/GMRTMapTool/?

The data can be accessed by visiting the marine geosciences data system (MGDS) and using the GMRT Map Tool to select data

Full citation for the underlying bathymetry data is

Ryan, W.B.F., S.M. Carbotte, J.O. Coplan, S. O'Hara, A. Melkonian, R. Arko, R.A. Weissel, V. Ferrini, A. Goodwillie, F. Nitsche, J. Bonczkowski, and R. Zemsky (2009), Global Multi-Resolution Topography synthesis, Geochem. Geophys. Geosyst., 10, Q03014, doi: 10.1029/2008GC002332

**Ross\_Sea\_100m\_Bathy\_Contours**

The data represents bathymetry contours at 100m intervals. The contours were derived from a bathymetry raster downloaded from https://www.gmrt.org/GMRTMapTool/? In ARCMap 10.6 the Spatial Analyst Contour tool was applied using 100m intervals

Full citation for the underlying bathymetry data is:

Ryan, W.B.F., S.M. Carbotte, J.O. Coplan, S. O'Hara, A. Melkonian, R. Arko, R.A. Weissel, V. Ferrini, A. Goodwillie, F. Nitsche, J. Bonczkowski, and R. Zemsky (2009), Global Multi-Resolution Topography synthesis, Geochem. Geophys. Geosyst., 10, Q03014, doi: 10.1029/2008GC002332

**Ross\_Sea\_region\_Simple**

This file portrays the boundary of MPA Planning Domain 8 and the Ross Sea region MPA. Both files were downloaded from https://gis.ccamlr.org/

**Baseline Date: Areas**

**01\_Front\_x\_ice\_zonal**

The polygon depicts the shelf front intersection with the seasonal ice edge. This layer portrays the Ross Sea Shelf Front in combination with the marginal ice zone which is an area of elevated productivity targeted by top predators including seabirds, pinnipeds (crabeater seals), cetaceans (Minke whales and Type C killer whales) and adult toothfish

1 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Ainley, D.G. (2010) A History of the Exploitation of the Ross Sea, Antarctica. *Polar Record,* 46, 233-243.

Ainley, D.G., O’Conner, E.F. & Boekelheide, R.J. (1984). The marine ecology of birds in the Ross

Sea, Antarctica. *Ornithological Monographs*, 32: 97 p.

Gilbert, J.R. & Erickson. A.W. 1977. Distribution and abundance of seals in the pack ice of the

Pacific sector of Southern Ocean. In G.A. Llano (Ed) *Adaptations within Antarctic*

*ecosystems*, Smithsonian Institution, 703-748 pp. (Not in paper file)

Ichii, T. 1990. Distribution of Antarctic krill concentrations exploited by Japanese krill trawlers and minke whales*. Proceedings of the NIPR Symposium on polar Biology,* 3, 36-56. (not in paper file).

Loeb V, Siegel V, Holm-Hansen O, Hewitt R, Fraser W, Trivelpiece W, Trivelpiece S (1997) Effects

of sea ice extent and krill on salp dominance on the Antarctic food web. *Nature* 387:987- 900 (not in paper file).

Karnovsky et al. 2007 The impact and importance of production in polynyas to top-trophic predators: three case studies. In: *Polynyas: Windows to the World’s Oceans* (W.O. Smith, Jr. & D.G. Barber, eds.), Elsevier, Amsterdam (not in paper file).

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan.

Siegel V, Loeb V (1995) Recruitment of Antarctic krill Euphausia superba and possible causes for its variability. *Mar Ecol Prog Ser* 123:45-56.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**02\_Polar\_Front\_zonal**

Polygon depicts the polar front. It focusses on the areas where seabirds forage. It represents a transition zone between distinct distributions

2 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Ainley, D. G. & Jacobs, S. S. 1981 Seabird affinities for ocean and ice boundaries in the Antarctic. *Deep-Sea Research*, 28, 1173–1185.

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

Weimerskirch, H. & Y. Cherel. 1998. Feeding ecology of short-tailed shearwaters: breeding in

Tasmania and foraging in the Antarctic? *Mar Ecol Prog Ser*,167: 261-74.

**03\_Balleny\_Island\_Buffer\_zonal**

Polygon depicts Balleny Islands and proximity. The Islands disrupt circumpolar currents; altered ice regime and short-lived polynyas; top predator foraging; land-based predator colonies; E. superba; humpback whale migration destination

3 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Bradford-Grieve, J. & Fenwick, G. (2002) A review of the current knowledge describing the biodiversity of the Balleny Islands. New Zealand Ministry of Fisheries unpublished report (not in paper file).

SC-CAMLR-XXIV-BG-25 by Delegation of New Zealand 2005 Scientific justification for a Marine Protected Area designation around the Balleny Islands to protect ecosystem structure and function in the Ross Sea region, Antarctica: progress report.

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**04\_Polyna\_Marg\_Ice\_zonal**

Polygon depicts early summer marginal ice zone/polyna edge. This is high primary and secondary productivity and top predator foraging areas

4 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Ainley, D.G. (2010) A History of the Exploitation of the Ross Sea, Antarctica. Polar Record, 46, 233-243

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan.

WG-EMM-06/29 by Ainley, D.G.V. Toniolo, G. Ballard, K. Barton, J. Eastman, B. Karl, S. Focardi, G.Kooyman, P. Lyver, S. Olmastroni, B. S. Stewart, J. W. Testa, P. Wilson. 2006. Managing Ecosystem Uncertainty: Critical Habitat and Dietary Overlap of Top-Predators in the Ross Sea.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**05\_EasternRS\_MultiyrIce\_zonal**

Polygon depicts multi-year ice zone in the Eastern Ross Sea. This area is molting habitat for Adélie and Emperor penguins and crabeater seal habitat

5 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan .

WG-EMM-06/29 by Ainley, D.G.V. Toniolo, G. Ballard, K. Barton, J. Eastman, B. Karl, S. Focardi, G.Kooyman, P. Lyver, S. Olmastroni, B. S. Stewart, J. W. Testa, P. Wilson. 2006. Managing Ecosystem Uncertainty: Critical Habitat and Dietary Overlap of Top-Predators in the Ross Sea.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**06\_ Persistent\_Polyna\_zonal**

Polygon depicts areas of increased primary production in southern shelf polynas. These are persistent polynas that are ice free during the winter and are dominated by *Phaeocystis*

6 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Arrigo, K.R., van Dijken, G.L., 2004. Annual changes in sea ice, chlorophyll a, and primary production in the Ross Sea, Antarctica. Deep-Sea Research II 51, 117-138

Smith, W.O. Jr. & J.C. Comiso. 2008. The influence of sea ice on primary production in the Southern Ocean: a satellite perspective. J. Geophys. Res. 113, C05S93, doi:10.1029/2007JC004251.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**07\_Coastal\_Polyna\_zonal**

Polygon depicts primary and secondary productivity; foraging areas for land-based predator colonies

7 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Jacobs, S. S., and J. C. Comiso (1989), Sea ice and oceanic processes on the Ross Sea continental shelf, J. Geophys. Res., 94(C12), 18195–18211, doi: 10.1029/JC094iC12p18195.

Jacobs, S.S. and C.F. Giulivi (1998). Interannual Ocean and Sea Ice Variability in the Ross Sea. In Ocean, Ice, and Atmosphere: Interactions at the Antarctic Continental Margin (eds. S.S. Jacobs and R.F. Weiss), American Geophysical Union, Washington, D.C., doi: 10.1029/AR075p0135. (not in paper file)

Romanov AA 1994. Ice of the Sothern Ocean. Gidrometeoizdat, Leningrad, 150pages (not in paper file)

Tremblay, J.-E. & W.O. Smith, Jr. 2007. Phytoplankton processes in polynyas. In: Polynyas: Windows to the World’s Oceans (W.O. Smith, Jr. & D.G. Barber, eds.), Elsevier, Amsterdam, Pp. 239-270. (not in paper file)

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

Zwally, H.J.; J.C. Comiso; A.L. Gordon. 1985. Antarctic offshore leads and polynyas and oceanographic effects. In: Oceanology of the Antarctic Continental Shelf, S.S. Jacobs (ed.), Antarctic Research Series 43, AGU, Washington D.C., 102-336.

**08\_Antarctic\_Krill\_Core\_zonal**

Polygon depicts Antarctic Krill (*E. superba*) northwest Ross Sea aggregation, a focus area for krill predator foraging, especially at the overlap with the ice edge/ continental shelf.

8 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Azzali, M., I. Leonori, A. De Felice, and A. Russo. 2006. Spatial–temporal relationships between two euphausiid species in the Ross Sea. Chemistry and Ecology 22:S219-S233.

Azzali, A., and J. Kalinowski. 2000. Spatial and temporal distribution of krill Euphausia superba biomass in the Ross Sea (1989–1990 and 1994). Pages 433-455 in F. M. Faranda, L. Guglielmo, and A. Ianora, editors. Ross Sea Ecology. Springer-Verlag, Berlin.

Sala, A., M. Azzali, and A. Russo. 2002. Krill of the Ross Sea: distribution, abundance and demography of Euphausia superba and Euphausia crystallorophias during the Italian Antarctic Expedition (January-February 2000). Scientia Marina 66:123-133.

Taki, K., T. Yabuki, Y. Noiri, T. Hayashi, and M. Naganobu. 2008. Horizontal and vertical distribution and demography of euphausiids in the Ross Sea and its adjacent waters in 2004/2005. Polar Biology 31:1343-1356.

WG-EMM-07/07 by Naganobu, M., S. Nishiwaki, H. Yasuma, R. Matsukura, Y. Takao, K. Taki, T. Hayashi, Y. Watanabe, T. Yabuki, Y. Yoda, Y. Noiri, M. Kuga, K. Yoshikawa, N. Kokubun, H. Murase, K. Matsuoka, & K. Ito. 2007. Interactions between oceanography, krill and baleen whales in the Ross Sea and Adjacent Waters in 2004/05.

WG-EMM- 08/35 by Murase, H., H. Yasuma, R. Matsukura, Y. Takao, K. Taki, T. Hayashi, T. Yabuki, T. Tamura, K. Konishi, K. Matsuoka, K. Miyashita, S. Nishiwaki, and M. Naganobu. 2008. Distribution patterns and biomasses of Antarctic krill (Euphausia superba) and ice krill (E. crystallorophias) with note on distribution of Antarctic minke whales (Balaenoptera bonaerensis) in the Ross Sea in 2005

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**09\_Crystal\_Krill\_zonal**

Polygon depicts Crystal Krill (*E. crystallorophias*) core areas, a region known to be an important conduit for energy transfer to higher trophic levels on the shelf; Western Ross Shelf, precise location is not well resolved.

9 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Sala, A., M. Azzali, and A. Russo. 2002. Krill of the Ross Sea: distribution, abundance and demography of *Euphausia superba* and *Euphausia crystallorophias* during the Italian Antarctic Expedition (January-February 2000).Scientia Marina 66:123-133.

SG-ASAM-09/05 by O'Driscoll, R.L., G.J. Macaulay, S. Gauthier, M. Pinkerton, S. Hanchet. 2009. Preliminary acoustic results from the New Zealand IPY-CAML survey of the Ross Sea region in February-March 2008.

Taki, K., T. Yabuki, Y. Noiri, T. Hayashi, and M. Naganobu. 2008. Horizontal and vertical distribution and demography of euphausiids in the Ross Sea and its adjacent waters in 2004/2005.Polar Biology 31:1343-1356.

WG-EMM- 08/35 *by* Murase, H., H. Yasuma, R. Matsukura, Y. Takao, K. Taki, T. Hayashi, T. Yabuki, T. Tamura, K. Konishi, K. Matsuoka, K. Miyashita, S. Nishiwaki, and M. Naganobu. 2008. Distribution patterns and biomasses of Antarctic krill (*Euphausia superba*) and ice krill (*E. crystallorophias*) with note on distribution of Antarctic minke whales (*Balaenoptera bonaerensis*) in the Ross Sea in 2005

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**10\_Silverfish\_Core\_zonal**

Polygon depicts *Pleurogramma antarctica* core areas, a region known to be an important conduit for energy transfer to higher trophic levels on the shelf; Western Ross Shelf, precise location is not well resolved.

10 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

SG-ASAM-09/05 by O'Driscoll, R.L., G.J. Macaulay, S. Gauthier, M. Pinkerton, S. Hanchet. 2009. Preliminary acoustic results from the New Zealand IPY-CAML survey of the Ross Sea region in February-March 2008.

WG-EMM- 08/35 *by* Murase, H., H. Yasuma, R. Matsukura, Y. Takao, K. Taki, T. Hayashi, T. Yabuki, T. Tamura, K. Konishi, K. Matsuoka, K. Miyashita, S. Nishiwaki, and M. Naganobu. 2008. Distribution patterns and biomasses of Antarctic krill (*Euphausia superba*) and ice krill (*E. crystallorophias*) with note on distribution of Antarctic minke whales (*Balaenoptera bonaerensis*) in the Ross Sea in 2005

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**11\_Adelie\_summer\_zonal**

Polygon depicts Adélie penguin known foraging distributions during breeding and nesting season.

11 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Ballance, L.T.; Ainley, D.G.; Ballard, G.; Barton, K. (2009). An energetic correlate between colony size and foraging effort in seabirds, an example of the Adélie penguin Pygoscelis adeliae. Journal of Avian Biology, 40: 279-288.

Lyver, P’O.B., MacLeod, C.J., Ballard, G., Karl, B.J., Barton, K.J., Adams J. Ainley, D.G., and Wilson, P.R. 2011. Intra-seasonal variation in forgaing behaviour among Adélie penguins (*Pygocelis adeliae*) breeding at Cape Hallett, Antarctica. Polar Biology 34(1): 49-67.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**12\_Emperor\_Summer\_Zonal**

Polygon depicts Emperor penguin known foraging distributions during breeding and nesting season.

12 = Area Number

Area\_km2 = total area of the polygon in kilometers squared ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Ballance, L.T.; Ainley, D.G.; Ballard, G.; Barton, K. (2009). An energetic correlate between colony size and foraging effort in seabirds, an example of the Adélie penguin Pygoscelis adeliae. Journal of Avian Biology, 40: 279-288.

Lyver, P’O.B., MacLeod, C.J., Ballard, G., Karl, B.J., Barton, K.J., Adams J. Ainley, D.G., and

Wilson, P.R. 2011. Intra-seasonal variation in forgaing behaviour among Adélie penguins

(Pygocelis adeliae) breeding at Cape Hallett, Antarctica. Polar Biology 34(1): 49-67

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**13\_Weddell\_Summer\_zonal**

Polygon depicts Weddell seal foraging area distributions during breeding and pupping season

13 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

WG-EMM-06/29 by Ainley, D.G.V. Toniolo, G. Ballard, K. Barton, J. Eastman, B. Karl, S. Focardi, G.Kooyman, P.Lyver, S. Olmastroni, B. S. Stewart, J. W. Testa, P. Wilson. 2006. Managing Ecosystem Uncertainty: Critical Habitat and Dietary Overlap of Top-Predators in the Ross Sea.

Gilbert, J.R. & Erickson. A.W. 1977. Distribution and abundance of seals in the pack ice of the

Pacific sector of Southern Ocean. In G.A. Llano (Ed) Adaptations within Antarctic

ecosystems, Smithsonian Institution, 703-748 pp. (not in paper file)

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**14\_C\_KillerWhale\_Summer\_Zonal**

Polygon depicts Type C killer whale summer foraging areas. Presumed preferred summer foraging distributions, inferred from observed behaviors and average December-February ice edge position.

14 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Ainley, D.G., G. Ballard, S. Olmastroni. (2009). An Apparent Decrease in the Prevalence of “Ross

Sea Killer Whales” in the Southern Ross Sea. Aquatic Mammals 35(3), 335-347.

Pitman, R.L. & Ensor, P. (2003) Three forms of killer whales in Antarctic waters. Journal of

Cetacean Research and Management, 5, 1-9.

Pitman, R.L., W.L. Perryman, D. LeRoi & E. Eilers. (2007). A dwarf form of killer whale in

Antarctica. Journal of Mammalogy, 88(1): 43-48.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**15\_VictoriaCoast\_zonal**

Polygon depicts Victoria coast/ ice tongues and proximity; Platelet ice formation: important habitat for fish and invertebrate larvae on the underside of ice, and for other ice-associated fauna.

15 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

*Lewis, E.L. & Perkins, R.G. 1985. The winter oceanography of McMurdo Sound, Antarctica. Ant Res. Series, 43, 145-165.*

Vacchi et al unpublished. (not in paper file)

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**16\_TerraNova\_Bay\_zonal**

Polygon depicts Terra Nova Bay *Pleuragramma antarcticum* spawning area; persistent polynya ice-free in winter.

16 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Italy (2010). Terra Nova Bay – Wood Bay Marine Protected Area inside a wider proposal for a

Ross Sea MPA. ATCM XXXIII/IP 45.

La Mesa, M., Eastman, J. T. & Vacchi, M. 2004 The role of notothenioid fish in the food web of the Ross Sea shelf waters: a review. *Polar Biol*ogy 27, 321–338.

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*Pleuragramma antarcticum* Boulenger, 1902 in Terra Nova Bay (Ross Sea, Antarctica).

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WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**17\_PennellPolyna\_Zonal**

Polygon depicts Pennell Bank Polyna.

17 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

WS-MPA- 11/25 by Sharp BR, Watters G.M. 2011. Marine protected area planning by New Zealand and the United States in the Ross Sea region. WS-MPA- 11/25.

**18\_SubA\_Toothfish\_settle\_zonal**

Polygon depicts Antarctic toothfish: Deeper troughs in southern continental shelf likely preferred recruitment habitat for juveniles.

18 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

WG-EMM-09/40 by Hanchet, S., Mormede, S. & Dunn, A. 2009. Distribution and abundance of Antarctic toothfish in the Ross Sea.

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**19\_toothfish\_DispersalTrench\_zonal**

Polygon depicts Antarctic toothfish: Terra Nova Trench. Likely ontogenetic migration corridor between preferred juvenile and adult habitats

19 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Hanchet, S.M., Rickard, G.J., Fenaughty, J.M., Dunn, A.; Williams, M.J. (2008). A hypothetical life cycle for Antarctic toothfish *Dissostichus mawsoni* in Antarctic waters of CCAMLR Statistical Area 68. *CCAMLR Science 15:* 35–54.

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**20\_Toothfish\_AdultForag\_zonal**

Polygon depicts Antarctic toothfish: preferred adult habitat/feeding area, for weight gain between spawning migrations.

20 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

WG-EMM-09/40 by Hanchet, S., Mormede, S. & Dunn, A. 2009. Distribution and abundance of Antarctic toothfish in the Ross Sea.

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**21\_Tothfish\_NW\_spawn\_zonal**

Polygon depicts NW seamounts that are thought to be Antarctic toothfish spawning areas.

22 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Fenaughty, J.M. (2006). Geographical differences in condition, reproductive development, sex ratio, and length distribution in Antarctic toothfish (Dissostichus mawsoni) for the Ross Sea, Antarctica (CCAMLR statistical SubArea 68.1) *CCAMLR Science*, 13: 27-45.

SC-CAMLR-XXXVI/20 *by* Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan

WG-EMM-09/40 by Hanchet, S., Mormede, S. & Dunn, A. 2009. Distribution and abundance of Antarctic toothfish in the Ross Sea.

WG-EMM-10/30 *by* Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**22\_Toothfish\_NE\_spawn\_zonal**

Polygon depicts NE seamounts that are thought to be Antarctic toothfish spawning areas

21 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in :

Fenaughty, J.M. (2006). Geographical differences in condition, reproductive development, sex ratio, and length distribution in Antarctic toothfish (*Dissostichus mawsoni*) for the Ross Sea, Antarctica (CCAMLR statistical SubArea 68.1) *CCAMLR Science*, 13: 27-45.

SC-CAMLR-XXXVI/20 *by* Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan.

WG-EMM-09/40 by Hanchet, S., Mormede, S. & Dunn, A. 2009. Distribution and abundance of Antarctic toothfish in the Ross Sea.

WG-EMM-10/30 *by* Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**23\_Balleny\_Seamounts\_zonal**

Polygon depicts Balleny Seamounts.

23 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Developed from data presented in:

Bradford-Grieve, J. & Fenwick, G. (2002) A review of the current knowledge describing the biodiversity of the Balleny Islands. New Zealand Ministry of Fisheries unpublished report. (not in paper file)

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**24\_Admiralty\_Seamount-zonal**

Polygon depicts Admiralty Seamount

24 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total area of the polygon in each MPA zone.

Developed from data presented in:

Barry, J. P., Grebmeier, J., Smith, J. & Dunbar, R. B. 2003. Bathymetric versus oceanographic control of benthic megafaunal patterns in the Ross Sea, Antarctica, Antarctic Research Series, 78: 327-354 (not in paper file)

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

IPY unpublished data

**25\_CapeAdare\_Slope\_zonal**

Polygon depicts Cape Adare Slope

25 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total area of the polygon in each MPA zone.

Developed from data presented in:

Barry, J. P., Grebmeier, J., Smith, J. & Dunbar, R. B. 2003. Bathymetric versus oceanographic control of benthic megafaunal patterns in the Ross Sea, Antarctica, Antarctic Research Series, 78: 327-354 (not in paper file).

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

New Zealand unpublished data.

**26\_SE\_RS\_Slope\_zonal**

Polygon depicts SE Ross Sea Slope

26 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total area of the polygon in each MPA zone.

Developed from data presented in:

WG-EMM-10/30 *by* Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region

**27\_McM\_Sound\_zonal**

Polygon depicts Southern McMurdo Sound

27 = Area Number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total area of the polygon in each MPA zone.

Developed from data presented in:

Dayton, P. K., Watson, D. Palmisano, A. Barry, J. P., Rivera, D. 1986. Distribution patterns of benthic microalgae standing stock at McMurdo Sound, Antarctica. Polar Biology 6:207–213.

Thrush, S., Dayton, P., Cattaneo-Vietti, R., Chiantore, M., Cummings, V., Andrew, N., Hawes, I., Kim, S., Kvitek, R., Schwarz, A-M. (2006). Broad-scale factors influencing the biodiversity of coastal benthic communities of the Ross Sea. *Deep-Sea Research II*, 53, 959-971.

WG-EMM-10/30 *by* Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region.

**28\_Scott\_Seamount\_Zonal**

Polygon depicts a buffer around the Scott Seamount

28 in file name= layer/ area number

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total area of the polygon in each MPA zone.

Developed from data presented in

SC-CAMLR-XXXVI/20 by Dunn, A., M. Vacchi, and G. Watters. 2017. The Ross Sea region Marine Protected Area Research and Monitoring Plan.

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region

WS-MPA- 11/25 by Sharp BR, Watters GM (2011) Marine protected area planning by New Zealand and the United States in the Ross Sea region. WS-MPA- 11/25

**29\_Preds\_Analysis\_Area**

This polygon illustrates the total area considered for the predator conservation ranking analysis. Note that it does not overlap with every zone of the MPA. Overlap statistics have not been computed because it is solely a bounding box for the predator analysis.

Source:

Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. 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.

**29\_Predators\_zonal**

This polygon represents preferred areas for air breathing predators in the Ross Sea. It portrays areas with a 75% or higher conservation ranking as illustrated in WG-EMM-10-12. Predators included in this analysis were: Minke whale, Type C Killer Whale, Crabeater Seal, Weddell Seal, Adélie Penguin, Antarctic Petrel, Snow Petrel, and light mantled sooty albatross.

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Source Figure 7B in:

WG-EMM-10-12 by Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. Ross Sea Bioregionalization, Part II Patterns of co-occurrence of meso predators in an intact polar ocean ecosystem

**Baseline Data: Ballard et al Habitat model**

**Adelie\_Penguin\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Adélie Penguin (Pygoscelis adeliae) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet.

Models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus the models presented are ensemble means. Presence locations were taken from ship cruises except for Weddell seals whose data came from satellite tags. Model "target" background points were derived from data selected from the area within one grid cell of a ships tracks for all cruises. Weddell seal background points were derived from the entire study area.

Information on model data sources can be found in: WG-EMM-10/11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

WG-EMM-10/12 by Ballard, G., Jongsomjit, D., and Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: Ballard, G., Jongsomjit, D., Veloz, S.D., and Ainley D.G.. 2011. Coexistence of mesopredators in an intact polar ocean ecosystem: The basis for defining a Ross Sea marine protected area. Biological Conservation. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Antarctic\_Petrel\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Antarctic Petrel (*Thalassoica antarctica* ) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet.

Models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus, the models presented are ensemble means. Presence locations were taken from ship cruises except for Weddell seals whose data came from satellite tags. Model "target" background points were derived from data selected from the area within one grid cell of a ships’ tracks for all cruises. Weddell seal background points were derived from the entire study area.

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

WG-EMM-10/12 by Ballard, G., Jongsomjit, D., and Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: WG-EMM-10/11 by 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. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**C\_Killer\_Whale\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Ross Sea Killer Whale (Ecotype C) (*Orcinus orca* sp. Nov. ) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet.

Models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus the models presented are ensemble means. Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: WG-EMM-10/12 by Ballard, G., Jongsomjit, D., and Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

Ballard G, Jongsomjit D, Veloz SD, Ainley DG (2012) Coexistence of mesopredators in an intact polar ocean ecosystem: The basis for defining a Ross Sea marine protected area. Biological Conservation 15672-82 http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Conservation\_Rank\_Ballard**

Relative conservation importance using probability of occurrence models for Ross Sea Killer Whale (ecotype C), Minke Whale, Crabeater Seal, Weddell Seal, Emperor Penguin, Adélie Penguin, Antarctic Petrel, Snow Petrel, and Light-mantled Sooty Albatross; results from Zonation core area analysis (which prioritizes the inclusion of high-quality locations for all species) with all species given equal conservation priority and where all cells were assumed to have equal potential conservation costs. Species’ projected distributions were discounted by subtracting an ‘‘uncertainty surface’’ for each species proportional to the standard deviation of the bootstrapped distribution models for each species. See Ballard et al. 2012 for more details.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet.

The mathematical details and other methodological information pertaining to core-area Zonation are provided by Moilanen et al. (2005) and Moilanen (2007). Moilanen, A. 2007. Landscape zonation, benefit functions and target-based planning: Unifying reserve selection strategies. Biological Conservation, 134: 571-579. Moilanen, A., A.M.A. Franco, R. Early, R. Fox, B. Wintle & C.D. Thomas. 2005. Prioritizing multiple-use landscapes for conservation: methods for large multi-species planning problems. Proc. Royal Soc. London, Series B, Biol. Sci. 272: 1885-1891. Distribution models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus, the models used in this analysis are ensemble means.

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources. More information on modeling methodology can be found in: Ballard, G., Jongsomjit, D.,

WG-EMM-10/12 by Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information available in Ballard G, Jongsomjit D, Veloz SD, Ainley DG (2012) Coexistence of mesopredators in an intact polar ocean ecosystem: The basis for defining a Ross Sea marine protected area. Biological Conservation 15672-82. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Crabeater\_Seal\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Crabeater Seal (*Lobodon carcinophagus*) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet.<

Models were run 30 times using a bootsrap approach with the full dataset available in a random sort order each run. Thus, the models presented are ensemble means. Presence locations were taken from ship cruises except for Weddell seals whose data came from satellite tags. Model "target" background points were derived from data selected from the area within one grid cell of a ships tracks for all cruises. Weddell seal background points were derived from the entire study area.

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources. More information on modeling methodology can be found in: Ballard, G., Jongsomjit, D.,

WG-EMM-10/12 by Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

**Emperor\_Penguin\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Emperer Penguin (*Aptenodytes forsteri*) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet.

Models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus, the models presented are ensemble means. Presence locations were taken from ship cruises except for Weddell seals whose data came from satellite tags. Model "target" background points were derived from data selected from the area within one grid cell of a ships’ tracks for all cruises. Weddell seal background points were derived from the entire study area.

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Reuslts Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

WG-EMM-10/12 by Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: 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. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Light\_Mantled\_Sooty\_Albatross\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Light-mantled Sooty Albatross (*Phoebetria palpebrata* ) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet

Models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus, the models presented are ensemble means. Presence locations were taken from ship cruises except for Weddell seals whose data came from satellite tags. Model "target" background points were derived from data selected from the area within one grid cell of a ships’ tracks for all cruises. Weddell seal background points were derived from the entire study area.

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

WG-EMM-10/12 by Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: 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. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Minke\_Whale\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Antarctic Minke Whale (*Balaenoptera bonaerinsis*) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet

Models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus, the models presented are ensemble means. Presence locations were taken from ship cruises except for Weddell seals whose data came from satellite tags. Model "target" background points were derived from data selected from the area within one grid cell of a ships’ tracks for all cruises. Weddell seal background points were derived from the entire study area.

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

WG-EMM-10/12 by Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: 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. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Predators\_Ballard\_2012\_Zonal**

This polygon represents preferred areas for air breathing predators in the Ross Sea. It portrays areas with a 75% or higher conservation ranking as illustrated in Ballard et al. 2012. (derived from the Conservation\_Rank\_Ballard file). Predators included in this analysis were: Minke whale, Type C Killer Whale, Crabeater Seal, Weddell Seal, Adélie Penguin, Antarctic Petrel, Snow Petrel, and light mantled sooty albatross. This is an update of the work presented in WG-EMM-10-12. Note that the underlying model has changed and that the location of the top 75% areas have changed

Area\_km2 = total area of the polygon in kilometers squared

ovrlp\_km2 = area of the polygon in each MPA zone in km2

ovrlp\_perc = percent of total polygon area in each MPA zone

Source Figure 4B in:

Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. 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.

**Snow\_Petrel\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Snow Petrel (*Pagodroma nivea*) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet.

Models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus, the models presented are ensemble means. Presence locations were taken from ship cruises except for Weddell seals whose data came from satellite tags. Model "target" background points were derived from data selected from the area within one grid cell of a ships’ tracks for all cruises. Weddell seal background points were derived from the entire study area.

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

WG-EMM-10/12 by Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: 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. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Species\_Richness\_Ballard**

Modeled species richness (sum of individual species’ presence) of mesopredators of the Ross Sea: Ross Sea Killer Whale (ecotype C), Minke Whale, Crabeater Seal, Weddell Seal, Emperor Penguin, Adélie Penguin, Antarctic Petrel, Snow Petrel, and Light-mantled Sooty Albatross based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables. We applied a threshold to each model that maximized training sensitivity and specificity (Phillips et al., 2006) and converted all values above the threshold to 1 (predicted presence) and all values below the threshold to 0 (predicted absence). See Ballard et al. 2012 for more information.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet

Individual species models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus, the models presented are ensemble means. We applied a threshold to each model that maximized training sensitivity and specificity (Phillips et al., 2006) and converted all values above the threshold to 1 (predicted presence) and all values below the threshold to 0 (predicted absence).

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: WG-EMM-10/12 Ballard, G., Jongsomjit, D., and Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

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. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Weddell\_Seal\_maxent**

Probability of occurrence from a maximum entropy (Maxent v3.3.1) model for Weddell Seal ( Leptonychotes weddellii ) in the Ross Sea region, Antarctica based on occurrence (presence only) data sea ice cover, chlorophyll concentration, circumpolar deep water, and bathymetric variables.

The Ross Sea is the anthropogenically least affected stretch of ocean remaining on Earth, still has a full suite of top predators, and unusually high primary productivity. For these reasons, elucidating the patterns of co-occurrence of this fauna within the relatively small confines of the Ross Sea may offer ecological insights not possible elsewhere in the world ocean where most top predators have been severely depleted for a long time. These models were part of an analyses of niche occupation of all air-breathing mesopredators in the Ross Sea considering projected distribution across the surface, foraging depth, and diet

Models were run 30 times using a bootstrap approach with the full dataset available in a random sort order each run. Thus, the models presented are ensemble means. Presence locations were taken from ship cruises except for Weddell seals whose data came from satellite tags. Model "target" background points were derived from data selected from the area within one grid cell of a ships’ tracks for all cruises. Weddell seal background points were derived from the entire study area.

Information on model data sources can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

More information on modeling methodology can be found in: WG-EMM-10/12 Ballard, G., Jongsomjit, D., and Ainley D.G.. 2010. Ross Sea Bioregionalization, Part II: Patterns of Co-occurrence of mesopredators in an intact polar ocean ecosystem. Report to the Working Group on Ecosystem Monitoring and Management of the Commission for the Conservation of Antarctic Marine Living Resources.

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. http://dx.doi.org/10.1016/j.biocon.2011.11.017

**Baseline Data: Bioregions**

**PelagicBio\_zonal**

Pelagic Bioregions in Planning Domain 8

code = bioregion

code\_km2 = total area in kilometers squared of the bioregion

ovrlp\_km2 = area in km of bioregion in MPA zone

ovrlp\_perc = percent of bioregion in each MPA zone

Bioregions described in

WG-EMM-10/30 by Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea

**BenthicBio\_zonal**-

Benthic bioregions in planning Domain 8

Benthic Bioregions in Planning Domain 8

code = bioregion

code\_km2 = total area in kilometers squared of the bioregion

ovrlp\_km2 = area in km squared of bioregion in MPA zone

ovrlp\_perc = percent of bioregion in each MPA zone

Bioregionalization described in: WG-EMM-10/30 *by* Sharp, B.R., S.J. Parker, M.H. Pinkerton, B.B. Breen, V. Cummings, A. Dunn, S.M. Grant, S.M. Hanchet, H.J.R. Keys, S.J. Lockhart, P.O.B. Lyver, R.L. O'Driscoll, M.J. M. Williams, and P.R. Wilson. 2010. Bioregionalization and spatial ecosystem processes in the Ross Sea region

**Baseline Data: Point Data**

**APIS\_Crabeater\_seal**

These data represent satellite tag "pings" for crabeater seals tagged on an APIS cruise during 1999-2000. Some seals traveled outside of Planning Domain 8, but those data have not been included here.

These data were contributed to CCAMLR as a personal communication from B. Stewart, W. Testa. J. Burns, J. Bengston, and P. Boveng as part of WG-EMM-10/12- by Ballard, Jongsomjit and Ainley "Ross Sea Regionalization, Part II: Patterns of co-occurrence of mesopredators in an intact polar ocean"

Further analyses on these data were published in:

Bengtson JL, Laake JL, Boveng PL, Cameron MF, Bradley Hanson M, Stewart BS (2011) Distribution, density, and abundance of pack-ice seals in the Amundsen and Ross Seas, Antarctica. Deep Sea Research Part II: Topical Studies in Oceanography 58(9):1261-1276

**APIS\_Leopard\_seal**

These data represent satellite tag "pings" for Leopard seals tagged on an APIS cruise during 1999-2000.

These data were contributed to CCAMLR as a personal communication from B. Stewart, W. Testa. J. Burns, J. Bengston, and P. Boveng as part of WG-EMM-10/12- by Ballard, Jongsomjit and Ainley "Ross Sea Regionalization, Part II: Patterns of co-occurrence of mesopredators in an intact polar ocean"

Further analyses on these data were published in:

Bengtson JL, Laake JL, Boveng PL, Cameron MF, Bradley Hanson M, Stewart BS (2011) Distribution, density, and abundance of pack-ice seals in the Amundsen and Ross Seas, Antarctica. Deep Sea Research Part II: Topical Studies in Oceanography 58(9):1261-1276

**APIS\_Ross\_seal**

These data represent satellite tag "pings" for Ross seals tagged on an APIS cruise during 1999-2000. Some seals traveled outside of Planning Domain 8, but those data have not been included here.

These data were contributed to CCAMLR as a personal communication from B. Stewart, W. Testa. J. Burns, J. Bengston, and P. Boveng as part of WG-EMM-10/12- by Ballard, Jongsomjit and Ainley "Ross Sea Regionalization, Part II: Patterns of co-occurrence of mesopredators in an intact polar ocean"

Further analyses on these data were published in:

Bengtson JL, Laake JL, Boveng PL, Cameron MF, Bradley Hanson M, Stewart BS (2011) Distribution, density, and abundance of pack-ice seals in the Amundsen and Ross Seas, Antarctica. Deep Sea Research Part II: Topical Studies in Oceanography 58(9):1261-1276

**APIS\_Weddell\_seal**

These data represent satellite tag "pings" for Weddell seals tagged on an APIS cruise during 1999-2000. Some seals traveled outside of Planning Domain 8, but those data have not been included here.

These data were contributed to CCAMLR as a personal communication from B. Stewart, W. Testa. J. Burns, J. Bengston, and P. Boveng as part of WG-EMM-10/12- by Ballard, Jongsomjit and Ainley "Ross Sea Regionalization, Part II: Patterns of co-occurrence of mesopredators in an intact polar ocean"

Further analyses on these data were published in:

Bengtson JL, Laake JL, Boveng PL, Cameron MF, Bradley Hanson M, Stewart BS (2011) Distribution, density, and abundance of pack-ice seals in the Amundsen and Ross Seas, Antarctica. Deep Sea Research Part II: Topical Studies in Oceanography 58(9):1261-1276

**Ballard\_Weddell\_Seal\_Adult\_tracks**

These data represent satellite pings for adult Weddell seals. We have not corrected the points or removed low quality points. The "ID" column gives the seal's tag number.

These data were contributed to CCAMLR as a personal communication from B. Stewart, W. Testa. J. Burns, J. Bengston, and P. Boveng as part of WG-EMM-10/12- by Ballard, Jongsomjit and Ainley "Ross Sea Regionalization, Part II: Patterns of co-occurrence of mesopredators in an intact polar ocean"

For more information about these data points please see the appendices of

Ballard G, Jongsomjit D, Veloz SD, Ainley DG (2012) Coexistence of mesopredators in an intact polar ocean ecosystem: The basis for defining a Ross Sea marine protected area. Biological Conservation 15672-82

**Ballard\_Weddell\_Seal\_Pup\_tracks**

These data represent satellite pings for Weddell seal pups. We have not corrected the points or removed low quality points. The "ID" column gives the seal's tag number.

These data were contributed to CCAMLR as a personal communication from B. Stewart, W. Testa. J. Burns, J. Bengston, and P. Boveng as part of WG-EMM-10/12- by Ballard, Jongsomjit and Ainley "Ross Sea Regionalization, Part II: Patterns of co-occurrence of mesopredators in an intact polar ocean"

For more information about these data points please see the appendices of

Ballard G, Jongsomjit D, Veloz SD, Ainley DG (2012) Coexistence of mesopredators in an intact polar ocean ecosystem: The basis for defining a Ross Sea marine protected area. Biological Conservation 15672-82

**Brooks\_Silverfish**

From Table 3 in Brooks C.M., Caccavo J.A., Ashford J., Dunbar R., Goetz K., La Mesa M., Zane L. 2018. Early life history connectivity of Antarctic silverfish (Pleuragramma antarctica) in the Ross Sea. Fisheries Oceanography 27(3):274-287

Abundance indices (n/1,000 m3) for larval and juvenile Pleuragramma antarctica, caught by 300 micron nets and 700 micron nets

**Brooks\_Silverfish\_Map**

Mean number of larval and juvenile silverfish by MPA zone as calculated from the abundance indices presented in Table 3 in Brooks C.M., Caccavo J.A., Ashford J., Dunbar R., Goetz K., La Mesa M., Zane L. 2018. Early life history connectivity of Antarctic silverfish (Pleuragramma antarctica) in the Ross Sea. Fisheries Oceanography 27(3):274-287

Value represents the number of larval and juvenile Pleuragramma antarctica per 1,000 m3 averaged across both nets

**Davis\_E\_Crystal**

Euphausia crystallorophias densities in g/m2 as portrayed in

Davis LB, Hofmann EE, Klinck JM, Piñones A, Dinniman MS (2017) Distributions of krill and Antarctic silverfish and correlations with environmental variables in the western Ross Sea, Antarctica. Marine Ecology Progress Series 58445-65.

**Davis\_E\_crystal\_Map**

Mean E. crystallorophias density in g/m2 in each MPA zone as estimated from

Davis LB, Hofmann EE, Klinck JM, Piñones A, Dinniman MS (2017) Distributions of krill and Antarctic silverfish and correlations with environmental variables in the western Ross Sea, Antarctica. Marine Ecology Progress Series 58445-65

**Davis\_E\_superba**

Euphausia superba densities in g/m2 from Davis LB, Hofmann EE, Klinck JM, Piñones A, Dinniman MS (2017) Distributions of krill and Antarctic silverfish and correlations with environmental variables in the western Ross Sea, Antarctica. Marine Ecology Progress Series 58445-65

**Davis\_E\_superba\_Map**

Mean Euphausia superba densities in g/m2 in each MPA zone. Estimated from the data presented in Davis LB, Hofmann EE, Klinck JM, Piñones A, Dinniman MS (2017) Distributions of krill and Antarctic silverfish and correlations with environmental variables in the western Ross Sea, Antarctica. Marine Ecology Progress Series 58445-65

**Davis\_Silverfish**

Antarctic silverfish (Pleuragramma antarctica) densities in individuals /1000 m3. From the data presented in Davis LB, Hofmann EE, Klinck JM, Piñones A, Dinniman MS (2017) Distributions of krill and Antarctic silverfish and correlations with environmental variables in the western Ross Sea, Antarctica. Marine Ecology Progress Series 58445-65

**Davis\_Silverfish\_Map**

Mean density of Antarctic silverfish (Pleuragramma antarctica) in individuals /1000 m3. Estimated from the data presented in Davis LB, Hofmann EE, Klinck JM, Piñones A, Dinniman MS (2017) Distributions of krill and Antarctic silverfish and correlations with environmental variables in the western Ross Sea, Antarctica. Marine Ecology Progress Series 58445-65.

**E\_Crystal\_Ackley\_Dom8**

Redrawn from:

Ackley SF, Bengtson JL, Boveng P, Castellini M, Daly KL, Jacobs S, Kooyman GL, Laake J, Quetin L, Ross R, Siniff DB, Stewart BS, Stirling I, Torres J, Yochem PK (2003) A top–down, multidisciplinary study of the structure and function of the pack-ice ecosystem in the eastern Ross Sea, Antarctica. Polar Record 39(3):219-230

Data bins were represented by the mid-point except for the largest bin which was represented by 8- the lowest integer value in that bin.

**ECrystal\_Ackley\_Map**

Mean Euphausia crystallorophias density by MPA zone estimated from the data presented in:

Ackley SF, Bengtson JL, Boveng P, Castellini M, Daly KL, Jacobs S, Kooyman GL, Laake J, Quetin L, Ross R, Siniff DB, Stewart BS, Stirling I, Torres J, Yochem PK (2003) A top–down, multidisciplinary study of the structure and function of the pack-ice ecosystem in the eastern Ross Sea, Antarctica. Polar Record 39(3):219-230

Data bins were represented by the mid-point except for the largest bin which was represented by 8- the lowest integer value in that bin.

**IWC\_AB\_KillerWhale**

Sightings data for Ecotype A/B Killer whales in the Ross Sea region as collected on selected Southern Ocean Whale Ecosystem Research (SOWER) cruises.

Pods comprised of 10 or fewer individuals were classed as Ecotype A/B. Pods with greater than 20 individuals were classed as Ecotype C. Pods comprised of 11-20 individuals were classified as unknown Ecotype (WG-EMM-10-11, WG-EMM-10,12). Pod size is given in the column labelled "Count". Please note that the values in the year column do not match the years specified in the papers submitted to EMM. This subset of IWC Killer whale data is all that is currently available

Information about the SOWER cruises can be found here: https://iwc.int/sower

More information about the data sets can be found in

WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean.

WG-EMM-10-12 by Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. Ross Sea Bioregionalization, Part II Patterns of co-occurrence of meso predators in an intact polar ocean ecosystem.

**IWC\_AB\_KillerWhale\_Map**

This layer summarizing the sightings of Ecotype A/B killer whales in the Ross Sea as presented in data layer IWC\_AB\_Killer\_Map. Sightings data for Ecotype A/B Killer whales in the Ross Sea region were collect on Southern Ocean Whale Ecosystem Research (SOWER) cruises. Pods comprised of 10 or fewer individuals were classified as Ecotype A/B.

Num\_Survey = The number of surveys (as defined by survey year), that recorded seeing this ecoytype of killer whale

Num\_Pods = The number of killer whale pods sighted in each MPA zone

Num\_Whales = The number of individual killer whales sighted in each MPA Zone

Information about the SOWER cruises can be found here: https://iwc.int/sower

More information about the data sets can be found in

WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean.

WG-EMM-10-12 by Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. Ross Sea Bioregionalization, Part II Patterns of co-occurrence of meso predators in an intact polar ocean ecosystem.

**IWC\_C\_KillerWhale**

Sightings data for Ecotype C Killer whales in the Ross Sea region as collected on selected Southern Ocean Whale Ecosystem Research (SOWER) cruises.

Pods comprised of 10 or fewer individuals were classed as Ecotype A/B. Pods with greater than 20 individuals were classed as Ecotype C. Pods comprised of 11-20 individuals were classified as unknown Ecotype (WG-EMM-10-11, WG-EMM-10,12). Pod size is given in the column labelled "Count". Please note that the values in the year column do not match the years specified in the papers submitted to EMM. This subset of IWC Killer whale data is all that is currently available

Information about the SOWER cruises can be found here: https://iwc.int/sower

More information about the data sets can be found in

WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean.

WG-EMM-10-12 by Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. Ross Sea Bioregionalization, Part II Patterns of co-occurrence of meso predators in an intact polar ocean ecosystem.

**IWC\_C\_KillerWhale\_Map**

This layer summarizing the sightings of Ecotype C killer whales in the Ross Sea as presented in data layer IWC\_C\_KillerWhale. Sightings data for Ecotype C Killer whales in the Ross Sea region were collect on Southern Ocean Whale Ecosystem Research (SOWER) cruises. Pods comprised of more than 20 individuals were classified as Ecotype C.

Num\_Survey = The number of surveys (as defined by survey year), that recorded seeing this ecoytype of killer whale

Num\_Pods = The number of killer whale pods sighted in each MPA zone

Num\_Whales = The number of individual killer whales sighted in each MPA Zone

Information about the SOWER cruises can be found here: https://iwc.int/sower

More information about the data sets can be found in

WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean.

WG-EMM-10-12 by Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. Ross Sea Bioregionalization, Part II Patterns of co-occurrence of meso predators in an intact polar ocean ecosystem.

**IWC\_Unknown\_KillerWhale**

Sightings data for Ecotype Unknown Killer whales in the Ross Sea region as collected on selected Southern Ocean Whale Ecosystem Research (SOWER) cruises.

Pods comprised of 10 or fewer individuals were classed as Ecotype A/B. Pods with greater than 20 individuals were classed as Ecotype C. Pods comprised of 11-20 individuals were classified as unknown Ecotype (WG-EMM-10-11, WG-EMM-10,12). Pod size is given in the column labelled "Count". Please note that the values in the year column do not match the years specified in the papers submitted to EMM. This subset of IWC Killer whale data is all that is currently available

Information about the SOWER cruises can be found here: https://iwc.int/sower

More information about the data sets can be found in

WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean.

WG-EMM-10-12 by Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. Ross Sea Bioregionalization, Part II Patterns of co-occurrence of meso predators in an intact polar ocean ecosystem.

**IWC\_Unknown\_KillerWhale\_Map**

This layer summarizing the sightings of Unknown Ecotype killer whales in the Ross Sea as presented in data layer IWC\_Unknown\_KillerWhale. Sightings data for Unknown Ecotype Killer whales in the Ross Sea region were collect on Southern Ocean Whale Ecosystem Research (SOWER) cruises. Pods comprised 11- 20 individuals were classified as Unknown Ecotype.

Num\_Survey = The number of surveys (as defined by survey year), that recorded seeing this ecoytype of killer whale

Num\_Pods = The number of killer whale pods sighted in each MPA zone

Num\_Whales = The number of individual killer whales sighted in each MPA Zone

Information about the SOWER cruises can be found here: https://iwc.int/sower

More information about the data sets can be found in: WG-EMM-10-11 by Ainley, D.G., Ballard G., and Weller J. 2010. Ross Sea Biodiversity. Part I: Validation of the 2007 CCAMLR Bioregionalisation Workshop Results Towards Including the Ross Sea in a Representative Network of Marine Protected Areas in the Southern Ocean.

WG-EMM-10-12 by Ballard, G., D. Jongsomjit, S. D. Veloz, and D. G. Ainley. Ross Sea Bioregionalization, Part II Patterns of co-occurrence of meso predators in an intact polar ocean ecosystem.

**KrillBase\_Dom8**-

All haul data for Antarctic Krill, Euphausia superba, caught in planning Domain 8

Data made readily available by Quantarctica: http://quantarctica.npolar.no/data-catalog/

Data from KrillBase:

KRILLBASE is a data rescue and compilation project to improve the availability of information on two key Southern Ocean zooplankton: Antarctic krill and salps. We provide a circumpolar database that combines 15,194 scientific net hauls (1926 to 2016) from 10 countries. These data provide a resource for analysing the distribution and abundance of krill and salps throughout the Southern Ocean to support ecological and biogeochemical research as well as fisheries management and conservation.

Atkinson, A., Hill, S. L., Pakhomov, E. A., Siegel, V., Anadon, R., Chiba, S., Daly, K. L., Downie, R., Fielding, S., Fretwell, P., Gerrish, L., Hosie, G. W., Jessopp, M. J., Kawaguchi, S., Krafft, B. A., Loeb, V., Nishikawa, J., Peat, H. J., Reiss, C. S., Ross, R. M., Quetin, L. B., Schmidt, K., Steinberg, D. K., Subramaniam, R. C., Tarling, G. A., and Ward, P.: KRILLBASE: a circumpolar database of Antarctic krill and salp numerical densities, 1926–2016, Earth Syst. Sci. Data, 9, 193-210, https://doi.org/10.5194/essd-9-193-2017, 2017.

**KrillBase\_zone\_Map**

Zone estimates of density standardized to a single, relatively efficient sampling method (STANDARDISED\_KRILL\_UNDER\_1M2, no.m-2). It was derived from the KrillBase data

Atkinson, A., Hill, S. L., Pakhomov, E. A., Siegel, V., Anadon, R., Chiba, S., Daly, K. L., Downie, R., Fielding, S., Fretwell, P., Gerrish, L., Hosie, G. W., Jessopp, M. J., Kawaguchi, S., Krafft, B. A., Loeb, V., Nishikawa, J., Peat, H. J., Reiss, C. S., Ross, R. M., Quetin, L. B., Schmidt, K., Steinberg, D. K., Subramaniam, R. C., Tarling, G. A., and Ward, P.: KRILLBASE: a circumpolar database of Antarctic krill and salp numerical densities, 1926–2016, Earth Syst. Sci. Data, 9, 193-210, https://doi.org/10.5194/essd-9-193-2017, 2017.

Data were made available through Quantarctica : <http://quantarctica.npolar.no/data-catalog/>

**LaMesa\_Silverfish**

Total\_Fish= The number of all larval and juvenile Pluerogramma antarcticum caught per station in number of fish/ 1000 m3

Age\_0\_Fish = The number of age 0 Pluerogramma antarcticum caught per station in number of fish/ 1000 m3

Age\_1\_Fish = The number of age 1 Pluerogramma antarcticum caught per station in number of fish/ 1000 m3

Age\_2\_Fish = The number of age 2 Pluerogramma antarcticum caught per station in number of fish/ 1000 m3

Data are those presented in Figure 4

La Mesa, M., B. Catalano, A. Russo, S. Greco, M. Vacchi, and M. Azzali. 2010. Influence of environmental conditions on spatial distribution and abundance of early life stages of Antarctic silverfish, Pleuragramma antarcticum (Nototheniidae), in the Ross Sea. Antarctic Science 22:243-254

And the same data were used to draw Figure 1 of

Brooks C.M., Caccavo J.A., Ashford J., Dunbar R., Goetz K., La Mesa M., Zane L. 2018. Early life history connectivity of Antarctic silverfish (Pleuragramma antarctica) in the Ross Sea. Fisheries Oceanography 27(3):274-287

Data provided by Marino Vachi, Massimo Azzali, Barabara Catlano and Mario La Mesa

**LaMesa\_Silverfish\_Map**

Data calculated from the number of fish at each station and averaged by MPA zone

Mean\_Total = Mean total number of larval and juvenile *Pluerogramma antarcticum* caught per station in number of fish/ 1000 m3 per MPA zone

Mean\_Age\_0 = Mean number of Age 0 *Pluerogramma antarcticum* caught per station in number of fish/ 1000 m3 per MPA zone

Mean\_Age\_1 = Mean total number of Age 1 *Pluerogramma antarcticum* caught per station in number of fish/ 1000 m3 per MPA zone

Mean\_Age\_2 = Mean total number of Age 2 *Pluerogramma antarcticum* caught per station in number of fish/ 1000 m3 per MPA zone

Data are those presented in Figure 4

La Mesa, M., B. Catalano, A. Russo, S. Greco, M. Vacchi, and M. Azzali. 2010. Influence of environmental conditions on spatial distribution and abundance of early life stages of Antarctic silverfish, Pleuragramma antarcticum (Nototheniidae), in the Ross Sea. Antarctic Science 22:243-254

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Brooks C.M., Caccavo J.A., Ashford J., Dunbar R., Goetz K., La Mesa M., Zane L. 2018. Early life history connectivity of Antarctic silverfish (Pleuragramma antarctica) in the Ross Sea. Fisheries Oceanography 27(3):274-287

Data provided by Marino Vachi, Massimo Azzali, Barabara Catlano and Mario La Mesa

**MAPPPD\_Adelie\_Model**

MAPPPD model estimate of Adélie Penguin colony nest counts for the year 2016

<http://www.penguinmap.com/mapppd>

**MAPPPD\_Adelie\_Model\_Map**

Sum of mean model MAPPPD model estimated Adélie Penguin colony nest counts by MPA zone. Colony counts estimated for the year 2016

[http://www.penguinmap.com/mapppd](http://www.penguinmap.com/mapppd" \t "_blank)

**MAPPPD\_Adelie\_Most\_Recent\_Count**

The most recent count of Adélie penguin nests at colonies in the Ross Sea region as cataloged in MAPPPD

http://www.penguinmap.com/mapppd

In the attribute table, a reference and count date for each colony is listed

**MAPPD\_Adelie\_Most\_Recent\_Count\_Map**

Sum of recent count of Adélie penguin nests at colonies in the Ross Sea region as cataloged in MAPPPD

http://www.penguinmap.com/mapppd, by MPA zone

**MAPPPD\_Emperor\_Most Recent\_Count**

Most recent count of Emperor penguin colonies as cataloged in MAPPPD:

[http://www.penguinmap.com/mapppd](http://www.penguinmap.com/mapppd" \t "_blank)

In the attribute table, there is a publication reference for each colony.

Most colonies were counted in 2012 and published in: Kooyman GL, Ponganis PJ (2016) Rise and fall of Ross Sea emperor penguin colony populations: 2000 to 2012. Antarctic Science 29(3):201-208

Only colony was counted in 2009 and published in: Fretwell PT, LaRue MA, Morin P, Kooyman GL, Wienecke B, Ratcliffe N, Fox AJ, Fleming AH, Porter C, Trathan PN (2012) An emperor penguin population estimate: the first global, synoptic survey of a species from space. PLoS One 7(4):e33751.

**MAPPPD\_Emp\_Count\_Map**

Sum of Emperor Penguin colony counts per zone

Based on the most recent count of Emperor penguin colonies as cataloged in MAPPPD:

[http://www.penguinmap.com/mapppd](http://www.penguinmap.com/mapppd" \t "_blank)

In the attribute table, there is a publication reference for each colony.

Most colonies were counted in 2012 and published in: Kooyman GL, Ponganis PJ (2016) Rise and fall of Ross Sea emperor penguin colony populations: 2000 to 2012. Antarctic Science 29(3):201-208

Only colony was counted in 2009 and published in: Fretwell PT, LaRue MA, Morin P, Kooyman GL, Wienecke B, Ratcliffe N, Fox AJ, Fleming AH, Porter C, Trathan PN (2012) An emperor penguin population estimate: the first global, synoptic survey of a species from space. PLoS One 7(4):e33751

**MEOP\_Weddell\_Seal\_Dom8**

Weddell seal tracking data, made available by Quantarctica:

[http://quantarctica.npolar.no/data-catalog/](http://quantarctica.npolar.no/data-catalog/Traces)

[Traces](http://quantarctica.npolar.no/data-catalog/Traces) of available temperature/salinity data collected by sensors attached to marine mammals. Almost all in situ oceanic data in the Southern Ocean were collected in austral summer. Few exceptions are these data collected by marine mammals carrying CTD (conductivity-temperature-depth profiler). We only show the geographic location of data. Data can be downloaded from the MEOP website.

Roquet F., Wunsch C., Forget G., Heimbach P., Guinet C., Reverdin G., Charrassin J.-B., Bailleul F., Costa D. P., Huckstadt L. A., Goetz K. T., Kovacs K. M., Lydersen C., Biuw M., Nøst O. A., Bornemann H., Ploetz, J., Bester M. N., Mcintyre T., Muelbert M. C., Hindell M. A., McMahon C. R., Williams G., Harcourt R., Field I. C., Chafik L., Nicholls K. W., Boehme L., and Fedak M. A., 2013. Estimates of the Southern Ocean General Circulation Improved by Animal-Borne Instruments. Geoph. Res. Letts., 40:1-5. doi: 10.1002/2013GL058304.

**Q\_Emp\_Dom8**

Emperor Penguin colonies and population estimates using very high resolution satellite imagery acquired in the 2009 breeding season.

Fretwell PT, LaRue MA, Morin P, Kooyman GL, Wienecke B, Ratcliffe N, et al. (2012) An Emperor Penguin Population Estimate: The First Global, Synoptic Survey of a Species from Space. PLoS ONE 7(4): e33751. <https://doi.org/10.1371/journal.pone.0033751>

Data made available through Quantarctica: http://quantarctica.npolar.no/data-catalog/

**Q\_Emp\_zone\_Map**

Emperor Penguin totals by zone calculated from data made available on

http://quantarctica.npolar.no/data-catalog/

Root source of data is:

Fretwell PT, LaRue MA, Morin P, Kooyman GL, Wienecke B, Ratcliffe N, et al. (2012) An Emperor Penguin Population Estimate: The First Global, Synoptic Survey of a Species from Space. PLoS ONE 7(4): e33751. https://doi.org/10.1371/journal.pone.003375