Seabird Monitoring on Alaska Maritime National Wildlife Refuge

Vernon Byrd
Alaska Maritime National Wildlife Refuge, Homer, Alaska

Abstract

Alaska Maritime National Wildlife Refuge (Alaska Maritime NWR) has an ongoing long-term seabird monitoring program designed to detect significant changes in seabird populations that might signal conservation problems for the birds. At the same time the seabirds are used as indicators of change in the marine ecosystem, and the data from the monitoring program can be used along with data on climate change, oceanography, fish, marine mammals, and other physical and biological variables to better understand changes in the marine ecosystem. The monitoring program includes annual data gathering on populations of selected fish-eating and plankton-eating seabirds at nine locations scattered along the Alaska coastline and at additional locations visited less frequently. The data are summarized in an annual report and are in the process of being entered into the Pacific Seabird Monitoring Database so that interested parties will have access to the information.

Introduction

The Alaska Maritime National Wildlife Refuge was created primarily to conserve marine bird and marine mammal populations and habitats and the marine resources on which they rely (Alaska National Interest Lands Conservation Act of 1980). The refuge is far-flung. It includes islands, islets, and headlands from Southeast Alaska to the Chukchi Sea (alaskamaritime.fws.gov). Most of the Aleutian Islands are part of the refuge (formerly the Aleutian Islands NWR, created in 1913).

An important aspect of conservation of marine wildlife is to monitor populations to identify serious declines. In addition, it is important to understand patterns of change in the marine ecosystem to evaluate

causes of observed changes in wildlife populations. Seabirds are particularly sensitive to changes in the marine environment, and therefore they can be used like "miner's canaries" to reflect fluctuations in marine food webs (e.g., Cairns 1987, ICES 2003). Because seabirds are long-lived, comprehending the dynamics of their populations requires long-term monitoring to understand their response to not only interannual variation but also to decadal or longer time scale patterns in the marine ecosystem (e.g., Hare and Mantua 2000). "Baseline" data provided by monitoring also facilitates determining impacts of acute perturbations like oil spills. This report describes the rationale, design, and implementation of the long-term seabird monitoring program on Alaska Maritime NWR.

Design of the monitoring program

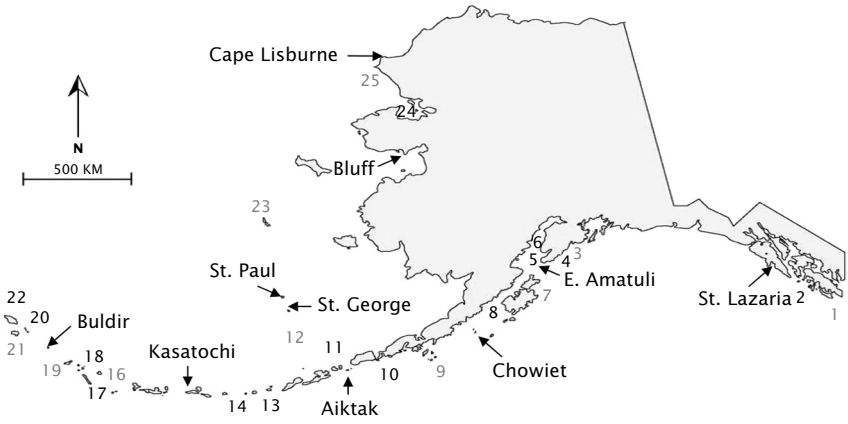
The objectives of the refuge monitoring program are to provide long-term, time-series data from which "biologically significant" changes can be detected and from which hypotheses about causes may be tested.

To accomplish the first part of the objective (i.e., detect population change) involves counting birds. The second part (i.e., understanding causes of change) involves measuring other parameters like timing of nesting, productivity, diets, and mortality events like die-offs along with environmental variables like ocean temperature.

As with any monitoring program basic questions include (1) where to monitor, (2) which species to include, (3) which parameters to measure, and (4) how often and when to conduct the surveys. Choosing the environmental variables to monitor also is important. On Alaska Maritime NWR, there are hundreds of seabird breeding sites scattered over thousands of miles of coastline (Sowls et al. 1978, USFWS 2002, Byrd et al. 2005). Furthermore, there are more than 30 breeding species of seabirds to choose from, and a number of different parameters such as breeding timing, reproductive success, chick growth rates, etc., are candidates for study.

Locations

Because the refuge spans most of the coastline of Alaska, the monitoring program needed to include at least one site in each major ecoregion, and that was the basis for selecting particular sites. The monitoring program includes sites in southeast Alaska, the north Gulf of Alaska, off the Alaska Peninsula, the eastern, central, and western Aleutians, the southern and northern Bering Sea, and in the Chukchi Sea (Fig. 1) ensure adequate geographic coverage.



1. Forrester*
2. Hazy
3. Chiswells*
4. Pyes
5. Nord
6. Chisik
7. Chiniak Bay*
8. Ugaiushak
9. Outer Shumagins*
10. Midun
11. Krenitzins
12. Bogoslof*
13. Kagamil
14. Chagulak
15. Adak
16. Gareloi*
17. Semisopochnoi
18. Segula
19. Kiska*
20. Nizki-Alaid
21. Agattu*
22. Attu
23. St. Matthew*
24. Chamisso
25. C Thompson*

Figure 1. Map showing annual (named on map), periodic (asterisk by names), and examples of intermittent seabird monitoring sites on Alaska Maritime National Wildlife Refuge.

Species

At least 30 species of seabirds are known to breed on Alaska Maritime NWR. It is not feasible to monitor all of them, so we selected species that forage in different ways and eat different kinds of prey in order to be able to use the birds to tell when there are big changes in different parts of the marine food web. The two major subdivisions of breeding birds were fish feeders (piscivores) and plankton feeders (planktivores). For instance, we selected species like murres to represent piscivores and storm-petrels to represent planktivores (see Table 1). At any particular monitoring site 6-10 species of seabirds are monitored.

Parameters

From the standpoint of species conservation, population trend is probably the most important parameter to monitor. Nevertheless, understanding causes of change requires monitoring annual responses of seabirds to their environment and particularly to their prey. A number of aspects of breeding biology could reflect seabird response to environmental fluctuation (see Hatch et al. 1994), but our primary focus is on timing of nesting events like average hatch date and on overall reproductive success (e.g., chicks produced per nesting pair). Another important

Table 1. Foraging guilds of breeding seabirds on the Alaska Maritime National Wildlife Refuge.

Foraging guild	Primary domain	Seabird species
Diving fish-feeder	Offshore	**Common murre**
		Thick-billed murre
		Rhinoceros auklet
		Tufted puffin
		Horned puffin
	Inshore	Pelagic cormorant
		Red-faced cormorant
		Double-crested cormorant
		Brandt's cormorant
		Black guillemot
		Pigeon guillemot
		Marbled murrelet
		Kittlitz's murrelet
Surface fish-feeder	Offshore	Northern fulmar
		Black-legged kittiwake
		Red-legged kittiwake
	Inshore	Arctic tern
		Aleutian tern
Diving plankton-feeder	Offshore	Ancient murrelet
		Cassin's auklet
		Least auklet
		Crested auklet
	Inshore	**Parakeet auklet**
		Whiskered auklet
Surface plankton-feeder	Offshore	**Fork-tailed storm-petrel**
		Leach's storm-petrel
Opportunistic feeder		Parasitic jaeger
		Mew gull
		Glaucus-winged gull
		Glaucus gull

Bold indicates species is selected for use in one or more site.

measure is composition of diets, because shifts in prey signal changes in the food web and can affect reproductive success. Finally, surveying beaches for dead birds can provide an index to unusual mortality events. The refuge, and some of the neighboring communities, has recently been using an approach similar to The Coastal Observation and

Seabird Survey Team (COASST) at the University of Washington (www.coasst.org). Sea temperature is the primary environmental measurement that we included. Data collection protocols for each of the parameters (e.g., Williams et al. 2002) ensure comparability of data.

Frequency of sampling

It is important to collect data for some of the parameters annually in order to understand ecosystem processes that affect the seabirds and their prey. Therefore, we selected one site in each of the ecoregions (Fig. 1), where crews collect data annually. Nevertheless, these annual sites are on average more than 500 km apart, so it is important to fill geographic gaps with measurements at other colonies in each region. The additional sites can only be surveyed periodically due to funding limitations. At least one site in each region was selected for data collection at 3-5 year intervals and other sites were selected for survey at least every 10 years. Typically visits to these periodic (3-5 year) and intermittent (10 year) sites are for shorter periods than the season-long work at annual sites, and particularly at intermittent sites, only population trend data are gathered. Nevertheless, data from these less-than-annual sites allow determination of the geographic extent of changes seen at annual sites.

Environmental variables

Hobo data loggers® are moored in nearshore marine waters at most annual monitoring sites to record sea temperatures throughout the breeding season for seabirds. These time series are used to distinguish between relatively cold and warm years.

Food web description

To facilitate comparison of patterns of change in seabirds among monitoring locations, the refuge ship M/V *Tiglax* enables us to describe the nearshore marine food web at each annual monitoring site. This aspect of the monitoring program is called "Seabird, Marine Mammal, Oceanography Coordinated Investigations" (SMMOCI, see Byrd et al. 1997). It involves having the ship run transect lines from the colony out to about 50 km. Observers record locations and numbers of all species of birds and marine mammals while simultaneously recording with a sounder the relative density of plankton and fish in the water column and the temperature and salinity of the water at the surface. Additionally, profiles of temperature and salinity at various depths in the water column are measured at a series of sampling stations. Test fishing (small research bottom trawls and midwater trawls) and plankton tows are conducted to determine the relative abundance of different types of prey in the area. The refuge is currently conducting SMMOCI

surveys in multiple years at some sites to evaluate interannual variability and evaluate the potential of this type of survey as a monitoring tool in addition to basic descriptions of the nearshore marine ecosystem.

Data summaries

Annually, data are compiled from seabird monitoring on Alaska Maritime NWR and from special studies and other seabird monitoring efforts in Alaska (e.g., Dragoo et al. 2006). Furthermore, a new database has recently been developed to be the repository for all seabird monitoring data for the North Pacific including Alaska. It is called the Pacific Seabird Monitoring Database, and it will be available online soon. This will make data from the refuge monitoring program widely available to interested parties.

Conclusions

The Alaska Maritime NWR seabird monitoring program is part of a broader effort to document and evaluate causes of change in Alaska's marine ecosystems. Integration of these data with data from other ongoing monitoring programs (such as marine mammals, fish, plankton, and other biological elements; and oceanographic and climate data) and with local knowledge, particularly about causes of changes, will strengthen the interpretation of results. The ultimate goal for all these efforts is to conserve in the long-term a healthy marine ecosystem.

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