

Biologists shed light on health of marbled murrelet population in early 1900s

February 5 2007



Juvenile marbled murrelet on its nest platform high in an old growth Douglas-fir tree. (Tom Hamer photo)

To better understand why an endangered seabird's numbers plummeted over the past century, researchers at the University of California, Berkeley, turned to museums for help. By studying marbled murrelet specimens collected around the early 1900s, biologists now have reconstructed the seabird's rates of reproduction and survival before its dramatic decline, providing for the first time a baseline measure of health by which contemporary populations can be compared.

The researchers found that birth rates for marbled murrelets were 8.5 times greater about 100 years ago than they are today.

This unique approach to studying the demography of an endangered species, described in the cover story for the February issue of the journal *Ecology*, points to museum collections as an underutilized resource for diagnosing the causes of decline and measuring population changes in a species, the authors said.

"Conservation biologists don't often have exact measures of what reproduction and survival rates should be for a healthy population," said Steven Beissinger, UC Berkeley professor of environmental science, policy and management and lead author of the paper. "Until about 30 years ago, systematic studies of the birth rates and death rates of wildlife species were rare."

That changed after 1973 with the passage of the Endangered Species Act, which required biologists to assess a species' risk of extinction. When a population is unable to produce enough offspring to replace those that die, biologists know that it is in decline.

"The problem is that nobody has that sort of baseline data from 100 years ago," said study co-author, M. Zachariah Peery, a former Ph.D. student in ecosystem sciences at UC Berkeley who is now a post-doctoral researcher at Moss Landing Marine Laboratory. "Usually what happens with endangered species is that biologists start to really study a species only after they realize it's in trouble. Museum specimens allow us to estimate the baseline level of success for a species. To the best of my knowledge, that has never been done before."

Little was known about the nesting habits of the marbled murrelet (*Brachyramphus marmoratus*) until 1974, when its first nest was discovered. Researchers now know that the seabird nests high in the canopy of coastal old-growth forests from California north to Alaska. Conservationists point to the murrelet's dwindling nesting habitat as a major factor in the seabird's decline. In 1992, the marbled murrelet was

listed as endangered.

The researchers noted that to get an idea of a population's historic size, biologists typically extrapolate from reports by early naturalists or biologists. Such reports can provide a general sense of the changes in a species' range when compared to contemporary locations that it occupies, but not changes in its birth or death rates. Knowing the details of a population's reproduction and survival rates would provide benchmarks for the recovery of threatened or endangered species, the researchers explained.

For the marbled murrelet, the researchers estimated rates of reproduction and survival by comparing the ratios of birds in different age groups using 170 specimens collected between 1892 and 1922 housed in the collections of the California Academy of Sciences and the UC Berkeley Museum of Vertebrate Zoology. They compared these results with values predicted from comparison with other bird species, and with contemporary rates obtained from murrelets they captured at sea and from their mark-recapture studies.

Based upon the study, the researchers estimate that 100 years ago, there were nearly 30 juvenile marbled murrelets - those less than a year old - for every 100 adults in the central California population they studied between Half Moon Bay and Santa Cruz, a ratio that was nearly identical to that predicted from comparative analysis. Today, there are only three to four juveniles for every 100 adults.

At the historic rate of reproduction, a marbled murrelet population would have experienced a stable to healthy growth rate of 2 percent per year. The authors note that murrelets only lay one egg each year, so the population, even when healthy, likely never grew very quickly. The modern-day reproduction rate suggests a population declining at a rate of 7 to 9 percent per year, the researchers report.

By contrast, the survival rates for adults remained unchanged over the past 100 years.

"A change in reproduction levels for the marbled murrelet suggests limitations in nesting habitat and food availability, and increased predation on eggs and chicks by jays and ravens," said Peery. "Had survival rates been affected, it could have meant that more murrelets were being killed by peregrine falcons - which tend to prey on adults - or from oil spills."

"Our results suggest the marbled murrelet will need all the protection it can get - both on land and at sea - to recover healthy rates of reproduction," said Beissinger. "Unfortunately, the U.S. Fish and Wildlife Service recently proposed to greatly reduce the area of old growth forest designated for protection as critical habitat for this bird and has not protected near-shore habitats at sea, where the murrelet spends most of its life."

The researchers acknowledge the limitations of using museum specimens to accurately represent the historic demography of a species. For instance, collections of some species may be biased toward ages of birds that happened to be easier to catch, such as the very young or old. In addition, not all collections are large enough to ensure adequate representation of the population at the time.

The researchers were confident that these limitations were not a factor for the marbled murrelets in this study. For one, they found correspondence from collectors in the early 20th century indicating that collecting was fairly indiscriminate, involving men rowing out to sea with a shotgun to gather as many birds as possible. In addition, the researchers did not find juvenile marbled murrelets to be easier to capture than adults.

The researchers note that there are a significant number of species that may make good candidates for analysis through museum samples.

"There are many museum collections across a broad array of taxas that may prove to be useful," said Beissinger. "They are a neglected set of resources for conservation biologists, but we're starting to find more exciting and creative uses for them."

Source: UC Berkeley

Citation: Biologists shed light on health of marbled murrelet population in early 1900s (2007, February 5) retrieved 19 April 2024 from <https://phys.org/news/2007-02-biologists-health-marbled-murrelet-population.html>

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