Journal of Sea Research 89 (2014) 44–51

Contents lists available at ScienceDirect

Journal of Sea Research

journal homepage: www.elsevier.com/locate/seares

Spatial overlap of Black-browed albatrosses with longline and trawl fisheries in the Patagonian Shelf during the non-breeding season

Sofía Copello *, Juan Pablo Seco Pon, Marco Favero

Instituto de Investigaciones Marinas y Costeras (IIMyC), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Universidad Nacional de Mar del Plata, Argentina

ARTICLE INFO

Article history:
Received 11 June 2013
Received in revised form 6 February 2014
Accepted 12 February 2014
Available online 22 February 2014

Keywords:
Thalassarche melanophris
Argentine fisheries
Vessel monitoring system
Satellite tracking
At-sea distribution
Conservation priority areas

ABSTRACT

Incidental mortality in fisheries is the main at-sea threat albatrosses are facing nowadays. In this study we used remote sensing techniques to model the degree of spatial overlapping between the Black-browed albatross (*Thalassarche melanophris*) and Argentine fisheries, assuming this as a proxy of risk for albatrosses. Eleven tags were deployed on albatrosses during the non-breeding seasons 2011 and 2012 in the Patagonian Shelf. Their distribution overlapped to different extents with the two coastal trawl, three offshore trawl and one demersal longline fisheries. The overlap index showed highest values with both coastal fleets, followed by the ice-chilling trawl fleet. These intersections were located in the Argentinean–Uruguayan Common Fishing Zone, in coastal areas of the SE of Buenos Aires province, El Rincón estuary and over the shelf break. The analysis of intersections of focal areas from albatrosses and all fisheries allowed the identification of thirty-four fishing management units (1° by 1° grid within the Argentine EEZ) classified as of medium, high or very high conservation priority. Very high priority units were placed between 35 and 38°S in the external mouth of Rio de la Plata, and between 45 and 47°S in neighboring waters East to the hake fishing closure. Although there were possible biases due to the limited number of tracked birds and the locations where albatrosses were captured and instrumented, the information presented in this study provides a comprehensive picture of important areas of overlapping during winter that could be used by the fishery administration to prioritize conservation actions under limited resource scenarios.

1. Introduction

Most of the albatross species are currently threatened with extinction (BirdLife International, 2012) and one of their main threats is the incidental mortality in association with commercial fisheries (Croxall et al., 2012). Literature shows that seabird bycatch occurs in vessels using different fishing gears such as pelagic and bottom longlines, trawl and gillnets, among others (Anderson et al., 2011; Baker et al., 2007; Zydelis et al., 2013). Hence, a multi-gear approach is essential to understand and deal with this conservation issue threatening a large number of very fragile species. In the South Atlantic, waters within the Argentine economic exclusive zone present a clear example of an area where large fisheries comprising some 800 vessels operate throughout the year using a wide range of fishing gears (Consejo Federal Pesquero, 2010), and overlap with the distribution of seabirds such as albatrosses and petrels. The dynamics of these fisheries are highly complex, not just because of the multiplicity of fishing gear (e.g. coastal and offshore ice trawlers and freezer trawlers, bottom longliners) but also because the existence of changing fishery regulations over time (regarding use of particular fishing gears, management jurisdictions, and spatial and temporal fishing closures). Moreover, the high biodiversity and biomass of marine top predators, including albatrosses and petrels, create an environment where the interaction with fishing activities is at least not negligible and in most cases important.

More than half of the 22 albatross species make use of this marine space as a foraging area during the breeding and/or the non-breeding period (Falabella et al., 2009; Favero and Silva Rodriguez, 2005; Nicholls et al., 2002; Seco Pon et al., 2007). Some of these species have been previously reported in the bycatch of longline (Favero et al., 2013) and trawl fleets, including coastal vessels and those operating in the high seas (Favero et al., 2011; González-Zevallos and Yorio, 2006; Sullivan et al., 2006). Incidental mortality is a result of seabirds converging with fisheries in the same areas and consequently attending vessels due to the attraction generated by the availability of food in the form of bait, offal and/or discards (Tasker et al., 2000). This predictable and abundant source of food can certainly affect the distribution of seabirds (Bartumeus et al., 2010). Although this food subsidy could be understood as beneficial for some seabirds, it is clear that for low productive seabird species such as albatrosses and petrels, the negative effect of incidental mortality on albatross populations is by far more important than any positive effect (Finkelstein et al., 2008).

The accession of Argentina to the Agreement on the Conservation of Albatrosses and Petrels in 2006 triggered a number of domestic

* Corresponding author. Tel.: +54 2234757008; fax: +54 2234753150.
E-mail address: scopello@mdp.edu.ar (S. Copello).

http://dx.doi.org/10.1016/j.seares.2014.02.006
1385-1101/

conservation actions, including the adoption in 2008 of a binding measure for the use of mitigation (bird scaring lines, night setting and line weighting) in longliners (Federal Fisheries Council Resolution CFP 8/2008, entering into force in 2010), and the formal adoption in 2010 of the National Plan of Action-Seabirds (Resolution CFP 15/2010) addressing all fisheries known or suspected to interact with seabirds in Argentine waters. Despite the progress achieved, issues dealing with the full implementation of the conservation measures in longliners and the bycatch reduction in the large and complex trawl fishery remain partially addressed and need urgent attention.

Similar to other fisheries in the South Atlantic (Anderson et al., 2011; Bugoni et al., 2008; Jiménez et al., 2009; Watkins et al., 2008), the Black-browed albatross (*Thalassarche melanophris*, herein BBA[1]) is among the most common Procellariiform species in the bycatch in Argentina (Favero et al., 2011, 2013). This species is the most abundant of the southern hemisphere albatrosses with a current global population estimated at 600,000 breeding pairs, of which c. 70% breed in Malvinas (Falkland) islands and chiefly forage in Argentinean, Uruguayan and Brazilian waters on the continental shelf (Catry et al., 2013; Copello et al., 2013; Grémillet et al., 2000; Huin, 2002). Although present along the Patagonian shelf throughout the year, BBAs migrating northwards during the winter concentrate in two large marine areas, one from the mouth of Rio de la Plata towards the E–SE reaching the shelfbreak, and another at El Rincón estuary and waters to the South (Copello et al., 2013). The unsustainable levels of incidental mortality of this species in longline and trawl fisheries has caused steep population declines (Arnold et al., 2006; Huin and Reid, 2007; Tuck et al., 2011) and the deterioration of its conservation status. However, increases recently reported for the population breeding in Malvinas, likely as a result of reduced seabird bycatch and favorable feeding conditions (Catry et al., 2011; Wolfaardt, 2012) triggered the recent downlisting of the species from Endangered to Near Threatened (BirdLife International, 2014).

In order to better understand the interactions between seabirds and fisheries and to implement an ecosystem-based management in the area, it is crucial to take into account the spatial dynamics of such interactions (Crowder and Norse, 2008). The miniaturized bio-logging devices deployed on live animals, broadly used nowadays, have enabled the detailed study of individual distribution patterns, particularly of seabirds at sea (Ropert-Coudert and Wilson, 2005). When combined with fisheries data, such information can allow a better understanding of the spatial overlap between seabirds and fisheries (see for example Granadeiro et al., 2011). This spatial overlap is a necessary precondition for interactions and/or bycatch, thus it can be used as a proxy of risk faced by the birds interacting with fisheries (Delord et al., 2010; Tuck et al., 2011; Yorio et al., 2010).

Most of the available fishery datasets are provided at a spatial resolution of 5° × 5° (e.g. Regional Fisheries Management Organizations), and some studies highlighted the need for data at a finer scale for overlapping modeling studies (Granadeiro et al., 2011; Votier et al., 2013). In recent years Argentina converted its system for the obtainment of data on fisheries distribution from the traditional logbooks with a spatial resolution of 1° × 1° grid to a satellite vessel monitoring system with even higher resolution and enhanced capabilities for monitoring and surveillance. This largely improved the context in which detailed studies on the interaction between albatrosses and a range of fisheries can be conducted. In the present study, we used remote sensing techniques (satellite telemetry devices installed on albatrosses and vessel monitoring system, VMS) to model the degree of spatial overlapping between BBAs and Argentine fisheries known to pose a threat to albatrosses.

[1] BBA — Black-browed albatross

2. Material and methods

2.1. Black-browed albatross tracking data

We deployed 11 satellite transmitters (battery-powered Platform Terminal Transmitters PTTs, K3H 179A KiwiSat303, Sirtrack® and TAV-2656 Telonics Inc.) on adult Black-browed albatrosses during the austral winters (June–September) 2011 and 2012 (see Copello et al., 2013 for more details about tracking procedure). The distribution of this species was recently analyzed to characterize the use of marine space and oceanographic areas during the nonbreeding season (Copello et al., 2013). Tags weighed 63 and 55 g respectively, representing less than 1.6% of the adult body mass (mean = 4 kg, n = 31, Seco Pon unpub. data), and well under the maximum of 3% recommended to avoid adverse effects on bird behavior (Phillips et al., 2003). Birds were captured at sea from fishing vessels (sport and commercial) using hoop nets. Tags were attached to the back feathers with Tesa® tape and zip ties. The devices were programmed to transmit with a duty cycle of 8 h on (0900–1700 h local time) and 16 h off, and 12 h on (0600–1800 h local time) and 12 h off for 2011 and 2012, respectively. On average, 7.1 (range: 3–18) and 12.5 locations (range: 3–16) were obtained per duty cycle for the tags deployed in 2011 and 2012, respectively. This setting was decided considering that (1) BBAs are essentially diurnal feeders and (2) fishing operations in the large trawl fleets occur during daytime. Position fixes for satellite-tagged albatrosses were received from Argos System (CLS America, Inc., Largo, Maryland, USA) using the Satellite Tracking and Analysis Tool to download the data (Coyne and Godley, 2005). All Argos locations (accuracy classes A, B, Z, 0, 1 to 3) were used after filtering positions according flight speed (maximum velocity was set at 100 km h^{-1}) (BirdLife International, 2004). Standard locations (classes 3 to 0) accounted for most of the gathered locations (82%) and the speed filter removed 9% of received positions. Tracks were re-sampled at 30 min intervals, assuming that birds moved in a straight line between positions (no assumptions were made about the bird's locations along the track during the "off" cycle for PTTs).

2.2. Fishery data

Black-browed albatrosses have been reported to interact with a range of fisheries in Argentine waters (Favero et al., 2011, 2013; Gandini et al., 1999; González-Zevallos and Yorio, 2006; González-Zevallos et al., 2011; Seco Pon et al., 2012, 2013; Yorio and Caille, 1999). Accordingly, in this study two coastal fisheries (close and distant coastal trawl), three offshore demersal trawl fisheries (ice-chilling, freezer and double-beam trawl), and the bottom-demersal longline fishery were included in the analysis (see Table 1). Information on the distribution of these fleets for the winter 2011 was obtained from the Argentinean Vessel Monitoring System (VMS, Ministerio de Agricultura, Ganadería y Pesca), providing the GPS position of each vessel every hour. Vessel positions were filtered by speed and time of day in order to represent the distribution of the actual fishing effort (i.e. including only vessels actively fishing, for trawlers between 2 and 5 knt, 0700–2200 h local time −3 GMT; for longliners speeds lower than 6 knt, 24 h).

2.3. Data analysis

The geographic mean center was estimated for each fishery (Fotheringham et al., 2000). At-sea distribution of the BBAs and main fishing fleets were analyzed with kernel home-range utilization distributions (UD, based on Worton, 1989). Kernel density analyses have been successfully used in modeling the habitat of albatrosses and petrels (BirdLife International, 2004; Tancell et al., 2013) as well as fisheries (Favero et al., 2013; Louzao et al., 2011). The smoothing parameter (h) was 50 km, and contour levels were estimated for 50% (core area), 75% (focal area) and 95% (range area) of the locations