Chapter 13

Interannual Differences in Detections of Marbled Murrelets in Some Inland California Stands

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Abstract: I compared the mean level of detections of Marbled Murrelets by month over five years at three inland sites in northern California. These areas all have relatively high levels of detections. There were no significant differences in mean detection levels year to year at any site, and for any month with the exception of April at one site. This lack of evidence for significant interannual variation in the number of detections of birds suggests that data from any one of the years would have been sufficient to detect occupancy of these stands by Marbled Murrelets. Caution must be used in applying this result, as interannual variation in detection rates may be greater at sites with relatively few birds, and only three sites were investigated in this study.

Most species of birds vary in the proportion of birds breeding among years, with profound effects upon the demography of the species. In the case of the Marbled Murrelet, it would be useful to know the proportion of the population breeding. This knowledge would help determine if surveys taken in different years are comparable for purposes of determining the occupancy status of stands proposed for timber harvest. Changes in the number of murrelets detected in a stand during the breeding season are assumed to be related to changes in the number actually breeding in the stand. In this study, I compared the detection rates of murrelets at three sites for evidence of year-to-year variation. Finding a significant difference would indicate that surveys in any one year might not detect birds in a stand that would have had birds in another year, especially a stand with a relatively low detection rate. Although detection rates are not equivalent to numbers of birds actually breeding in a stand (Paton, this volume), I make the assumption that they are analogous.

Methods

I examined the among-year variations for three areas with moderate and high detection levels (*table 1*) in northern California: Lost Man Creek, in Redwood National Park, Humboldt County; James Irvine Trail, in Prairie Creek Redwoods State Park, Humboldt County; and Redwood Experimental Forest, near Klamath, Del Norte County. These three survey sites all are located within large contiguous stands of old-growth redwood in a natural reserve and parks.

Data used in this analysis were total number of detections (both audio and visual) per survey for each study site for the years 1989–1993. Surveys at these sites were conducted according to Marbled Murrelet survey protocol (Ralph and others 1993). Only data from April through August of each year were used, the recommended murrelet survey period in the protocol.

Data were analyzed using one-way ANOVAs ($\alpha < 0.05$), for each month and year with surveys (*table 1*). The number of birds detected in a morning's survey were *log (count + 1)* transformed to approximate normality of the distribution of detections.

Results

The detection rate was highest at Lost Man Creek with monthly means ranging up to 240 detections in July 1990 (*table 1*). James Irvine Trail had fewer detections with a maximum average of 146 in July 1990. Experimental Forest had the lowest rate, with a maximum average detection rate of 111 in July 1993.

I first compared each site separately by month. An inspection of the average number of detections of murrelets (*table 1*) shows that months in a given year, even with only a few samples, were generally very similar to the averages for that month in the other years with more robust samples. Monthly means were not significantly different at any site, with the exception of April at Lost Man Creek ($P = 0.004$). This month had a larger range of mean detections than in other months or at other sites. Comparing among years at Lost Man Creek in April, I found that 1990 and 1991 were similar, but that 1989 and 1992 were both different from each other, as well as from other years (Ryan-Einot-Gabriel-Welsch multiple comparison test).

Discussion

Though only one month was significantly different over a five-year period at three sites, it is quite likely that further data would show that detections are lower in certain years at specific sites.

Particularly unseasonable weather during the breeding season could impact numbers of inland detections at specific sites. Fluctuations of prey fish populations may also be a factor in inland murrelet detection levels. Warmer ocean temperatures associated with an El Niño event are responsible for changing local and global weather cycles that affect many species of marine animals, including nesting seabirds and their food (Ainley and Sanger 1979). The ocean temperature events may also affect Marbled Murrelet prey (Burkett, this volume), although this has not been documented. The effects of warmer offshore water

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Table 1—Mean level of detections of Marbled Murrelets by month over five years at three sites in Northern California, and one-way ANOVA results

Location	1989			1990			1991			1992			1993				
Month	Mean[1]	*s.e.*[2]	*n*[3]	Mean	*s.e.*	*n*	Mean	*s.e.*	*n*	Mean	*s.e.*	*n*	Mean	*s.e.*	*n*	*F*	*P*
Lost Man Creek																	
April	36.8	7.9	6	83.6	10.3	9	91.0	32.0	2	113.0	9.6	9	63.0	–	1	6.09	0.004
May	115.7	11.9	3	104.8	5.1	9	109.7	13.0	6	137.1	19.0	15	76.8	6.8	4	0.92	0.465
June	124.8	22.0	4	147.8	34.0	9	129.8	14.0	4	203.0	31.0	2	92.1	21.0	8	1.30	0.296
July	222.7	50.4	3	239.8	26.5	8	193.1	19.2	7	109.0	–	1	174.0	46.7	3	1.91	0.153
August	5.0	–	1	94.4	31.3	6	100.4	63.5	3	22.0	18.5	2	60.0	37.6	3	0.81	0.519
James Irvine Trail																	
April	34.0	10.0	2	38.4	6.9	7	35.8	3.4	4	–	–	–	–	–	–	0.04	0.962
May	63.8	14.0	8	52.5	11.1	8	–	–	–	–	–	–	24.0	–	1	1.47	0.262
June	68.3	11.1	8	51.4	8.2	5	54.4	11.4	3	–	–	–	43.0	5.2	4	0.85	0.486
July	117.0	10.4	3	146.4	25.3	8	89.0	–	1	137.0	34.2	3	109.5	17.4	4	0.42	0.744
August	53.0	34.0	2	35.2	17.7	5	0.3	56.0	2	3.5	3.5	2	33.0	30.2	4	1.32	0.326
Redwood Experimental Forest																	
April	21.0	–	1	27.8	7.8	4	–	–	–	–	–	–	–	–	–	–	–
May	34.4	7.3	5	16.5	5.5	2	–	–	–	–	–	–	49.0	–	1	–	–
June	24.0	6.5	4	42.0	8.4	3	–	–	–	–	–	–	37.8	4.1	4	1.69	0.245
July	58.5	1.6	4	77.0	30.3	4	–	–	–	84.0	27.2	4	111.0	36.9	4	0.49	0.697
August	14.0	6.1	4	20.4	24.0	3	–	–	–	0.0	–	1	38.0	29.5	3	0.04	0.962

[1] Mean level of detection
[2] Standard error
[3] Sample size = number of survey mornings

temperatures during an El Niño event may cause a reduction in murrelet breeding effort, and thus influence inland detection levels. The current El Niño has become the longest on record, beginning in early 1991, or perhaps even earlier.

All of the sites studied had relatively high murrelet activity, as compared to many sites elsewhere in the Pacific Northwest. This may have had an effect of moderating differences if social facilitation is a factor in levels of murrelet activity. However, we have no data at present to support such a supposition, although Shaughnessy (pers. comm.) and Nelson (pers. comm.) found differences between years when comparing murrelet use at a site. Also, there is some evidence that detections vary as a function of weather (Naslund and O'Donnell, this volume). For example, there are frequently more detections on foggy mornings. Thus, a year in which low detection rates would have been expected might instead have normal detection rates because of unusually foggy weather in that year. However, the amount of daily variation induced by clouds in our studies has been less than 20 percent (O'Donnell, pers. comm.).

The great variation between mornings at most sites might be the key to the lack of significant difference among years. However, the fact that the monthly average values were quite similar indicates that no differences exist.

I was unable to find any evidence that would suggest that the number of detections of birds was consistently lower or higher in any one of the five years. Therefore, results of inland surveys used to determine presence or absence of Marbled Murrelets in proposed timber harvest stands would likely have been valid in any of these years in this area of California. Caution must be used in applying these data to other sites and regions, however, as only three sites were surveyed, and the variance was large.

I suggest that we need continued monitoring of murrelets at established sites over several years, combined with careful quantification of the many influences on inland detection levels, to fully resolve the indications derived from this study. This effort would greatly increase our understanding of this bird and its use of inland habitats.

Acknowledgments

I am very grateful to the biologists who have worked in the early dawn over the years to put together this data set. Especially noteworthy are Sherri Miller, Brian O'Donnell, and Linda Long. I thank Robin Wachs for her excellent help in tabulating and analyzing these data. I also thank Jim Baldwin, Ann Buell, George Hunt, Debbie Kristan, Kim Nelson, Peter Paton, and Meg Shaughnessy for helpful comments on the manuscript.