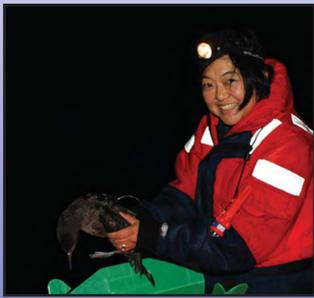


Response of Non-breeding Sooty Shearwaters (*Puffinus griseus*) to Spatial and Temporal Variability in Winds Within the California Current System



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Introduction

Sooty Shearwaters (*Puffinus griseus*) are the most abundant avian predator in the California Current System (CCS); however, their movements during the upwelling season have not been well studied. They often forage in huge flocks (>100,000) consuming massive amounts of forage fish, and potentially impacting forage fish availability for other predators. We examined the at-sea movements of satellite-tracked non-breeding Sooty Shearwaters in the CCS during the 2008 upwelling season, and their responses to spatial and temporal variability in winds.

Study questions

- Do Sooty Shearwaters respond to variability in winds?
- Do they redistribute in coordinated movements?

Methods

- 28 SOSH were captured at sea in three regions: Columbia River Plume (CR, n = 7), Monterey Bay (MB, n = 12), and Santa Barbara Channel (SB, n = 9) (Fig. 1)
- Back-mounted satellite tags were attached in late June to early July 2008 (Fig. 2)
- Hourly wind data acquired from NDBC Columbia River buoy, 46029
- Wind speed and direction converted to **u** (Eastward) and **v** (Southward) components, and plotted to represent upwelling and downwelling favorable winds
- Upwelling index calculated from buoy winds

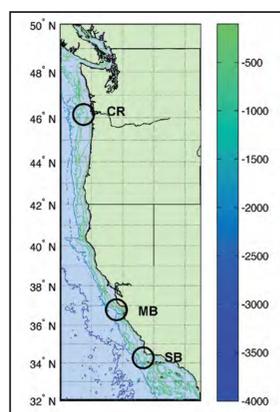


Figure 1. Study area with three focal regions and bathymetry in meters.



Figure 2. Shearwater with satellite tag

Results

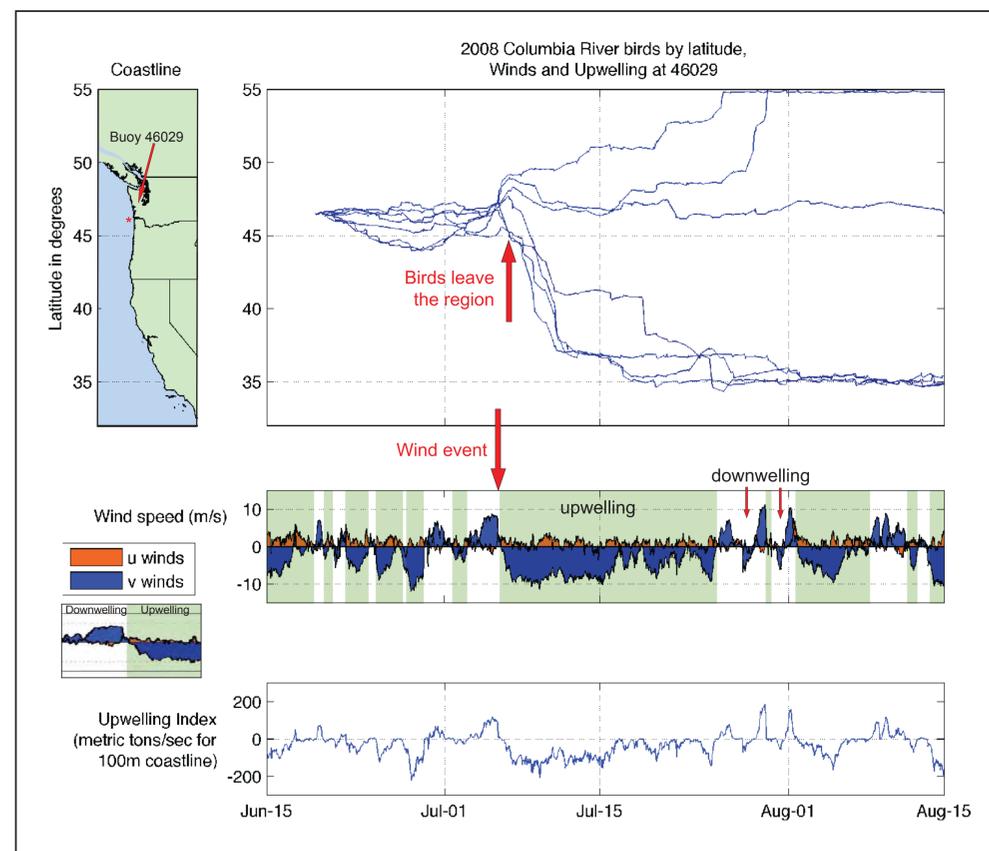


Figure 3. Latitudes of Columbia River birds plotted with time; Wind time series from CR in center panel with upwelling favorable winds indicated by green background; Upwelling index at CR in bottom panel. CR winds from buoy 46029 indicated by red star on coastline map to the left.

Sooty Shearwaters:

- Were tracked up to 173 days (Fig. 5)
- Vacated the Columbia River (CR) region on 7-8 July (Fig. 3, upper panel) following a wind event on 5-6 July (Fig. 3 center panel)
- 6 of 7 (86%) CR birds did not return to the region for the rest of the season (Fig. 5)

Wind event:

- Characterized by a shift from downwelling favorable (DF) to upwelling favorable (UF) winds (5-6 July).
- UF winds persisted for about 2 weeks (Fig. 3, center panel)
- Extended spatially down through Oregon

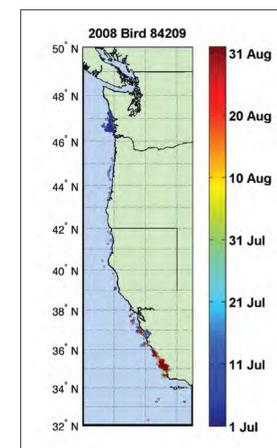


Figure 4. Shearwater tracks for one individual tagged in CR, showing coastal movements typical of shearwaters.

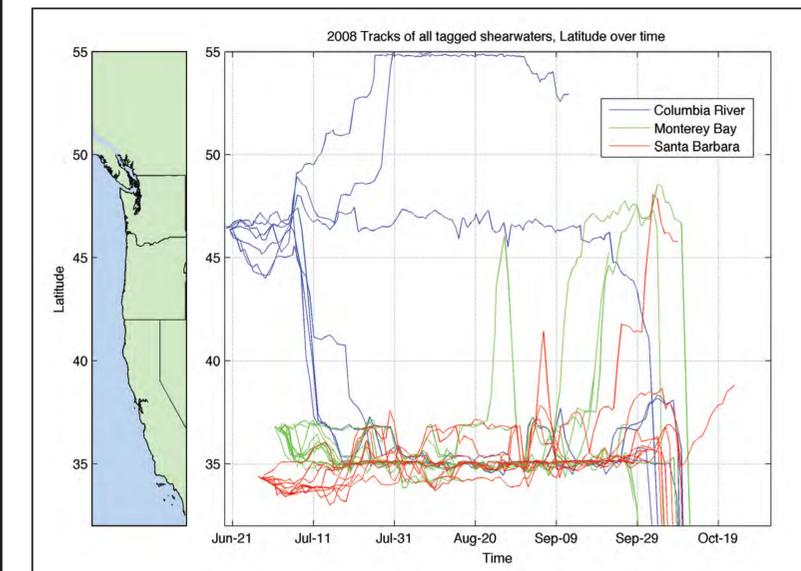


Figure 4. Latitudes of all shearwater tracks through time. MB and SB birds dispersed to San Luis Bay at 35 degrees latitude.

Conclusions

- Sooty Shearwaters tagged in CR responded to a wind event, vacating the region
- Birds had coordinated movements when leaving the CR region
- During upwelling favorable winds birds appeared to seek out other regions in the CCS, by spending the rest of the summer in the SB region.
- San Luis and Morro Bay areas were bird hot spots
- Coordinated return migration to New Zealand in October

Future work

- Examine SOSH response to variability in winds, upwelling, sea surface temperature, chlorophyll for MB and SB for 2008 and 2009 telemetry data

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