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ANALYSIS

Ex post economic analysis of reproduction-monitoring and predator-removal variables associated with protection of the endangered California least tern

Stephanie A. Shwiff[a,*], Ray T. Sterner[a], John W. Turman[b], Brian D. Foster[c]

[a]*USDA, Wildlife Services, National Wildlife Research Center, 4101 LaPorte Ave, Fort Collins, CO 80521-2154, United States*
[b]*USDA, Wildlife Services, 9380 Bond Avenue, El Cajon, CA 92021, United States*
[c]*The Zoological Society of San Diego, P.O. Box 120551, San Diego CA 92112-0551, United States*

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Abstract

Important nest sites for the endangered California least tern remain at the U.S. Marine Corps Base, Camp Pendleton, CA; these terns comprise approximately 17% of the state's breeding population. This paper presents an empirical analysis of annual, fixed-cost budgets expended for reproduction-monitoring and predator-removal activities to protect this shorebird. The ex post study covered the inclusive 7-year period between 1995 and 2001. Separate regression analyses were computed using 15 biological (X_B), economic (X_E), and meteorological (X_M) variables. In separate analyses, 14 of these variables served as independent variables to predict each of four dependent tern observation variables (i.e., Y_{nests}, Y_{eggs}, $Y_{fledglings}$, and Y_{adults}), with certain variables "lagged" (i.e., regressed after fixed intervals) to compensate for delayed effects of predator management. Mean net current annual reproduction-monitoring and predator-removal budgets were US$80,115 and US$78,178, respectively; annual fiscal data were converted to "proxy" variables of personnel time (h) for analysis of economic effects. Mean time spent in reproduction-monitoring (3.12 h/day) and predator-removal activities (6.96 h/day) differed greatly. Expenditures for both reproduction-monitoring and predator-removal staff hours were associated with greater counts of tern eggs and adults, with increased monitoring hours predictive of finding more tern nests and fledglings and increased predator-removal hours linked with fewer fledgling counts. No meteorological variables predicted any dependent variable. Economic issues involved in recovery of threatened and endangered species (TS/ES) are discussed.
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Keywords: Endangered species; California least tern; Predator management; Reproduction monitoring; Regression analysis; Economics

1. Introduction

In the United States, the Endangered Species Act, perhaps more than any other single legislative event,

* Corresponding author. Tel.: +1 970 266 6150; fax: +1 970 266 6157.
E-mail address: stephanie.a.shwiff@aphis.usda.gov (S.A. Shwiff).

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reinforced the idea of qualitative and quantitative valuations for rare animals and plants (see U.S. Department of the Interior, 1973). Still, few studies have attempted to empirically measure the effectiveness of fiscal variables on the production of threatened and endangered species (TS/ES).

The California least tern (*Sterna antillarium brownii*) was one of the originally listed TS (sic ES) in the United States (Federal Register 35:8491–8498, 1970). This small (<25 cm), ground-nesting seabird inhabits the Pacific Coast of Central and North America, migrating north and south annually to nest during the spring and summer months in colonies on coastal dunes and beaches from southern Baja to San Francisco, CA (Bent, 1921; Grinnell and Miller, 1944). A century ago, breeding populations numbered in the thousands (Secrist, 1915), but by the time of its listing, the total known population numbered between 300 and 600 nesting pairs (U.S. Department of the Interior, 1973). Predation, coastal development, and human recreation have impacted recruitment, while dredging, filling, and water pollution continue to degrade offshore fisheries (see Butchko and Small, 1992; Caffrey, 1994).

Important nest sites of the California least tern remain at the U.S. Marine Corps Base, Camp Pendleton. These terns comprise approximately 17% of the total California breeding population (Caffrey, 1994). In recent years, fixed-cost agreements have been effected here to monitor reproduction and to limit predation. Reproduction monitoring has delineated tern reproductive success, has improved surveillance, and has guided predator management activities. Similarly, predator management has been practiced since 1988 (see Avery et al., 1995; Butchko, 1990; Butchko and Small, 1992).

Here, we describe an ex post study of monetary expenditures to protect the California least tern at Camp Pendleton. Seven years (1995–2001) of annual fixed-cost budgets for reproduction-monitoring and predator-management activities were analyzed. Descriptive, correlation, and regression statistics were used to characterize the influence of 14 biological, economic, and meteorological variables (e.g., predators removed, monitoring hour, precipitation) upon four dependent variables of tern reproduction (i.e., nests, eggs, fledglings, and adults).

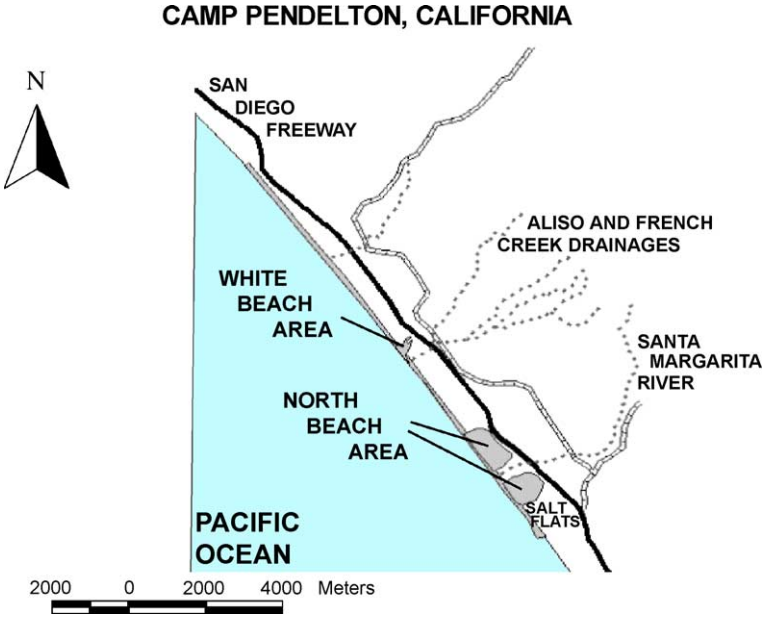

Fig. 1. Map of Camp Pendleton showing main nesting areas of the California least tern.