

Implications of seabird prey consumption for forage fish management in California

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Effective ecosystem-based fishery management involves assessment of foraging interactions among consumers, including upper level predators such as marine birds and humans. This is essential to understanding the tradeoffs associated with maintaining the integrity of food web structure.

To address this issue, we examined the prey requirements of 3 indicator species, common murre (*Uria aalge*), Brandt's cormorant (*Phalacrocorax penicillatus*), and rhinoceros auklet (*Cerorhinca monocerata*) in the central California Current over a 30-year period, 1986–2015. We developed a bioenergetics model that incorporates species-specific values for daily basic energy needs, diet composition, energy content of prey items, assimilation efficiency, and population size. We then compared seabird consumption to stock size and commercial take for several species of forage fish.

We found that the total biomass of forage species

consumed during the breeding season varied annually from 8,500 to > 60,000 metric ton (t) and is now more than five times greater than it was 20 years ago.

During this same time period, independent ecosystem assessment surveys conducted annually by NOAA indicate that forage fish abundance has declined.

Fishery management practices established when predator populations were small a few decades ago are now being confronted by the growing needs of predators as their respective populations recover.

Increased forage species take by predators, as revealed by seabirds, may be adding consumptive pressure to key forage fish populations, regardless of the potential additional impacts of commercial fisheries. Improving estimates of consumption by predators and fisheries will promote more effective management from an ecosystem perspective.

Main Points

Seabirds consume a large amount of the available forage fish off California every year.

As seabird populations recover from previous disturbance, their prey consumption has increased 5x.

Forage species are either not managed or have outdated harvest limits.

Changing needs of top predators, such as seabirds, must be considered in fisheries management.

Warzybok, P, JA Santora, DG Ainley, RW Bradley, JC Field, PJ Capitolo, RD Carle, M Elliott, JN Beck, GJ McChesney, MM Hester, & J Jahncke. 2018. Prey switching and consumption by seabirds in the central California Current upwelling ecosystem: Implications for forage fish management. *Journal of Marine Systems*. 185: 25-39.

<https://doi.org/10.1016/j.jmarsys.2018.04.009>