

**Miller et al.**

## **AT-SEA MONITORING OF MARBLED MURRELET POPULATION STATUS AND TREND IN THE NORTHWEST FOREST PLAN AREA**

Sherri L. Miller<sup>1</sup>, C. John Ralph<sup>2</sup>, Martin G. Raphael<sup>3</sup>, Craig Strong<sup>4</sup>, Christopher W. Thompson<sup>5</sup>, Jim Baldwin<sup>6</sup>, Mark H. Huff<sup>7</sup>, and Gary A. Falxa<sup>8</sup>

One objective of the Marbled Murrelet Effectiveness Monitoring Plan for the Northwest Forest Plan (Madsen et al. 1999) is to monitor changes in Marbled Murrelet abundance throughout the Forest Plan area, using a unified and scientifically valid sampling design. At this point in our understanding of Marbled Murrelet ecology, there is general consensus that populations are best assessed at sea.

A team of Marbled Murrelet biologists and statisticians<sup>9</sup> was assembled by the U.S. Fish and Wildlife Service in to design and implement a population monitoring protocol consistent with the goals of the Forest Plan. The approach adopted by the team included several steps. We reviewed survey methods and sampling designs used to monitor murrelets in North America since 1989. We analyzed specific aspects of methods and results using past population survey data and explored potential sampling designs using computer simulated populations and samples. A variety of analysis techniques for estimating population size was reviewed and considered in the context of murrelet biology and the Forest Plan objectives. Tests of the suggested approaches were conducted during the 1998 and 1999 field seasons. We reached consensus on the new methods and began using the new population-monitoring sampling design in 2000.

In 4 years (2000-2004), we conducted over 750 Primary Sampling Unit surveys on approximately 16,120 miles of transects, and recorded over 18,000 murrelet observations in the target population zones, a 3,402 square mile offshore area. Surveys have been conducted through the efforts, funding, and cooperation of Federal and State governments, contractors, and private industry.

The total population estimate for the coastal waters adjacent to the Plan area for 2003, the most recent year, was 22,300 murrelets with a 95% confidence interval of 18,300 to 26,300. We estimated the highest densities of birds at the zone level over all four years to be 8.62 to 12.35 birds per square mile, in Zones 3 and 4. As expected, densities varied within zones with 2- to 8-fold differences between strata. We observed the lowest densities of birds, 0.16 to 0.73 birds per mi<sup>2</sup>, in Zone 5.

Our results did not detect a decrease in the size of the target population over the four years of monitoring at the 5% significance level. Our measure for assessing this monitoring program is its power to detect decreases in the mean density (and the resulting mean total population) of murrelets over time. When all of the zones are combined, we would have an 80 to 95% chance of detecting a 3% to 4% annual decrease with a 10-year sampling period. The actual change that we could detect in 10 years, with 80 to 95% power, varies in the five zones because of differences in densities, variability, and effort. For all zones combined, in 15 years we could detect an annual decrease of 2% with 95% power. In only 10 years, we could detect a 3% annual decrease with 80% power. As the Effectiveness Monitoring effort continues, the consequences of errors in estimating trends should be evaluated and goals established. In addition to setting population targets, management response to observed trends should be considered.

<sup>9</sup> The original team of experts assembled by U.S. Fish and Wildlife Service in 1998 consisted of the following members: Naomi Bentivoglio, Team Lead, USDI Fish and Wildlife Service; Steven R. Beissinger, Professor, University of California, Berkeley; Jim Baldwin, Statistician, USDA Forest Service, Pacific Southwest Research Station; Tim Max, Statistician, USDA Forest Service, Pacific Northwest Research Station; Sherri Miller, Wildlife Biologist, USDA Forest Service, Pacific Southwest Research Station; Ken Ostrom, GIS/Database Specialist, US Fish and Wildlife Service; C. John Ralph, Research Ecologist, USDA Forest Service, Pacific Southwest Research Station; Martin G. Raphael, Research Wildlife Biologist, USDA Forest Service, Pacific Northwest Research Station; Craig Strong, Consulting Biologist, Crescent Coastal Research; Chris Thompson, Research Scientist, Washington Department of Fish and Wildlife. Some team memberships changed over the period of design and implementation.

**STATUS & TREND REPORTS CONCURRENT SESSIONS- Marbled Murrelet**

<sup>1</sup> USDA Forest Service, Pacific Southwest Research Station- 1700 Bayview Drive, Arcata, CA

<sup>2</sup> USDA Forest Service, Pacific Southwest Research Station- 1700 Bayview Drive, Arcata, CA

<sup>3</sup> USDA Forest Service, Pacific Northwest Research Station- 3625 93rd Ave. SW, Olympia, WA

<sup>4</sup> Crescent Coastal Research- P.O. Box 2108, Crescent City, CA

<sup>5</sup> School of Aquatic & Fishery Sciences- 1122 Boat St., Seattle, WA

<sup>6</sup> USDA Forest Service, Pacific Southwest Research Station- 800 Buchanan St., Albany, CA

<sup>7</sup> USDI Fish & Wildlife Service, Pacific Regional Office, Ecological Services- 911 NE 11th Avenue, Portland, OR

<sup>8</sup> USDI Fish & Wildlife Service, Arcata Field Office- 1655 Heindon Rd., Arcata, CA