BODY CONDITION AND OCEANOGRAPHIC DETERMINANTS OF SOOTY SHEARWATER MOVEMENTS: A MODEL FOR POST-RELEASE SURVIVAL STUDIES IN SEABIRDS

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ABSTRACT: We propose that the quantitative assessment of 'typical' movement patterns in wild seabirds will provide wildlife rehabilitators with the necessary baseline information for evaluating post-rehabilitation success. Before the advent of miniaturized telemetric devices and data archival tags, the study of free-ranging behavior of seabirds was limited to ship-based observations. To assess the effectiveness of their treatments in a more quantitative fashion, wildlife rehabilitators now have the ability to quantify the behavior of post-rehabilitated seabirds using telemetry. Because the necessary behavioral information of unaffected (i.e., non-rehabilitated) individuals is often lacking, a comparative assessment of rehabilitation success is unfeasible. Furthermore, a consistent methodology to quantify the post-rehabilitation behavior of free-ranging seabirds is urgently needed. As part of our proposed research, we will analyze the movements of migrating Sooty Shearwaters using satellite telemetry, and will use data to develop a series of quantitative criteria designed to assess the baseline behavior of unaffected birds. Sooty Shearwater is the most numerous and cosmopolitan seabird in the Pacific Ocean, therefore, make a good candidate for a study of movements and energetics during migration.

We focus this study on the fall (September – November) return migration to southern hemisphere breeding grounds for ecological and logistical reasons. Migration is perhaps the most energetically expensive event in the annual cycle of the far-ranging Sooty Shearwater, with the successful return (*ca*. 12,000 km one-way) likely depending on endogenous (e.g., body condition) and exogenous (e.g., wind field) factors. First, an individual's ability to maintain positive energy assimilation and good body condition during the pre-migration phase are essential to ensure sufficient lipid stores before migration. Shearwater body mass is directly related to accumulated lipid stores and together, when scaled to body size, provides a good index of an individual's potential range of movement in terms of the power required for flight. When shearwaters arrive off California they are in poor body condition, with their status improving through the summer and reaching a maximum before their trans-Pacific migration. Secondly, a shearwater's ability to maintain efficient flight likely requires encountering favorable wind conditions (speed and direction) – conducive to energetically efficient soaring and gliding flight over vast expanses of open ocean. Moreover, because shearwaters complete their molt in late summer, fall deployments will yield prolonged tracks due to the firmer attachment of the transmitters.

Because shearwater movements depend on each bird's body condition, and on the underlying environmental conditions, a multi-disciplinary approach is needed to analyze the satellite tracking data. We will integrate satellite-telemetry and remotely sensed environmental data into a Geographic Information Systems (GIS) framework to test the hypothesis that body status and environmental conditions influence the movements of (1) wintering (austral) shearwaters off California, and (2) the return migration of shearwaters back to their colonies in the southern hemisphere (e.g., New Zealand, Australia, Chile). We will use satellite telemetry to quantify the regional movements of shearwaters off California, and subsequently to determine the duration and timing of trans-Pacific migration. Movements will be evaluated in association with remotely sensed oceanographic and wind conditions. Empirical telemetry results will be used in conjunction with cost-of-flight analyses to model potential range of flight as a function of body condition and environmental factors. The techniques and results of this study will provide a conceptual model and a standardized methodology to evaluate the post-release survival and behavior of migratory marine birds including other shearwater species, albatrosses, gulls, loons, and sea-ducks, in the event of rehabilitation from exposure to oil.