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

**Results**

- 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

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

**Figure 2.** Shearwater with satellite tag

**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.

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

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