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MARBLED MURRELET (*BRACHYRAMPHUS MARMORATUS*) POPULATION TRENDS AND THE CALIFORNIA CURRENT

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Introduction

The marbled murrelet (*Brachyramphus marmoratus*) is a federally-protected seabird species that occurs in the Pacific Northwest of North America (Figure 1). This bird nests on large branches of mature trees near the coast from Northern California to Alaska. Their population along the Washington, Oregon, and California coast appears to be greatly reduced compared to a century ago (Loehle et al. 2022), though exact figures are not available for historical levels. From the same study, the most common explanation for the decline is that harvest of mature trees has reduced their nesting habitat. For this reason, protection of mature forest in their nesting range has been a priority of the Northwest Forest Plan. Recent evidence, however, points to a decline in forage fish stocks as a potential population driver (Rivers et al. 2022). Although surveys of the coastal at-sea population have been ongoing as part of conservation efforts (McIver et al. 2022), there is uncertainty about status and trends of murrelet populations. Population trends often indicate how broadly conservation measures need to be applied to ensure long-term survival of a species. However, cause(s) of low population numbers for marbled murrelet, whether terrestrial or at-sea conditions, or a combination of these factors, affects what type of conservation measures are needed. To better understand this, NCASI (Loehle and Verschuyl 2024) recently investigated trends in murrelet populations and possible causes for any observed trends.

Figure 1. *Marbled murrelet foraging at sea. [Photo credit: "Marbled Murrelet" by seabamirum]*

The marbled murrelet population in near-coastal waters of CA, OR, and WA appears stable

Loehle et al. (2022) recently fit multiple trend models to 2001–2020 at-sea survey data from McIver et al. (2022) for marbled murrelet in California, Oregon, and Washington. To better understand population trends, the statistical properties and plausibility of each model were compared. Linear, exponential, and Monte-Carlo exponential models all indicated that a flat trend (λ close to zero) existed, indicating that the species population is stable when considering this three state region. The best model overall was a sinusoidal model with a linear term, which also may correlate with ocean conditions (Figure 2). This relationship cannot be explained by terrestrial conditions (nesting sites), which have been slowly increasing over the period of the study (Loehle et al. 2022; Prisley and Verschuyl 2018).

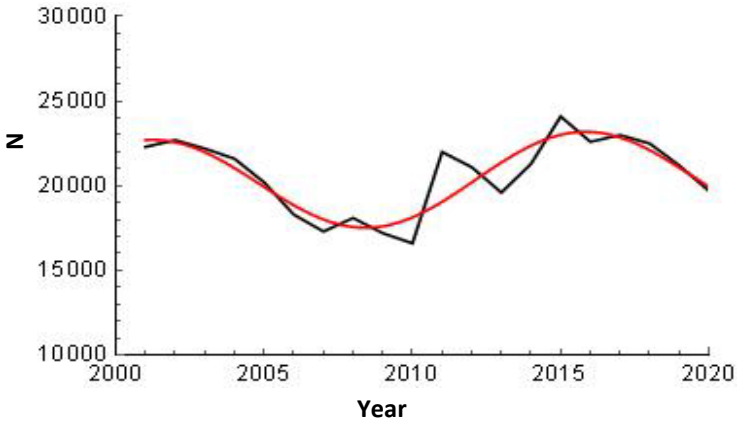

Figure 2. *Sinusoidal fit to marbled murrelet at-sea population trend data.*

Ocean conditions may drive periodicity and magnitude of murrelet population trends

Conditions in the California Current in the Pacific Ocean are likely related to murrelet productivity, as this current affects prey availability. To understand the ocean mechanisms driving murrelet demography, we would need detailed information on diet, where and when murrelets forage, how their prey varies over time, and demographic response to diet, yet most of this information is not readily available (Rivers et al. 2022). However, there are some historical patterns in the California Current that may point to mechanisms worth exploring. For example, on average, there is a five-fold increase in chlorophyll concentrations from Northern California to southern Vancouver Island (Hickey and Banas 2008), a trend that corresponds roughly to murrelet density along this zone. Sydeman et al. (2013) found a large decline in seabird (all species) productivity off the coast of California during 2001-2007, the same period that saw a decline in murrelets. In the 1980s and 1990s, there was roughly a 14–15 year interval between January–March temperature peaks along the coasts of Washington and Oregon (Figure 3 in Hollowed et al. 2001) compared to the estimated 14.6 year population cycle found for murrelet in the same area (Figure 2). Fiedler and Mantua (2017) found a pattern of high California Current sea surface temperature values in the 1990s and 2014–2016 (the end of their data, their Figure 1) with a local minimum between these peaks in 2008, the same year as the minimum value for estimated murrelet populations. These correlations suggest that variation of the California Current may be related to murrelet demographic drivers, as also noted by Rivers et al. (2022).

Ocean conditions may also explain movement to and from CA, OR, and WA

Ocean productivity may also influence murrelet movements in and out of the at-sea survey area of California, Oregon, and Washington, mainly via exchanges with Canada (Loehle et al. 2022). Such movements could explain rapid annual changes (over 40% in some years) found in the study population (Figure 2), which are difficult to explain by demographic processes as the species only lays a single egg and not all birds reproduce every year (Loehle et al. 2022). Further, the most dramatic variations in single year at-sea counts occur in Washington, adjacent to Canada. For more information see Loehle and Verschuyl (2024).

Conclusions

While nesting habitat has been greatly reduced from historical conditions, recent trends and fluctuations, including population movements, are more correlated with ocean conditions which have known effects on forage fish stocks. A focus solely on nesting habitat is unlikely to achieve restoration of marbled murrelet. Further, because this species is highly mobile, survey and conservation efforts should consider marbled murrelets across their range, not by state, to obtain better estimation of populations trends.

Literature Cited

Fiedler, P., and Mantua, N. 2017. How are warm and cool years in the California Current related to ENSO? *Journal of Geophysical Research* 122:5936-5951.

Hickey, B., and Banas, N. 2008. Why is the northern end of the California Current system so productive? *Oceanography* 21:90-107.

Hollowed, A., Hare, S., and Wooster, W. 2001. Pacific Basin climate variability and patterns of Northeast Pacific marine fish production. *Progress in Oceanography* 49:257-282.

Loehle, C., J. Verschuyl and K. Solarik. 2022. Population Trends for Marbled Murrelet (*Brachyramphus marmoratus*) in the Pacific Northwest, USA. Northwestern Naturalist 103:20-29.

Loehle, C. and J. Verschuyl. 2024. Marbled Murrelet (*Brachyramphus marmoratus*) Population Trends and the California Current. NCASI WP-24-04.

McIver, W., Baldwin, J., Lance, M., Pearson, S., Strong, C., Raphael, M., Duarte, A., and Fitzgerald, K. 2022. *Marbled murrelet effectiveness monitoring, Northwest Forest Plan: At-sea Monitoring - 2021 summary report*. 25 p.

Prisley, S. and Verschuyl, J. 2018. NCASI Technical Analysis of Recent Trends in Forest Growth and Harvest within 50 Miles of the Pacific Ocean, Oregon. NCASI memo to Oregon Department of Fish and Wildlife.

Rivers, J., Guerrero, J., Brodeur, R., Krutzikowsky, G., Adrean, L., Heppell, S., Jacobson, K., Milligan, K., Nelson, S., Roby, D., Sydeman, W., Torres, L.G., and Barth, J.A. 2022. Critical Research Needs for Forage Fish within Inner Shelf Marine Ecosystems. *Fisheries* 47:213-221.

Sydeman, W., Santora, J., Thompson, S., Marinovic, B., and Di Lorenzo, E. 2013. Increasing variance in North Pacific climate relates to unprecedented ecosystem variability off California. *Global Change Biology* 19:1662-1675.USDA (U.S. Department of Agriculture) Forest Service and BLM (Bureau of Land Management). 1994a. Final supplemental environmental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. USDA Forest Service, Portland, Oregon, and BLM, Moscow, Idaho.