PHYSIOLOGICAL CONSTRAINTS ON BREEDING BY EMPEROR GEESE: INTERACTING EFFECTS OF PARASITISM, CONDITION, AND DISEASE POTENTIAL

Biological Objectives

- Restore the population to a level that can provide sustainable harvest opportunity.
- Evaluate whether the persistently low population size may be influenced by poor physiological health of emperor geese that results in less than ideal production of young.

Background

The number of emperor geese in spring, while staging on the Alaska Peninsula, was counted in 1964 and then every spring since 1980. The population declined from 139,000 in 1964 to near 50,000 in 1986 and has only subtly increased in the 25 years since then. The current population is slightly more that 50% of the population objective established in the Pacific Flyway Management Plan. All legal harvest ceased by 1986 and remains closed today. The management goal is to restore the population to a level that can sustain a managed harvest. The cause for this persistently low population size is unknown but one hypothesis is that emperor geese may be physiologically compromised in some way that impedes their ability to reproduce at a rate great enough to increase the population. Hints of this come from frequent observation of emperor geese foregoing the opportunity to nest and instead they commonly produce eggs and lay them in the nests of other emperor geese that are nesting. This pattern of “egg dumping”, seen in many waterfowl species, is usually interpreted as being done by those individuals who are in such poor physical condition that they cannot both successfully produce eggs and also incubate them, which requires a nearly complete fasting period. Because the frequency of egg dumping in emperor geese exceeds that of any other species, it suggests that emperor geese may experience particularly poor levels of physiological condition in spring. Our research goal is to assess whether or not emperor geese are indeed physiologically compromised. By examining the manner in which physiological health is compromised and the magnitude of compromise among individuals, we may reveal causes for poor condition. Identification of causes of poor condition may then lead to management opportunities to improve the status of the emperor goose population.

Planning/Project Design

The vast majority of the world’s emperor geese breed on the Yukon-Kuskokwim Delta. In the midst of this delta, along the Manokinak River, an ongoing study of emperor geese has provided a useful context for this study of their physiological health. At this site, up to 200 nesting emperor geese are monitored in most years, and many geese are marked with plastic leg bands, which allows us to keep track of who is who and compute rates of survival from one year to the next. This specific study of physiological health is directed at the subset of adult females, and their young, that we capture while they incubate their eggs. By taking blood from these nesting females, and also blood from the leftover membranes of eggs from which goslings have hatched, we can obtain DNA samples that allow us identify which eggs were laid by the goose incubating the nest versus being laid by another goose – a ‘parasite’, who essentially shirks the demanding responsibility of incubating a clutch of eggs. Hormonal analysis of residual egg material left in eggshells can tell us how physiologically stressed the females were when they laid these eggs. Thus, this analysis can tell us if parasites are more stressed than the host females that incubate the eggs, and confirm whether some aspect of their environment is constraining parasites from making their own nest, which would likely provide them greater breeding success. Before arriving at breeding areas, waterfowl typically feed heavily in late winter and early spring, building body fat, and then later use that body fat to help initiate breeding. Isotopic analyses (measurements of the amounts of different forms of carbon, nitrogen, and other elements in animal tissues) of goose blood, goose eggs, and goose foods can tell us what types of foods they used to make eggs. Using such analyses with emperor geese, we are evaluating to what degree individuals make their eggs and fuel their incubation behavior from intertidal foods primarily garnered in coastal lagoons of the Alaska Peninsula, where they stage for a month or so during migration, or from grasses and sedges at their breeding sites. If physiological stress and parasitism are related to where they obtained their foods to make eggs, then this could be indicative of which habitats are most important and possibly a sign of change in quality of certain key habitats.

Management

The identification of how physiological stress is manifested in populations and quantification of its impact on breeding success could prove vital for harvest management of waterfowl populations. A core element of the harvest management process includes ecological models of how waterfowl breed and survive. Thus, knowledge from this study could be imbedded in models of how to best manage future harvests of emperor geese.

Accomplishments

During 2011 we located 185 nesting emperor geese and recorded their breeding success. From most of these nests, we also collected feathers from the adult females and membranes of the eggs to get DNA and isotope samples. We also collected over 85 samples of residual egg material for stress hormone analyses. We captured 42 nesting females on their nests, collected blood samples, and obtained traditional measures of condition (body mass relative to body size) to relate to other health parameters (antioxidants and white blood cell counts). Analyses are underway, and the specific manner in which these results affect future management will be dictated by the nature of the results.

Fig. 1. Emperor Geese are very attentive to their nests, making them easy to capture.

Fig. 3. By using stable isotope techniques on blood samples, we can estimate how much egg production is reliant on local foods at the breeding area versus body fat formed earlier while on migration. We also get DNA from the blood and we can run tests on their immunological health (e.g., white blood cell counts).

Fig. 2. Many of the Emperor Geese seen nesting in 2011 had been previously captured, banded, and bled. We color-mark their eggs so we can more assuredly identify which egg is which when we sample the residual material after a gosling departs from the nest.

Fig. 4. After a gosling hatches, an egg membrane like this is left behind. From the DNA we obtain from this membrane, we determine if this egg was laid by the goose incubating the nest or if it was laid by a 'parasite' – a goose that dumps its eggs in the nests of others. Also, goslings usually leave a fresh feces in this egg membrane when they leave the nest. This feces can be analyzed to assess the hormonal state of the mother when she laid the eggs, and thus tell us something about how physiologically stressed she is.

Fig. 5. This trio of geese are anxiously honking and circling Ian while he samples the goslings and egg membranes in the nest bowl. The observation of three geese, rather than a pair of geese, attending this nest, may provide insight as to how so many of their nests include eggs laid by females other than the one incubating the nest.