Kuroshio and Oyashio boundary currents: Critical foraging habitat for the short-tailed albatross (*Phoebastria albatrus*), one of Japan's natural monuments







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Impetus for Studies

Endangered Species





Thought extinct by 1949 Currently ~ 2,000 individuals

Bycatch in Commercial Fisheries





Objectives

- 1. Determine breeding and post-breeding season migration routes
- 2. Identify important habitat features used by short-tailed albatrosses.
- **3.** Construct a mathematical model of habitat use.

Ultimately to understand the ecology of this species to aid recovery efforts and to identify spatial and temporal overlap with domestic and international fisheries of Pacific Rim countries





Main Breeding Colony



Satellite Tracking









Habitat Variables





-10000 -9000 -8000 -7000 -6000 -5000 -4000 -3000 -2000 -1000 m

Gradients of Chl *a*, SST, Depth Sobel Gradient Operator (3X3 pixel)



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Wind Speed and STAL Migration

06-May-2003 Latitude ×11117 N# 11171 Longitude

m s⁻¹

Wind direction relative to albatross heading – when traveling > 100 km/day



Locations from 14 albatrosses tracked in 2002 & 2003



Mixed Effects Linear Model Results

Residence time (FPT) = Response Variable Individual Bird = Random Effect Habitat Variables = Fixed Effects

70 km First Passage-Time radii

| Variables | R ² | ΔΑΙC |
|---|----------------|------|
| wspd, depth, depthgrad, wspd*depth, chlgrad | 0.40 | 0 |
| wspd, depth, depthgrad, wspd*depth, chl | 0. 38 | 2.0 |

Albatrosses Tracked From Torishima, 2006



Bathymetric Domains n = 8 birds during chick-rearing period (Feb – Apr) Kuroshio & Oyashio Current regions



Distribution of "Albatross Hours" and Bathymetry



Distribution of "Albatross Hours" and Chl-a Concentration



Distribution of "Albatross Hours" and Chl-a Concentration



June Albatross Locations and SST

(Post-breeding Dispersal)

2002 (n = 4 birds)



Wind & Waves in Bathymetric Domains



Adult & Subadults vs. Juveniles (< 2 yr)





Juveniles Adults & Subadults Average Distance Traveled 245 km/day 133 km/day

Survan et al. 2006. Deep Sea Research II 53:370-386

Conclusions

Short-tailed albatrosses primarily foraged within boundary currents throughout the North Pacific Rim above 30°N latitude.

> Wind speed and sea floor depth and gradient in particular, and chl a gradient to a lesser extend were associated with albatross distribution.

Albatrosses foraged primarily over continental shelf break and slope regions and within passages among the Kuril and Commander Islands (Russia) and Aleutian Islands (Alaska).

The Kuroshio Current region and Kuroshio-Oyashio convergence were used exclusively during the chick-rearing period – the most energy demanding portion of the year.

Juvenile albatrosses traveled twice as far as adults and also more extensively over continental shelf regions (e.g., in the Bering Sea and off B.C.).

Continued international collaboration is critical to protect this vulnerable species throughout its range