**Gregory D. Hayward,** Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming 82071

and

**George C. Iverson,** Alaska Region, U.S.D.A. Forest Service, P. O. Box 21628, Juneau, Alaska 99802-1628

# The Challenge of Evaluating Population Trend for Conservation Management: Marbled Murrelets in Alaska

In 1995, while working on issues regarding management of forest lands in Southeast Alaska, we were alarmed to read that marbled murrelets (*Brachyramphus marmoratus*) throughout Alaska may have experienced a steady 50% decline in abundance of over the previous two decades (Piatt and Naslund 1995). We were alarmed because a 50% decline in a seabird population is a dramatic change; a condition demanding attention. In a conservation context, management initiated in response to this information could result in consequences for the murrelet and other species. Therefore, we asked whether Christmas Bird Count (CBC) data, the main quantitative trend information available for Alaska, suggested a similar decline for one of the states' three main areas of murrelet concentration, Southeast Alaska.

In Hayward and Iverson (1998) we examined CBC for evidence regarding the status of marbled murrelets in Southeast Alaska. The clear goal of our paper was to: examine CBC data for evidence of trend in murrelet populations in Southeast Alaska. We emphasized the limitations of CBC data to examine trend and stressed that CBC represents only one type of evidence to evaluate population status. Unfortunately, CBC data were the only long-term quantitative data on trend for murrelets in this sub-region. Ultimately, when evaluating the results of our analysis, we emphasized that "our failure to detect a decline does not indicate that a decline has not occurred, only that CBC data do not support such a conclusion." (Hayward and Iverson 1998:170).

Piatt has responded to our manuscript with a strong rebuttal (Piatt 1998). In May, 1995, we twice sent copies of our draft to Piatt with a request for dialogue. It is sad that it took over 3 years and publication of our manuscript for him to accept our invitations. Here we respond to Piatt's (1998) comments.

As many of the points raised by Piatt (1998) are clearly addressed in our original manuscript, we do not respond to them point by point. Instead, we begin by re-emphasizing the goal of our paper which Piatt (1998) mis-states. Then, we use two examples to highlight inconsistencies and errors in Piatt's rejoinder. We address questions regarding quantitative evidence for a decline and the accusation that we mislead readers regarding the potential impact of declining old-growth forest in the region. Finally, we address the point Piatt raises at the end of his rejoinder — hypotheses to explain the pattern of counts at the end of the timeline illustrated in Hayward and Iverson (1998:Table 1).

## Goal of Hayward and Iverson (1998)

Throughout his rebuttal Piatt (1998) implies that we sought to evaluate the status of marbled murrelets in Alaska, suggesting at one point that "Hayward and Iverson provide a dismal review of relevant information." To the contrary, we repeatedly expressed our limited goal — to examine the only long-term data on murrelet population trend in Southeast Alaska. After presenting the results of our analysis, we placed the conclusions in perspective by comparing our analyses with the few other quantitative data from Alaska. We agreed with Piatt and Naslund (1995) that information on food resources, nesting habitat, and threats from gill netting and oil pollution all provided evidence that murrelet populations may be declining (see Hayward and Iverson 1998:170). We also emphasized the vulnerability of this species due to its life history. However, we questioned the conclusions reached by Piatt and Naslund (1995:293-294) regarding quantitative evidence for population decline based on their description of data analyses and inconsistencies between the evidence presented and inferences made.

## Quantitative Evidence of Murrelet Trend

A major theme of Piatt's response is that "Marbled Murrelets Have Declined in Alaska" (Piatt 1998:TITLE PAGE) and that we overlooked the compelling evidence for the downward trend. Murrelets may have declined (Hayward and Iverson 1998), but is there sound quantitative evidence to support this population trend? In his rejoinder, Piatt supports the argument for a population decline with 2 quantitative analyses of trend from Alaska: 1) data from CBC presented in Piatt and Naslund (1995) and, 2) data from surveys in Prince William Sound first presented in Klosiewski and Laing (1994). The other quantitative assessment of population abundance presented by Piatt comes from surveys along the southern coast of British Columbia. Below we address several points Piatt makes regarding the evidence from Alaska. We do not address the studies from southern British Columbia because Burger (1995:306) notes potential difficulties interpreting these results and Wiens and Parker (1995) have thoroughly discussed the problems evaluating trend when only a single historical count is available. British Columbia surveys also represent counts geographically associated with northern Washington, where murrelets are formally recognized as threatened under the Endangered Species Act, rather than Southeast Alaska where they are not listed.

Referring to his analysis of CBC data (Piatt and Naslund 1995), Piatt (1998) defends his earlier conclusion that the visual pattern provides evidence of a steady decline in murrelet abundance. He indicates 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)."(Piatt 1998:4th paragraph). Unfortunately, this conclusion *is unwarranted* for several substantial reasons. Piatt and Naslund (1995) based their conclusion on patterns observed in smoothed data AFTER performing a nonsignificant regression on the raw data (and not presenting the raw data for review). As suggested by J. Baldwin (Research Statistician, U. S. Forest Service, Pacific Southwest Station, pers. comm.) this approach has important consequences:

1) Smoothing does not add any new information to a linear regression or allow a regression more capacity to see through the variability in the data. Rather, smoothing introduces correlations among observations (violating a key assumption of regression), *and trends can frequently appear where none truly exist.* Simulation results suggest that Type I error rates increase from a predefined 5% to over 40%, due to smoothing, when applied to the CBC counts examined by Piatt and Naslund (1995). Therefore, even a visual trend may be an artifact of smoothing.

2) Any assessment of trend in smoothed data must account for the introduced error structure in the smoothed data (Barker and Sauer 1992). In this case, smoothing increases the variance of the standard slope estimate.

3) Suggesting a "steady decline" is inappropriate when no statistical test is performed on the smoothed data, considering the lack of significance with the raw data. The conclusion that a trend exists, implies that a true relationship exists between abundance and time (the nonsignificant relationship explored in regression).

4) And perhaps most important, when the reader looks at the potentially introduced trends (as in Figure 7, Piatt and Naslund 1995), the reader does not have the information to account for the correlation structure in the data.

In summary, smoothing can introduce 'false trends' at a high rate and neither Piatt and Naslund (1995) nor Piatt (1998) addressed this critical concern. To the contrary, they imply that the smoothed data presents the best representation of reality.

The second quantitative evidence Piatt (1998) uses to conclude that murrelets have declined comes from boat surveys conducted in Prince William Sound before and after the *Exxon Valdez* oil spill (Klosiewski and Laing 1994). This study found a marked decline in murrelet counts after the oil spill compared with a count 20 years earlier. Conclusions by Klosiewski and Laing (1994) differed from those of Murphy et al. (1997) regarding temporal patterns of murrelet abundance and we contrasted the two investigations in our paper (Hayward and Iverson 1998:177).

Unfortunately, Klosiewski and Laing (1994) is not a refereed paper available in the primary literature. Furthermore, biologists familiar with the surveys (pre- and post-spill) used in the Klosiewski and Laing (1994) analysis, question the comparability of survey methods (R. H. Day and S. M. Murphy, ABR Inc., Fairbanks, AK, pers.

comm.). Piatt's analysis also fails to account for the potential influence of observer bias, an important consideration in any assessment of trend (Thompson et al. 1998). Our paper did not state that either Murphy at al. (1997) or Klosiewski and Laing (1994) provided more compelling evidence regarding murrelet trend. In evaluating evidence for trend in murrelet populations in Alaska, however, the contrasting conclusions of these two papers must be considered. Piatt (1998) chooses to ignore the peer reviewed publication (Murphy at al. 1997) in evaluating the strength of evidence for trend, while we do not. In summary, the second piece of quantitative evidence is not as compelling as Piatt (1998) contends.

## Murrelet Relationship with Old-growth Forest

Piatt (1998) openly questioned our treatment of information on the status of old-growth forests in Southeast Alaska. In Hayward and Iverson (1998) we emphasize that several resources important to marbled murrelets are currently experiencing negative trends. We noted the decline in high volume old forest in our introduction and declines in all classes of old-growth in our discussion. Contrary to our intent, Piatt (1998) suggests we "downplay concerns...over the disappearance of marbled murrelet breeding habitat". In doing so, however, Piatt (1998) seriously misrepresents current scientific evidence regarding relationships between murrelets and forest habitats.

Piatt (1998) indicates that "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)." Piatt (1998) misrepresents this information in two important ways. First, the cited studies of nesting habitat relationships did not address 'preference'. Habitat preference implies choice of one habitat over others and cannot be established in descriptive studies of use (Peek 1986:82-83). The studies cited by Piatt (1998) generally documented habitat use (Naslund et al 1995) or for some variables, they compared levels of use (Kuletz 1995a). More important, however, Kuletz et al. (1995a:9) emphasized that evidence for nesting behaviors was greatest, *not in high volume old forest* as suggested by Piatt (1998), but in "moderate volume classes". Also, of the 33 murrelet nests that have been located in Alaska, only 19 (57%) were in old growth trees with the remainder being located on the ground; as were 2 of the 6 nests located in Southeast Alaska (DeGange 1996). We suggest that murrelet nesting habitat relationships are NOT "well established" for Alaska and deserve further investigation, particularly to determine whether nesting habitat is indeed a limiting factor to murrelet populations.

## High CBC Counts During 1992-1996

Piatt's (1998) final argument regards our failure to explain the high murrelet numbers in CBC recorded in Southeast Alaska from 1992-1996. We see little reason to focus on the last quarter of the time series to explain the long-term temporal pattern. First, we question whether a "marked increase in murrelet numbers" is consistent across the 7 CBC sites in Southeast Alaska. An exploratory analysis of the 26 year time-series (regression and examination of mean counts) failed to demonstrate a consistent, marked-increase in numbers across sites. More important, however, we suggest that any attempt to explain pattern in the counts should address the entire time series. Focusing on the last 5 years suggests that 'explaining' the recent counts is the objective rather than understanding the factors influencing CBC overall. When Piatt and Naslund (1995) used CBC as evidence for a decline, they implied that CBC data reflect murrelet abundance. Interestingly, alternative explanations for the pattern in CBC were not offered in the initial conclusion of a 50% decline but Piatt (1998) explores alternatives when considering increasing counts.

Our decision to not focus on the high counts during the past 5 years was consistent with our objectives. We were concerned with detecting any actual decrease in abundance which is why we used one-tailed tests to increase statistical power to detect declines. Had we focused our attention toward potential increases in abundance, we might have noted that recent estimates of murrelet abundance throughout Alaska (Agler et al. 1998) more than double the estimates reported in Piatt and Naslund (1995).

## Broader Message for Conservation Management

Although Piatt (1998) suggests that Hayward and Iverson (1998) did little service for readers of

*Northwest Science*, we stand by the conclusions reached in our paper. Efficient conservation management demands close scrutiny of population trends. Some threshold of evidence is necessary to prompt management action. It is regretful that some biologists are not interested in throwing multiple bricks of data at management hypotheses as suggested by Murphy and Noon (1991). Repeated testing of hypotheses and failure to reject them strengthens conclusions and increases scientific credibility.

Our results do not unequivocally establish that marbled murrelets in Southeast Alaska have not declined, but CBC data from the region do not provide evidence to support Piatt's (1998) conclusion that murrelets have declined substantially throughout their range in Alaska. We repeat our agreement with Piatt and Naslund (1995) that resource conditions, particularly the loss of old-growth forest nesting habitat, and changes in food resources, can pose a significant threat to murrelet populations.

Clearly we perceive murrelet trends differently than Piatt. Where he sees unequivocal evidence of a substantial decline, we suggest, as did DeGange (1996), that the data are weak and the jury is still out. Our differing conclusions have implications for management of marbled murrelets AND other sensitive species. Establishing conservation priorities depends upon evaluation of evidence regarding the status of species or ecological systems. Early identification of conservation problems has been recognized as an important step to improve management effectiveness and efficiency (Tear 1993); failure to detect a decline and to discern the cause is a critical conservation error. However, allocation of limited resources toward a perceived higher priority species, precludes use of those resources elsewhere. Therefore critical evaluation of evidence regarding conservation status is necessary to avoid serious errors in conservation planning; errors conservation biologists should seek to avoid.

The tradeoffs and shadow costs of conservation decisions have been recognized by others (e.g. Brown and Shogren 1998). Furthermore, Caughley and Sinclair (1994) emphasize the importance of identifying population trend and the specific deterministic factors influencing population declines as part of an effective conservation plan. Sorting among possible limiting factors is especially important for murrelet conservation because murrelets interact with both the marine and terrestrial system. We suggest that an enriched discussion of the species' status and relationship with resources may improve conservation efforts. For instance, if the decline in murrelet numbers illustrated in the smoothed data examined by Piatt and Naslund (1995:294) is real, then it may suggest a very different set of causal factors than the "steady decline" they describe (Piatt and Naslund 1995:293). The step decrease illustrated in Figure 7 would point toward a catastrophic change in resources (such as food resources) rather than the more gradual decline expected from change in other habitat conditions. Effective management of marbled murrelets depends on our ability to examine alternative hypotheses (Chamberlain 1965) regarding population trend and to discover the cause of documented population declines.

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