Annual Prey Consumption of the Common Murre, a Dominant Seabird in the California Current

William J. Sydeman, Farallon Institute for Advanced Ecosystem Research
Nadav Nur, PRBO Conservation Science

SUMMARY

In this project, researchers compiled information on Common Murre (*Uria aalge*) population size, diet, field metabolic rate, prey energy densities and assimilation efficiency to estimate the bird's annual prey consumption between Cape Blanco, Ore. and Point Conception, Calif.

According to results in press in the *ICES Journal of Marine Science*, the murre population in the mid-2000's consumed about 225,000 metric tons (mt) of prey, including about 66,000 mt consumed by breeding adults; 48,000 mt consumed by nonbreeding birds during the breeding season; 111,000 mt consumed by all birds during the wintering period, and 200 mt consumed by chicks at breeding colonies. Monte Carlo simulations suggest that the variation coefficient for the annual prey consumption estimate was ± 13.2%.

Pacific hake and market squid each comprised more than 20% of total prey biomass (excluding chicks at breeding season). Other species comprising at least 10% of the annual diet included shiner surfperch, northern anchovy and rockfish. Anchovy and sardine (63%), rockfish (21%) and smelt (7%) dominated chicks' diet. Most of the anchovy/sardine was likely northern anchovy (94% of those identified to species).

INTRODUCTION

As top predators, seabirds have substantial energetic needs and may often compete with commercial fishers, large fish and marine mammals for food. The lead researcher of this project reports that commercial harvest of forage fishes has been linked to seabird population declines in some areas of the world. Fisheries can also enhance prey populations, and hence seabird numbers, by removing large, predatory fish that otherwise compete with seabirds for food.

David Gardner, PRBO

Common Murres

SPECIES AND STUDY SITE

Although egg collecting, gill netting and oil spills have reduced murre populations below their historical levels, the birds remain a common species in the California Current and were selected for the study for this reason. The region between Cape Blanco and Point Conception was chosen because it is oceanographically and biologically distinct from the areas to the north and south.

MODEL ASSUMPTIONS

It was assumed that murre diets were similar throughout the study region. Prey consumption for the breeding (March to August) and nonbreeding (September to February) seasons were calculated separately. The scientists also treated breeding birds during the breeding season, nonbreeding birds during the breeding season, and wintering birds during the wintering period separately. The nonbreeding and wintering categories included sub-adult and adult birds. The wintering category also included juveniles (chicks produced earlier in the year). The biologists gathered the most recent and applicable information available on energy requirements, diet composition, prey energy densities, assimilation efficiency and population size. They did not include chicks at breeding colonies in the bioenergetics model. Instead, they estimated chick prey-consumption statistics from direct observations of chick feedings. Details regarding the parameter values used are described, in brief, below.

ENERGY REQUIREMENTS

A breeding season estimate of 1,789 kilojoules (kJ) per day was used as the basis for the model. The value reflects the field metabolic rate of breeding murres in Newfoundland, Canada. Field metabolic rate is affected by both bird size and latitude. For this reason, the estimate was adjusted to reflect the higher mass and the lower latitude of birds in the California study area. The resulting value was 1,652 kJ/day. A lower field metabolic rate (1,502 kJ/day) was used for nonbreeding and wintering birds, based on the assumption that they have lower energy requirements than breeding birds. It was assumed that the energy requirements of nonbreeding and wintering birds are similar, due to similar foraging requirements and a relatively mild climate throughout the year.

DIET COMPOSITION

The scientists used percent mass from Ainley et al. (1996) as the measure of sub-adult and adult diet composition. Those authors summarized diet composition (percent mass) for the pre-breeding (March to April), breeding (April to August) and nonbreeding (September to February) seasons in coastal, mid-shelf and outer-shelf habitats. The Sea Grant scientists calculated weighted averages for the breeding season (March to August) based on the number of months in Ainley's pre-breeding and breeding seasons. They then calculated weighted averages across habitat types for breeding and wintering periods, based on murre densities in each habitat. The densities were based on data collated by NOAA's National Centers

for Coastal Ocean Science (2003). Chick diet composition was calculated from direct observations of chick feedings at a colony on Southeast Farallon Island (SEFI) from 2000 to 2004.

PREY ENERGY DENSITIES

Energy densities for most prey species were obtained from the literature. Minor substitutions were made in the absence of published values. For example, a value for "euphausiids" was used for both *Euphasia pacifica* and *Thysanoessa spinifera*; a value for market squid (Spear 1993) was used for octopus; a value for "surfperch" was used for both kelp and shiner surfperch, and a value for topsmelt was used for jacksmelt. Estimates for Pacific hake and Pacific butterfish were calculated from published values of percent lipid and percent protein of Pacific hake (protein equals 15.7%; lipids equals 1.44%) and Atlantic butterfish; protein equals 16.55%; lipid equals 1.60%) fillets. Protein values were then multiplied by their calorific equivalent of 17 kJ/g; lipid values were multiplied by 38 kJ/g. The scientists used a value for short-bellied rockfish for all rockfish species and an average for all prey items, weighted by diet composition, to estimate the energy density of the "unknown" prey.

BREEDING SEASON POPULATION SIZE

The scientists used complete counts from 1988 and partial counts from 2004 to determine breeding population size in Oregon. Specifically, they reduced the 1988 count by 11% based on a comparison of common sites that were counted in both years. Complete counts from 2004 were used to determine breeding population size in California. A correction factor of 1.5 was used to adjust the raw counts to account for birds away from the colony at the time of the survey. The total population estimate for breeding birds was 715,000. They multiplied the number of breeding pairs by 0.86 (average hatching success on SEFI from 2000 to 2004) to calculate a total of about 307,000 chicks hatched at breeding colonies. They used demographic data from SEFI to estimate the proportion of the population that were nonbreeding birds. They averaged the results from two different demographic analyses with different estimates of juvenile, sub-adult and adult survival to arrive at an estimate for the nonbreeding population that equaled about 45% of the total population, or about 579,000 birds.

WINTERING POPULATION SIZE

To estimate wintering population size, they used data summarized in the Marine Mammal and Seabird Computer Database Analysis System: Washington, Oregon, California 1975 to 1997. The database contains seabird distribution and abundance data summarized as densities for each 5-degree-latitude-by-5-degree-longitude block, based on low aerial and ship transects that extended beyond the shelf-break and encompassed the murre distribution. They created tables with murre density and area for each grid block for the breeding and nonbreeding seasons. They then used that data to calculate the number of birds present during each season. Finally, they calculated the nonbreeding season to breeding season ratio (1.2) and multiplied that value by the 2004 breeding population estimate to obtain a total of about 1.5 million birds.

CONCLUSION

The results demonstrate the substantial prey requirements of a dominant seabird in the California Current. Murre consumption, as calculated in this study, can exceed commercial fisheries landings for some species. For comparison, in 2004 commercial fishers landed about 40,000 mt of squid and 4,700 mt of hake statewide, while murres were estimated to have consumed more than 45,000 mt of both squid and hake. The biologists believe that more information is needed on prey consumption by predators, relative to prey population sizes, to assess the impact of fisheries and animals on prey populations, and hence on the marine ecosystem at large.

STUDENT

Peter Warzybok, Master's Thesis

COLLABORATING ORGANIZATIONS

CalCOFI and NOAA Fisheries Southwest Fisheries Science Center, Santa Cruz

PUBLICATION

Roth, J.E., Nur, N., Warzybok, P. and Sydeman, W.J. Annual prey consumption of a dominant seabird, Common Murre, in the California Current System. In press with *ICES Journal of Marine Science*.

CONTACTS

William J. Sydeman
Farallon Institute for PRBO Advanced Ecosystem Research
707-781-2555
wsydeman@comcast.net

Nadav Nur
Farallon Institute for PRBO Advanced Ecosystem Research
nnur@prbo.org
707-478-1381

This publication is sponsored by a grant from the National Sea Grant College Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, under grant number NA080AR4170669, Project number C/P-1. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies. The U.S. government is authorized to reproduce and distribute for governmental purposes. This document is available in PDF on the California Sea Grant website: www.csgc.ucsd.edu.

California Sea Grant, University of California, San Diego, 9500 Gilman Drive, Dept. 0232, La Jolla, CA 92093-0232
Communications Phone: (858) 534-4446