

FEATURE ARTICLES

TRENDS IN RADAR-BASED COUNTS OF MARBLED MURRELETS ON THE OLYMPIC PENINSULA, WASHINGTON, 1996–2004

BRIAN A. COOPER^{1,4}, MARTIN G. RAPHAEL², AND M. ZACHARIAH PEERY³

¹*ABR, Inc.—Environmental Research and Services, P.O. Box 249, Forest Grove, OR 97116*

²*USDA Forest Service, Pacific Northwest Research Station, 3635 93rd Avenue SW, Olympia, WA 98512–9193*

³*Moss Landing Marine Laboratories, 7554 Sandholdt Road, Moss Landing, CA 95039*

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⁴ E-mail: bcooper@abrinc.com

Abstract. The Marbled Murrelet (*Brachyramphus marmoratus*) is a high profile, federally threatened seabird, but no reliable estimates of population trends at inland breeding areas exist for this species. We conducted land-based radar studies of Marbled Murrelets at 3–7 sites on the Olympic Peninsula, Washington, in 1996–2002 and 2004 to estimate population changes and to examine relationships between our counts and oceanographic conditions, murrelet productivity, and regional at-sea counts of murrelets. Morning radar counts of murrelets varied significantly among and within sites but did not decline from 1996–2004, suggesting that the inland breeding population of murrelets is stable in this area. A retrospective power analysis indicated that we had a 25% and 56% chance of detecting 2% and 4% annual declines, respectively. Thus, if relatively small annual declines did occur during our study period, there is a high probability that they would have gone undetected, even though they could add up to a biologically important decline over time. It is unlikely that murrelets on the Olympic Peninsula declined by $\geq 6\%$ annually, however, because retrospective analyses indicated that power to detect such declines was $>88\%$. There was no significant relationship between radar counts and at-sea counts or productivity of murrelets in the nearby San Juan Islands during the study period. We also did not detect a relationship between radar counts and mean sea-surface temperatures or the Northern Oscillation Index, suggesting that variation in oceanographic conditions (e.g., the strong 1998 El Niño event) was not associated with variation in morning radar counts of Marbled Murrelets. A prospective power analysis indicated that small (2%–4%) annual declines could be detected with reasonably high power ($\geq 80\%$) with the current radar sampling design by extending the study to 11–15 years.

Key words: *Brachyramphus marmoratus*, *Marbled Murrelet*, *Northern Oscillation Index*, *population trends*, *productivity*, *radar*, *sea-surface temperature*.