Northwest Science Forum

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Marbled Murrelets *Have* Declined in Alaska

In the last issue of *Northwest Science,* Hayward and Iverson ("Long-Term Trends in Marbled Murrelets in Southeast Alaska Based on Christmas Bird Counts") failed to mention other evidence for 40-75% declines in murrelet populations, or discuss implications of a climate regime shift that has reduced populations of seabirds in Alaska, or present any useful information on the status of old-growth breeding habitat for murrelets. They examined Christmas Bird Count (CBC) data from Southeast Alaska, and concluded there is no evidence for declines in populations. They suggested that our (Piatt and Naslund 1995) previous analysis of CBC data for murrelets was erroneous, and suggested that *"the disparity between our conclusions ... invites explanation"*.

Invitation accepted. In the following, I will show that there was no disparity in conclusions, that Hayward and Iverson mis-represented our conclusions and they conducted a highly selective review of evidence for murrelet population changes in Alaska. The result was a paper that was inaccurate, incomplete, out-of-date, mis-leading and of little service to the readers of *Northwest Science* who might have read their article hoping to gain some new insight on the status of marbled murrelets in Alaska.

Piatt and Naslund (1995) reviewed information available at the time on the abundance, distribution and population status of marbled murrelets in Alaska. With regard to population trends, we stated that *"there are few quantitative data to assess population trends... We analyzed 20 years (1972-1991) of Christmas Bird Count (CBC) data in the northern Gulf of Alaska (fig. 7). Totals for each year were calculated as the sum of all murrelets seen on CBC's in Sitka, Juneau, Glacier Bay, Cordova, and Kodiak Island. We could not take the average of counts among sites (n=5) because of missing data... There was considerable inter-annual variation in total numbers, which we smoothed by taking 5-year running averages of the annual data (fig. 7). Unsmoothed data were extremely variable, and did not reveal a statistically significant trend. However, the smoothed data suggest a steady decline in abundance of about 50 percent from the early 1970's to the early 1990's."*

Thus, we clearly stated that the trend was not statistically significant and that the raw annual counts were highly variable. This is exactly the same conclusion reached by Hayward and Iverson after conducting a *"battery of statistical tests"*. Where then is the disparity? We believed that in the absence of statistical power, due largely to the extreme annual variability, that the smoothed data might still be indicating a real biological trend— a conclusion not unwarranted for the data

we considered at the time (1972-1991 only). Indeed, Hayward and Iverson themselves concluded that *"Our failure to detect a decline does not indicate that a decline has not occurred"*.

Hayward and Iverson further imply that our analysis was in several ways inadequate and at odds with their analysis. Given that we both agree the CBC trends are not statistically significant, it may be moot, but some differences deserve better explanation than those provided by Hayward and Iverson. Firstly, we analyzed data between 1972 and 1991— the latest year of data available to us at the time of our analysis. Hayward and Iverson included data in their analyses from 1992 and 1993— which contain extraordinarily high counts (see their Table 1) that would obliterate any trend: significant or otherwise. These counts, and later high counts in 1994-1996 beg explanation (see below). Secondly, Hayward and Iverson imply that their analysis is more robust because they examined data from seven sites in Southeast Alaska, while Piatt and Naslund only examined *"CBC data from a limited number of sites along the Alaska Coast"*. In fact, we deliberately chose sites with long-term data and substantial winter populations of murrelets. It is still not clear to us how analysis of data from Ketchikan (with four counts between 1972 and 1991) or Mitkof (5 counts), or Haines (11/15 zero counts from 1972-1991) would have told us anything useful about murrelets in Alaska. Thirdly, we retained missing counts in our analysis (16 out of 100 possible counts), and concluded that since most (11) of these were from the first decade (1972-1980), their absence in our analysis would tend to underestimate a downward trend, if any. Hayward and Iverson chose to fill in missing cells by taking running averages. Thus, while Hayward and Iverson imply that we evaluated trends only after we smoothed the data— the opposite is in fact true: We statistically evaluated unsmoothed, raw data while Hayward and Iverson statistically evaluated interpolated data.

The attention to details of how CBC data were analyzed by ourselves and by Hayward and Iverson distracts from the main point of concern: Have marbled murrelet populations declined in Alaska? While professing to address this point, Hayward and Iverson provide a dismal review of relevant information. From our paper, it bears repeating that compelling evidence for population change is provided by boat surveys conducted in Prince William Sound between 1972/73 and 1989/90/91: *"Based on randomly selected transects censused throughout the entire Sound, and on surveys conducted in both winter and summer, populations of* Brachyramphus *murrelets apparently declined by 67-73 percent between the early 1970's and late 1980's. Surveys in all years were conducted using similar protocols, populations estimates were relatively precise (±37-47 percent in winter, ±16-32 percent in summer), and declines observed on surveys conducted in summer were highly significant ($P<0.01$; Klosiewski and Laing 1994). Declines observed for murrelets were paralleled by population declines in 15 other marine bird species as well."*

For reasons unclear to me, Hayward and Iverson chose to focus instead on a paper by Murphy et al. (1997) which reported no change in murrelet populations in Prince William Sound (PWS) between 1984/85 versus 1989/90. Hayward and Iverson briefly mention the discrepancy between Murphy et al. (1997) and Klosiewski and Laing (1994), and imply that the difference in findings occurred simply because they *"used different methods and sampled different portions of Prince William Sound"*. How different? Murphy et al. conducted surveys in 10 bays around one island in PWS, and compared their results to a previous study (with one-time counts) that used different survey methods. As noted above, Klosiewski and Laing's (1994) surveys were statistically rigorous, covered the entire Sound, used exactly the same transects and methods employed 20 years previously on three complete replicate surveys of the entire Sound. More importantly, Murphy et al. could only examine trends over a 5-7 year period, while Klosiewski and Laing's data span nearly 20 years— notably the same period covered by the Christmas Bird Count data we analyzed (1972-1991). Why would Hayward and Iverson choose to dismiss and ignore results of the superior study?

In the same volume in which our paper appeared, Burger (1995) summarized evidence for population changes in marbled murrelets in British Columbia. Whereas CBC data provided no clear indication of trend (Rodway et al. 1992), three different boat-based studies *"are consistent in showing a significant decline in the densities of Marbled Murrelets in Clayoquot and Barkley*

sounds." Measured declines ranged between 40-75% among studies and years of comparison (Burger 1995).

Further, at the time of writing our paper, there was considerable evidence that murrelet and other seabird populations had been negatively influenced by changes in their marine environment. Hayward and Iverson state only that *"changes in the marine ecosystem in the Gulf of Alaska are purported to have reduced availability and biomass of important prey fish (Piatt and Anderson in press, as cited in Piatt and Naslund 1995)."* Apparently Hayward and Iverson have been too busy to examine the actual paper (Piatt and Anderson 1996)— preferring instead to suggest that the *"purported"* changes had no effect *"if marbled murrelet populations are not declining in response to these changes"*— a circular argument at best. In fact, ecosystem-wide changes in the Gulf of Alaska may have had a profound effect on murrelets; potentially more important than all other effects combined.

Changes in forage fish availability resulted in a dramatic change in diets of marbled murrelets from fatty species such as capelin during the 1970's to low-energy forage such as juvenile pollock during the 1980's and 1990's (Piatt and Anderson 1996, Anderson et al. 1997, Bechtol 1997, Van Pelt and Piatt 1997). Similar dramatic changes in diets of other piscivorus seabirds including murres, puffins and kittiwakes were also observed. Associated with these diet changes was a marked reduction in productivity and population size of many seabird species in the Gulf of Alaska— noted by Klosiewski and Laing in their pelagic surveys in Prince William Sound, and in studies of colonial species at their rookeries (Piatt and Anderson 1996). For example, Common murre populations declined at 15 of 16 major colonies in the Gulf of Alaska between the 1970's and 1990's, and by 40% overall (Piatt and Anderson 1996). The change in forage fish availability was associated with a marked change in ocean climate— which apparently had dramatic effects on the entire Gulf of Alaska ecosystem— including phytoplankton, zooplankton, forage fish, groundfish, salmon, marine birds and marine mammals (see reviews by Francis et al. 1998 and McGowan et al. 1998). The effects of this change in climate and food base were so pervasive, it would be extraordinary if marbled murrelets were *not* affected!

Thus, Hayward and Iverson's statements that *"a majority of the evidence leading to the inference by Piatt and Naslund (1995) that murrelets had declined by 50% in Alaska came from CBC data"* and *"It should be emphasized that we focused on CBC counts because they represent the only long-term data for this population and counts were used as the primary empirical basis for the estimate of a 50% decline in murrelets in Alaska"* are demonstrably false and misleading. The best 'empirical evidence' available suggests that marbled murrelet populations in the northern Gulf of Alaska *declined by almost 75%* and in British Columbia *by 40-75%*. A compelling body of 'empirical evidence' suggests that a climate regime shift in the Gulf of Alaska affected the entire marine ecosystem. Thus, the CBC data on murrelets should be viewed at best as a small piece of the puzzle. We were, in fact, conservative in suggesting that Alaska populations had declined by only 50%.

Hayward and Iverson also downplay concerns we and others have raised over the disappearance of marbled murrelet breeding habitat in Alaska. It is revealing of their intent when the authors state that *"Harvest of productive virgin forest in Southeast Alaska has removed 182,250 ha of old forest (or about 8% of the commercially valuable timber land) on the Tongass National Forest since 1909 (USDA Forest Service 1991); this land area does not include the significant harvest of old forest from non-federal land."* This is an extremely misleading attempt to skate around an important issue by semantics. It is now well-established that Marbled Murrelets preferentially nest in "high-volume old-growth" forest stands in Alaska (Kuletz et al. 1995a,b, Naslund et al. 1995). Further, nest-sites are usually located in the largest trees within high-volume old-growth stands (Naslund et al. 1995). Whereas all high-volume old growth may be classified as 'virgin' or 'commercially valuable', the converse is not true.

The real question is: What proportion of high-volume old-growth forest remains in Alaska? According to the Tongass Land Management Plan referred to by Hayward and Iverson, *more than 50% of high-volume old growth* in the Tongass was already gone at the time it was written. Further, as noted in Piatt and Naslund *"Substantial areas of potential nesting habitat have also been logged on state and private lands elsewhere in Alaska, principally in Prince William Sound and*

the Kodiak Archipelago... Privately-owned forests, much of which were selected or granted because of their old-growth holdings, are found in all areas of known importance to murrelets. Clearcutting is planned or underway on all privately-owned forests (Mendenhall 1992)." This is less true for Southeast Alaska, because most of the privately-owned high volume old growth has *already* been cut. A more recent threat to murrelets in southcentral Alaska has been the devastation of 3 million acres of mature forests by spruce bark beetles. In Kachemak Bay, for example, more than 90% of high-volume old-growth has been destroyed, with an apparent sharp reduction in murrelet productivity (Kuletz et al. 1997).

Finally, the most interesting issue raised by Hayward and Iverson's paper, but not addressed by them, is the marked increase in murrelet numbers on Southeast Alaska CBC counts during the 1992-1996 period. At least two hypotheses can be advanced to explain these observations. First, it may represent an actual increase in murrelet populations. However, given their low productivity (Beissinger 1995), and data discussed above, it seems unlikely that this rapid increase could be accounted for by population growth alone. Secondly, it may represent a re-distribution of winter populations. Although post-breeding dispersal patterns are poorly known (Piatt and Naslund 1995), it appears that most of the northern Gulf populations disperse southward during winter. Water temperatures in the Gulf of Alaska during the winters of 1990-1997 have all been anomalously warm (Institute of Marine Science, Univ. of Alaska, Fairbanks), perhaps because of persistent El Niño-like conditions in the North Pacific (Trenberth and Hoar 1995). Larger numbers of murrelets may be overwintering in northern waters in recent years, leading to unusually high counts on CBC's. Unusually large nearshore aggregations of common murres have also been noted during recent warm winters (Piatt and Van Pelt 1997, J.F. Piatt, Unpubl. data).

In conclusion, we are inclined to agree with Hayward and Iverson (and Burger 1995) that CBC data may not lend itself to statistical evaluation of population trends in marbled murrelets. However, a wealth of other empirical data suggests that marbled murrelets *have* declined substantially throughout their range, and populations in Alaska *are* threatened by a host of factors including loss of old-growth breeding habitat by logging and spruce bark beetles, oil pollution, gill-netting, and changes in food supply.

Literature Cited

Anderson, P.J., J.E. Blackburn, and B.A. Johnson. 1997. Declines of Forage Species in the Gulf of Alaska, 1972-95, as Indicator of Regime Shift. *In* Baxter, B. S. (Ed.) 1997. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems November 13-16, 1996, Anchorage, Alaska. University of Alaska, Alaska Sea Grant Rep., 97-01. Pp. 531-543.

Bechtol, W.R. 1997. Changes in forage fish populations in Kachemak Bay, Alaska, 1976-1995. *In* Baxter, B.S. (Ed.) 1997. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems November 13-16, 1996, Anchorage, Alaska. University of Alaska Sea Grant Rep., 97-01. Pp. 441-455.

Beissinger, S.R. 1995. Population trends of the Marbled Murrelet projected from demographic analyses. *In* Ralph, C.J., G. Hunt, M. Raphael, and J.F. Piatt (Eds.). Ecology and Conservation of the Marbled Murrelet. General Technical Report PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, US Department of Agriculture. 420 pp. Pp. 385-393.

Burger, A.E. 1995. Marine distribution, abundance, and habitats of Marbled Murrelets in British Columbia. *In* Ralph, C.J., G. Hunt, M. Raphael, and J.F. Piatt (Eds.). Ecology and Conservation of the Marbled Murrelet. General Technical Report PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, US Department of Agriculture. Pp. 295-312.

Francis, R.C., S.R. Hare, A.B. Hollowed, and W.S. Wooster. 1998. Effects of interdecadal climate variability on the oceanic ecosystems of the NE Pacific. Fish. Oceanogr. 7:1-21.

Klosiewski, S.P. and K.K. Laing. 1994. Marine bird populations of Prince William Sound, Alaska, before and after the *Exxon Valdez* oil spill. *Exxon Valdez* Oil Spill State and Federal Natural Resources Damage Assessment Final Report (available from the Oil Spill Public Information Office, 645 G. St., Anchorage AK 99501).

Kuletz, K.J., E. Holsten, J.F. Piatt and K. Oakley. 1997. Spruce Beetle: A serious threat to Marbled Murrelets in Alaska? Pac. Seabirds 24:28.

Kuletz, K.J., D.K. Marks, N.L. Naslund, and M.B. Cody. 1995a. Marbled Murrelet activity relative to forest characteristics in the Naked Island area, Prince William Sound, Alaska. NW Nat. 76:4-11.

Kuletz, K.J., D.K. Marks, N.L. Naslund, N.J. Goodson, and M.B. Cody. 1995b. Inland habitat suitability for the Marbled Murrelet in South central Alaska. *In* Ralph, C.J., G. Hunt, M. Raphael, and J.F. Piatt (Eds.). Ecology and Conservation of the Marbled Murrelet. General Technical Report PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service. US Department of Agriculture. Pp. 141-150.

McGowan, J.A., D.R. Cayan, and L.M. Dorman. 1998. Climate-ocean variability and ecosystem response in the Northeast Pacific. Science 281:210-217.

Murphy, S.M., R.H. Day, J.A. Wiens, and K.R. Parker. 1997. Effects of the *Exxon Valdez* oil spill on birds: Comparisons of pre- and post-spill surveys in Prince William Sound, Alaska. Condor 99:299-313.

Naslund, N.L., K.J. Kuletz, M.B. Cody, and D.K. Marks. 1995. Tree and habitat characteristics and reproductive success at Marbled Murrelet tree nests in Alaska. NW Nat. 76:12-25.

Piatt, J.F. and N.L. Naslund. 1995. Abundance, distribution and population status of Marbled Murrelets in Alaska. *In* Ralph, C.J., G. Hunt, M. Raphael, and J.F. Piatt (Eds.). Ecology and Conservation of the Marbled Murrelet. General Technical Report PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, US Department of Agriculture. Pp. 285-294.

Piatt, J.F., and P. J. Anderson. 1996. Response of Common Murres to the *Exxon Valdez* oil spill and long-term changes in the Gulf of Alaska marine ecosystem. *In* *Exxon Valdez* Oil Spill Symposium Proceedings. Rice, S. D., R. B. Spies, D. A. Wolfe and B. A. Wright (Eds.). American Fisheries Society Symposium 18, Bethesda, Maryland. NMFS-AFSC-69. Pp. 720-737.

Piatt, J.F., and T.I. van Pelt. 1997. Mass-mortality of guillemots (*Uria aalge*) in the Gulf of Alaska in 1993. Mar. Poll. Bull. 34:656-662.

Rodway, M.S., H.R. Carter, S.G. Sealy, and R.W. Campbell. 1992. Status of the Marbled Murrelet in British Columbia. Pp. 17-41 *in* Carter, H.C., and M.L. Morrison (Eds.), Status and Conservation of the Marbled Murrelet in North America. Proc. West. Found. Vert. Zool. 5(1).

Trenberth, K.E. and T.J. Hoar. 1995. The 1990-1995 El Niño-Southern Oscillation event: Longest on record. Geophys. Res. Lett. 23:57-60.

Van Pelt, T., J.F. Piatt, B.K. Lance, and D.D. Roby. 1997. Proximate composition and energy density of some North Pacific forage fishes. Comp. Biochem. Physiol. 118(A): 1393-1398.