

Tracking a marine predator to design flexible boundaries of marine protected areas for an ecosystem approach to fisheries

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African penguin *Spheniscus demersus* populations showed a drastic decline during the past decade, and their abundance is substantially linked with the presence of their prey. However, environmental changes and resource competition with purse-seine fisheries disrupt this prey availability. Therefore, conservation efforts should ensure adequate local food availability. In this perspective, marine protected areas (MPAs) have been identified as a valuable tool in an ecosystem approach to fisheries (EAF). Furthermore, when designed with flexible boundaries, MPAs can be beneficial for both penguins and fisheries. In Algoa Bay, South Africa, an EAF has been attempted through experimental purse-seine fisheries closures from 2009 to present. We investigated the effectiveness of these closures and evaluated the conservation value of a newly proposed, zoned MPA. Using GPS loggers, we studied the foraging behaviour of African penguins to assess their spatial overlap with purse-seine fisheries catches. Furthermore, the GPS tags provided a suite of horizontal and vertical foraging measurements, which were modelled with several explanatory variables. Our results showed a decline in purse-seine fisheries catches since 2012, possibly due to limited fish abundance. Nevertheless, the experimental closures showed a marked reduction in the penguins' foraging effort. The presence of prey is probably the main cue to adapt their foraging strategy, and this is likely to be dependent on environmental conditions and fishing pressure. Also, geospatial mapping revealed a strong overlap between the foraging range of African penguin and purse-seine fisheries in Algoa Bay from 2008 until 2015. Conversely, the no-take zones of the proposed MPA cover less than half of that foraging range. In general, this study indicated that the proposed MPA would provide a legal improvement to the current situation, but is not sufficient to increase numbers of African penguin populations. Larger no-take zones around the penguins' colonies are necessary when prey biomass is low. As an immediate action, ongoing acoustic surveys could provide information on prey availability to design flexible boundaries and increase the benefits for all stakeholders involved. In the future, more quantitative research is necessary to reconcile conservation goals and the socio-economic needs of the coastal community of Algoa Bay.

Keywords: *Spheniscus demersus*; GPS tracking; adaptive fisheries management; no-take zones; foraging behaviour