THE KERGUELEN PLATEAU: MARINE ECOSYSTEM + FISHERIES
Proceedings of the Second Symposium
heardisland.antarctica.gov.au/research/kerguelen-plateau-symposium

Extended abstract

Historical demographic drivers and residual reproductive value: identifying critical at-sea areas for black-browed albatross

Pamela E. Michael[1]✉, Chris Wilcox[2], Christophe Barbraud[3], Michael Sumner[4,5], Karine Delord[3] and Henri Weimerskirch[3]

[1] Institute for Marine and Antarctic Studies (IMAS), University of Tasmania, Locked Bag 129, Hobart, Tasmania 7001, Australia
[2] Commonwealth Scientific and Industrial Research Organisation (CSIRO), Oceans and Atmosphere, GPO Box 1538, Hobart, Tasmania 7001, Australia
[3] Centre d'études Biologiques de Chizé – CNRS UMR 7372 / Université de La Rochelle, Villiers en Bois 79360, France
[4] Antarctic Climate & Ecosystems Cooperative Research Centre (ACE-CRC), University of Tasmania, Private Bag 80, Hobart, Tasmania 7001, Australia
[5] Australian Antarctic Division, 203 Channel Hwy, Kingston, Tasmania 7050, Australia
✉Corresponding author: pamela.e.michael@gmail.com

A recent integrated demographic analysis of a black-browed albatross (*Thalassarche melanophris*) population breeding on Kerguelen Islands characterised important historical drivers of population trends from 1950 through 2011 (Michael et al., 2017). This period included an observed population decline from the mid-1990s through the mid-2000s. The majority of model-estimated by-catch was attributed to the illegal, unreported, and unregulated (IUU) demersal longline fleet targeting toothfish in the plateau region coincident with the albatross decline. The role of this IUU fleet as the driver of the observed population decline was robust to changes in the assumed magnitude of effort, model-informed by-catch rate, and the probability that an albatross from the focal population was caught. Additionally, warmer sea-surface temperature (SST) near the colony during the incubation period related to increased breeding success. While the mechanism supporting this link is uncertain, we suspect this relationship relates to foraging conditions and the relative efficiency of parents provisioning their chick.

At first glance, the outlook for this population looks relatively positive. The forecast increase in SST would support population viability, although recent work indicates a sensitivity to extremes (Pardo et al., 2017). The impact of the IUU demersal longline fleet has been virtually removed due to collaborative surveillance and deterrence activities (Duhamel and Williams, 2011; Delegation of France, 2015). However, changes in fishing effort could alter by-catch patterns, overriding the benefit of increased SST. Tracking fishing effort and by-catch patterns across the at-sea range of this population presents a significant challenge, due to the spatial extent and overlap with fleets from multiple nations and managing bodies.

To help managers prioritise their by-catch monitoring efforts, we combine projected demographic data with known at-sea distributions to identify where and when by-catch could have the greatest impact on this population. We calculate the reproductive value (RV), or remaining expected reproductive contribution of an albatross (Bouwhuis et al., 2011; Zhang et al., 2015), using data projected from the above integrated population model through 2067 using forecast SST. The RV is class and age-specific. As individuals and their offspring are not tracked through their lifetime, variation in offspring quality is not accounted for (Dupont et al., 2018). Return rates for successful and failed breeders, adult and immature survival and breeding success are estimated by the model and vary interannually. The transition from an immature, pre-breeding albatross to a breeding adult is described by the proportion of birds having bred by a given age.

The highest RV value for a bird of any age or class is a five (minimum breeding age) year old breeding adult, followed by failed and non-breeding birds of the same age. The RV of pre-breeding birds increases sharply as they approach breeding age. Data are yet to be associated with space but have been calculated at a 2° × 2° spatial and monthly temporal scale. These data will be combined with known habitat-use patterns at the same scale, pinpointing the areas that individuals with the highest expected future contribution to the population use. These areas will represent the areas where by-catch could have the greatest negative impact on the population.

References

Bouwhuis, S., R. Choquet, B.C. Sheldon and S. Verhulst. 2011. The forms and fitness cost of senescence: age-specific recapture, survival, reproduction, and reproductive value in a wild bird population. *Am. Nat*., 179 (1): E15–E27.

Delegation of France. 2015. Information on IUU fishing in the French EEZs around Kerguelen and Crozet and in the CCAMLR Statistical Area 58. Document *CCAMLR-XXXIV/23*. CCAMLR, Hobart, Australia: 5 pp.

Duhamel, G. and R. Williams. 2011. History of whaling, sealing, fishery and aquaculture trials in the area of the Kerguelen Plateau. In: Duhamel, G. and D.C. Welsford (Eds.). *The Kerguelen Plateau: Marine Ecosystem and Fisheries*. Société Française d'Ichtyologie, Paris, France: 15–28.

Dupont, S.M., C. Barbraud, O. Chastel, K. Delord, S. Ruault, H. Weimerskirch and F. Angelier. 2018. Young parents produce offspring with short telomeres: A study in a long-lived bird, the Black-browed Albatross (*Thalassarche melanophrys*). *PloS One*, 13 (3): e0193526.

Michael, P.E., R. Thomson, C. Barbraud, K. Delord, S. De Grissac, A. Hobday, P. Strutton, G.N. Tuck, H. Weimerskirch and C. Wilcox. 2017. Illegal fishing bycatch overshadows climate as a driver of albatross population decline. *Mar. Ecol. Prog. Ser*., 579: 185–199.

Pardo, D., S. Jenouvrier, H. Weimerskirch and C. Barbraud. 2017. Effect of extreme sea surface temperature events on the demography of an age-structured albatross population. *Phil. Trans. R. Soc. B*, 372 (1723).

Zhang, H., M. Rebke, P.H. Becker and S. Bouwhuis. 2015. Fitness prospects: effects of age, sex and recruitment age on reproductive value in a long-lived seabird. *J. Anim. Ecol*., 84 (1): 199–207.