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ABSTRACT

Aim: I assessed possible linkages between the spatial distribution of primary productivity over the Northwestern Hawaiian Islands and trends of subpopulations of Hawaiian monk seals 1956-1995. This endangered seal is endemic to the Northwestern Hawaiian Islands (NWHI), where about 1300 to 1400 individuals are distributed among five main breeding subpopulations. A striking property in patterns of abundance among subpopulations is their spatial nature, a feature suggesting that these may be related to variation in the biotic marine environment. In examining linkages between trends in abundance at these subpopulations and the marine habitat of the NWHI, an understanding of the relative importance of intrinsic or extrinsic regulatory processes to the long-term dynamics of the seal can be gained.

Location: Northwestern Hawaiian Islands (Hawaiian Archipelago).

Methods: Productivity of the seascape was mapped using both remotely sensed images and data collected during oceanographic cruises. Measurements included sea surface temperature (SST), vertical water column structure, integrated chlorophyll, and their respective levels of variability. The spatial structure and heterogeneity of both mean values and coefficients of variation of these variables were quantified by calculating descriptive statistics for each block of a 20° X 10° grid (with 200 blocks of dimensions 1°) overlain on each map, and computing spatial statistics for each variable (based on the summary statistics calculated for each block). Multivariate techniques were used to identify biogeographical regions within the pelagic landscape of the NWHI. Monk seal trends among breeding sites within and among biogeographical regions were compared by analyzing correlations among mean beach counts for each subpopulation.

Results: Primary productivity over the marine habitat of the Hawaiian monk seal was found to be nonuniform. A significant spatial pattern of primary productivity over the NWHI, most apparent in a gradient along latitudinal lines, was documented. Multivariate groupings of environmental data partition the NWHI into distinct biogeographical regions, and Hawaiian monk seal breeding areas can be differentiated on the basis of

these. Regions with similar environments displayed synchronous variation in monk seal abundance.

Main Conclusions: These findings suggest the local trends in monk seal abundance have ultimately been shaped by the quality of the surrounding marine environment. In assessing the dynamics of the Hawaiian monk seal as a whole, and notwithstanding the short-term and local effects of proximate mortality factors, extrinsic, ecosystem-level mechanisms appear to be important in shaping the long-term population dynamics of this endangered mammal. If that is the case, then environmental variation may also be an important determinant of the potential for recovery of these subpopulations and, therefore, for the entire species.

Key words: Hawaiian monk seal, Northwestern Hawaiian Islands, spatial distribution, marine environment, productivity, abundance, population dynamics, geographic information systems