Ornithological Monographs
Volume (2007), No. 62, 1–77
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Printed in USA.

STORM-PETRELS OF THE EASTERN PACIFIC OCEAN: SPECIES ASSEMBLY AND DIVERSITY ALONG MARINE HABITAT GRADIENTS

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Abstract.—Residing in waters just west of the Americas, in a roughly triangular area from about 50°N to 50°S and out along the equator, are 26 distinct taxa of storm-petrels (Hydrobatidae), a diversity far greater for this group than in any equivalent stretch of the world ocean. We sought to understand how so many forms can co-occur within this very poorly known family.

We describe the ranges, at-sea behavior, and marine habitat affinities of 22 (of the 26) distinct forms included within 5 (of 6) genera and 16 (of 20) species of storm-petrel, all of which occur in that portion of the Pacific Ocean that stretches from the California Current south through the Humboldt Current and out to 170°W along the equator. We base our analysis on data collected during 23 cruises conducted in the eastern Pacific during the period 1980–1995. We also provide, for the first time for most forms, information on the annual cycle, as well as abundance estimates based on at-sea censusing during both the breeding and nonbreeding periods. Such information is unknown for almost all populations of storm-petrels, unless their at-sea range has been thoroughly censused. We include the following storm-petrels in our analysis: Leach's (*Oceanodroma leucorhoa*; represented by a light-rumped form, *O. l. leucorhoa*, and several dark-rumped forms: *O. l. socorroensis*, *O. l. cheimomnestes*, and *O. l. chapmani*), Band-rumped (*O. castro*), Ashy (*O. homochroa*), Least (*O. microsoma*), Wedge-rumped (*O. tethys*; represented by two races: *O. t. tethys* and *O. t. kelsalli*), Black (*O. melania*), Markham's (*O. markhami*), Ringed (*O. hornbyi*), Wilson's (*Oceanites oceanicus*; represented by two races: *O. o. oceanicus* and *O. o. chilensis*), White-vented (*Oceanites gracilis*; represented by two races: *O. g. gracilis* and *O. g. galapagoensis*), White-bellied (*Fregetta grallaria*; represented by three races: *F. g. grallaria*, *F. g. segethi*, and *F. g. titan*), Black-bellied (*F. tropica*), White-throated (*Nesofregetta fuliginosa*), and White-faced (*Pelagodroma marina*; represented by two races: *P. m. dulciae* and *P. m. maoriana*).

Information was gathered by strip censuses (400–600 m wide), observations of storm-petrel behavior along cruise tracks, and collection of specimens. Within the entire study area, we made 9,308.1 h of observation and surveyed 111,029 km^2 of ocean, including 61,131 km^2 in boreal spring–austral autumn and 49,898 km^2 in boreal autumn–austral spring. Surveys included 768.3 h within 1,000 km of the South American coast; >11,203.7 km^2 of ocean was surveyed, 7,382.1 km^2 in austral autumn and 3,821.6 km^2 in austral spring. Surveys within 500 km of North America included 2,557.2 h over 12,473 km^2 in boreal spring and 3,061.3 km^2 in boreal autumn. We also collected specimens during numerous stops where oceanographic studies were being conducted by other researchers who were also aboard the ship.

For the majority of taxa, our surveys covered the entire at-sea range of the taxon. We had complete coverage for the following storm-petrels: Ringed, White-vented, Markham's, *O. t. segethi* race of White-bellied, both races of Wedge-rumped, Galápagos race of Band-rumped (*O. c. bangsi*), races of dark-rumped Leach's (*O. l. socorroensis*, *O. l. cheimomnestes*, and *O. l. chapmani*), and Ashy. During boreal autumn, we also had nearly complete coverage for Black and Least storm-petrels, both of which vacate the Gulf of California after the breeding season. We also had nearly complete coverage of the Pacific range of the White-throated Storm-Petrel. Using generalized additive models, population estimation was quite satisfactory for these taxa.

Our results indicate that most storm-petrel taxa in the study area have robust populations, this report presenting the first estimates ever for most of the taxa treated. On the other hand, meager populations are indicated for Ashy and White-throated storm-petrels, for two races of White-bellied Storm-petrel (*F. g. grallaria* and *F. g. titan*), and for Band-rumped Storm-Petrels in Hawaii. All appear to have populations of <10,000 birds, especially in the case of the newly

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