2004 BIANNUAL REPORT

GAZOS CREEK MARBLED MURRELET MONITORING PROGRAM

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INTRODUCTION

This is a report of the 2003 and 2004 survey results obtained as part of the multi-year monitoring program of Marbled Murrelet (*Brachyramphus marmoratus*) use of Gazos Mountain Camp and the Gazos Creek Watershed in the central Santa Cruz Mountains. In 2003 only ground observer surveys were done, while in 2004, both ground observer surveys and radar surveys were done.

The monitoring program is funded by the Apex Houston Trustee Council and began in 1998 when the Council contributed money toward the purchase of Gazos Mountain Camp, a 110 acre parcel containing areas suitable for nesting by Marbled Murrelets. The Gazos Mountain Camp property was then purchased by the Sempervirens Fund and later transferred to the State Parks Department. It is now a part of Butano Redwoods State Park. The purpose of the monitoring program is to use radar to determine if the number of murrelets using Gazos Creek Canyon is increasing, decreasing, or remaining the same over time. A second goal, relying solely on volunteer effort that may or may not be realized, is to use ground observer surveys to determine whether or not occupied behaviors (and hence nesting) are continuing to occur at the Gazos Mountain Camp property. Funding for the multi-year radar monitoring program runs through the year 2008, at which time final results of the project will be made available.

Gazos Creek is located in the central, western Santa Cruz Mountains and discharges into the ocean at a point about midway between Santa Cruz and Half Moon Bay. Radar surveys were conducted at the Double Low Gazos site, about 2.0 kilometers upstream of the mouth of Gazos Creek. Ground observer surveys were conducted at Gazos Mountain Camp located at the end of pavement of Gazos Creek Road, about 4.2 kilometers upstream from the mouth of Gazos Creek. Survey stations are described in Singer and Hammer (2002, 2001, and 1999).

METHODS

Ground observer surveys were used to determine general murrelet detection levels and types of murrelet activities near the old-growth stand, while ornithological radar was used to develop a watershed-specific index of murrelet abundance that could be used to determine changes in murrelet use and total numbers over time (for example, see Cooper et al. 1999, Singer and Hamer 1999). The results will not be available until the end of the monitoring program.

Radar Surveys

Radar surveys were conducted using a modified marine radar system mounted onto a Teleelct T292 aerial bucket truck with a 29 foot vertical lift capacity. The hydraulic bucket unit was mounted on a 2000 GMC Heavy Duty 3500 truck. Specifications for the radar have been given previously (see Singer and Hamer, 2001). Radar surveys started 75 minutes before sunrise and ended 75 minutes after sunrise, and followed recommended procedures for conducting radar surveys in the appendix to the Pacific Seabird Group's "Methods for Surveying Marbled Murrelets in Forests" (Cooper and Hamer 2000).

The experimental design that would allow us to determine changes in murrelet use of the Gazos Creek Watershed was developed using the MONITOR and TRENDS population modeling software programs. The goal is to detect a 5% annual change in population size at a power of 0.80. Seven radar surveys from the Double Low Gazos station are conducted during each survey year with the first survey year having been done in year 2000. Surveys were conducted annually through 2002, and will continue on a biannual basis through 2008.

Ground Observer Surveys

Six ground observer protocol surveys were conducted each year during July in the lower meadow area of Gazos Mountain Camp, formerly known as the ballfield. This area was previously used as a ballfield, but is no longer used for sporting activities. All ground observer surveys were conducted according to the Pacific Seabird Group protocol that was in force when the project was initiated (PSG Marbled Murrelet Technical Committee, 1994).

RESULTS AND DISCUSSION

Radar Surveys

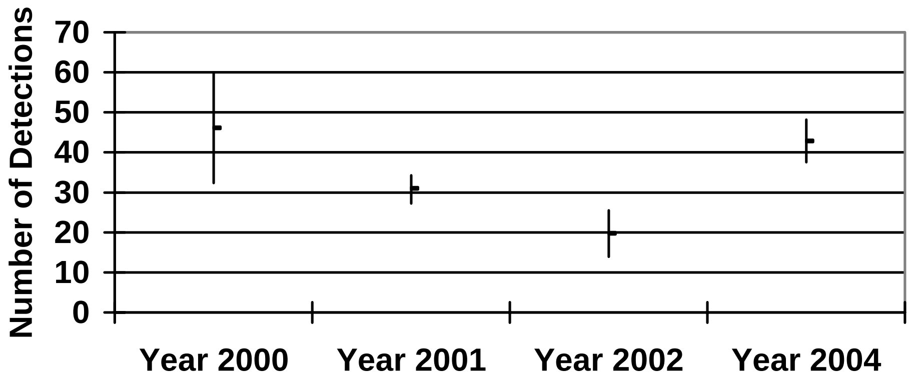
Seven radar surveys were conducted during July of 2004 at the Double Low Gazos site downstream of Gazos Mountain Camp. More murrelets were detected by radar in 2004 than in 2002, with a 7-day total of 300 detections in 2004 and 138 detections in 2002. It was interesting to note that the lowest day's total count in 2004 (35) was higher than the highest day's total count (27) in 2002. Results of the 2004 surveys are shown in Table 1 and compared with previous years in Table 2 and Figure 1. For a detection to be labeled as either “in-bound” or “out-bound”, the bird’s flight path had to be within 45 degrees of a line running along the long axis of the canyon. Detections labeled as “other” were of murrelets flying in other directions.

Table 1. Year 2004 results of radar surveys for murrelets at Double Low Gazos. Values for the mean (x), standard deviation (s.d.), and coefficient of variation (C.V.) are given in the bottom row.

Date	% Overcast	Total Number of Detections	In-bound Detections	Out-bound Detections	Other Detections
7/07/04	100	41	15	18	8
7/08/04	100	46	8	23	15
7/09/04	100	35	15	11	9
7/10/04	100	40	15	16	9
7/11/04	5	42	18	18	6
7/12/04	100	52	20	24	8
7/13/04	100	44	15	17	12
Totals		300	106	127	67
Mean		x = 42.86	x = 15.14	x = 18.14	x = 9.57
s.d.		s.d. = 5.31	s.d. = 3.71	s.d. = 4.38	s.d. = 2.99
C.V.		C.V.= 0.124	C.V. = 0.245	C.V. = 0.241	C.V. = 0.313

The 2004 radar total detection values ranged from 35 to 52, which contrasts with ranges from 2002 (11 – 27) and 2001 (27 – 36), but is comparable with the range found in 2000 (30 – 68).

Figure 1. Mean Number of Total Radar Detections



(Note: Error bars represent one standard deviation)

Table 2. Comparison of the totals, means, standard deviations, and coefficients of variation among 2000, 2001, 2002, and 2004 radar surveys at Double Low Gazos.

Detection Type	Parameter	2000	2001	2002	2004
All Detections	Total (all 7 days)	323	217	138	300
	Mean	46.14	31.00	19.71	42.86
	Standard Deviation	13.80	3.27	5.82	5.31
	Coefficient of Variation	0.299	0.105	0.295	0.124
In-bound Detections	Total (and % of All)	85 (26%)	52 (24%)	26 (19%)	106 (35%)
	Mean	12.14	7.43	3.71	15.14
	Standard Deviation	4.30	2.64	1.89	3.72
	Coefficient of Variation	0.353	0.354	0.509	0.245
Out-bound Detections	Total (and % of All)	144 (45%)	68 (31%)	65 (47%)	127 (42%)
	Mean	20.57	9.71	9.29	18.14
	Standard Deviation	10.24	5.25	4.86	4.38
	Coefficient of Variation	0.498	0.540	0.523	0.241
Other Detections	Total (and % of All)	94 (29%)	97 (45%)	47 (34%)	67 (22%)
	Mean	13.43	13.86	6.71	9.57
	Standard Deviation	7.32	8.59	2.98	2.99
	Coefficient of Variation	0.545	0.619	0.444	0.313

It should be noted that the lowest coefficient of variation is associated with the "All Detections" parameter each year, and that is the parameter we will be using to construct a population index.

It is known that the number of individuals flying inland varies from year to year due to factors other than population change (REF). This natural variation will tend to mask changes in population size and explains why this study must collect data over a many year period. In a two-year study, Peery et. al. (2004) placed radio-tags on 46 murrelets and found that, within their tagged sub-populations, non-breeders didn't fly inland as often as breeders, and that the proportion of non-breeders in the regional population varied from year to year. However, it is unclear to what extent the behavior of these birds was modified (or how it was modified) by the physical trauma of subcutaneous attachment of radio transmitters and possible physiological impacts. Other researchers have documented that radio tags can cause abnormal behavior in birds (REF). They also believe that the number of birds flying inland in 2000 was less than in 2001 because in their radio-tagged sub-populations, they found a smaller proportion of the birds to be in breeding condition in 2000. However, this was not the case, at least not the case in the Gazos Creek Watershed, where our radar data showed that inland detections in 2000 were actually greater than in 2001.

Ground Observer Protocol Surveys

Six ground observer surveys were conducted at Gazos Mountain Camp in July in both 2003 and 2004. Results are presented in Tables 3 and 4. Surveys are conducted in the lower meadow.

Table 3. Year 2003 results of ground observer surveys for murrelets at Gazos Mountain Camp. Values for the mean (x), standard deviation (s.d.), and coefficient of variation (C.V.) are given in the bottom row.

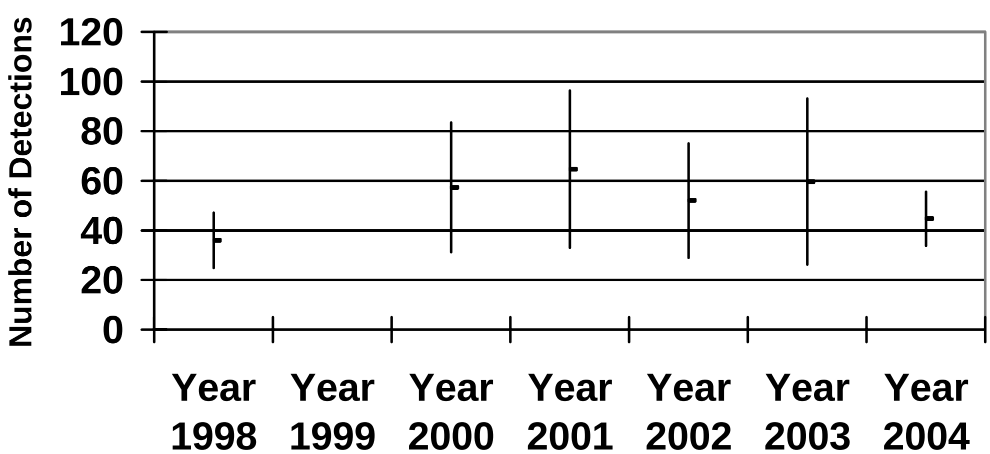
Date	% Overcast	Number of Detections (# visuals)	Number of Occupied Behaviors	Number of Single Silent Birds Below Canopy
7/1/03	0	46 (9)	4	0
7/2/03	0	39 (5)	5	2
7/3/03	0	45 (17)	15	0
7/4/03	0	45 (10)	9	0
7/13/03	0 - 70	56 (20)	10	0
7/27/03	100 - 25	127 (38)	15	0
Mean		x = 59.67	x = 9.67	x = 0.33
s.d.		s.d. = 33.44	s.d. = 4.72	s.d. = 0.81
C.V.		C.V. = 0.561	C.V. = 0.488	C.V. = 2.46

Table 4. Year 2004 results of ground observer surveys for murrelets at Gazos Mountain Camp. Values for the mean (x), standard deviation (s.d.), and coefficient of variation (C.V.) are given in the bottom row.

Date	% Overcast	Number of Detections (# visuals)	Number of Occupied Behaviors	Number of Single Silent Birds Below Canopy
7/9/04	100	44 (18)	15	5
7/12/04	0	59 (21)	18	7
7/14/04	0	53 (16)	11	0
7/19/04	0 - 33	47 (24)	11	1
7/21/04	0	29 (2)	1	0
7/26/04	100	36 (2)	1	0
Mean		x = 44.7	x = 9.5	x = 2.17
s.d.		s.d. = 10.97	s.d. = 7.09	s.d. = 3.06
C.V.		C.V. = 0.246	C.V. = 0.747	C.V. = 1. 41

Figure 2 plots the mean number of ground surveyor “total detections’ for these years. Tables 5 and 6 provide data from 1998, 2000, and 2001 for a more detailed comparison with 2004 data.

Figure 2. Mean Number of Ground Survey 'Total Detections'



(Note: Error bars represent one standard deviation)

Table 5. Comparison of the total detections and visual detections of Marbled Murrelets by ground observers – July of 1998, 2000, 2001, 2002, 2003, and 2004 at Gazos Mountain Camp. Results ranked high to low by number of total detections. No surveys were done in July of 1999.

1998 Detections-Total and (# of Visuals)	2000 Detections-Total and (# of Visuals)	2001 Detections-Total and (# of Visuals)	2002 Detections-Total and (# of Visuals)	2003 Detections-Total and (# of Visuals)	2004 Detections-Total and (# of Visuals)
49 (22)	100 (66)	105 (79)	75 (34)	127 (38)	59 (21)
42 (11)	67 (46)	85 (60)	72 (18)	56 (20)	53 (16)
41 (17)	59 (31)	85 (43)	71 (23)	46 (9)	47 (24)
38 (14)	57 (22)	53 (25)	38 (9)	45 (17)	44 (18)
28 (10)	36 (15)	34 (16)	31 (7)	45 (10)	36 (2)
18 (6)	25 (13)	26 (3)	25 (4)	39 (5)	29 (2)

Table 6. Comparison of the number of occupied behaviors and single silent birds below canopy (SSBBC) detected by ground observers - July of 1998, 2000, 2001, 2002, 2003, and 2004 at Gazos Mountain Camp. Results were ranked from high to low by the number of occupied behaviors. No surveys were conducted in July of 1999.

1998 Detections-Occupied Behaviors and (SSBBC)	2000 Detections-Occupied Behaviors and (SSBBC)	2001 Detections-Occupied Behaviors and (SSBBC)	2002 Detections-Occupied Behaviors and (SSBBC)	2003 Detections-Occupied Behaviors and (SSBBC)	2004 Detections-Occupied Behaviors and (SSBBC)
16 (10)	31 (1)	43 (2)	18 (0)	15 (0)	18 (7)
13 (4)	21 (0)	29 (3)	14 (2)	15 (0)	15 (5)
13 (3)	15 (0)	19 (1)	8 (7)	10 (0)	11 (1)
10 (3)	10 (0)	7 (2)	7 (0)	9 (0)	11 (0)
7 (3)	7 (4)	6 (2)	5 (0)	5 (2)	1 (0)
5 (1)	6 (1)	3 (0)	3 (0)	4 (0)	1 (0)

Tables 5 and 6 show that there is a large amount of both day-to-day and year-to-year variation in both the number of total detections and the number of occupied behaviors from 1998 to 2004. This is in agreement with the work of Jodice (1998) who conducted ground surveys at 5 sites in the Oregon Coast Range on a near-daily basis throughout the season for three breeding seasons. He found there to be high variation in daily activity levels and concluded that the power of ground surveys to detect annual declines in detections of 25 percent and 50 percent were only "very low" and "moderate", respectively. Consequently, we are only using ground survey data to determine if nesting, or more correctly, behaviors associated with nesting are occurring, and not to ascertain trends in the number of murrelets using the canyon. Radar surveys are a better tool for that.

Much research has shown that the behavior most strongly indicative of nesting in the vicinity is single silent birds seen flying below canopy (SSBBC). When this behavior is observed on all or nearly all survey mornings, as was the case in 1998 and 2001, we believe that nesting is occurring during the survey period in the general vicinity of the survey station within Gazos Mountain Camp. If this inference is correct, murrelets were attending a nest during the 1998 and 2001 breeding seasons, and possibly during the first part of July in 2004, but no direct evidence of nesting was observed.

CONCLUSIONS

Both radar and ground observer surveys are useful tools in monitoring murrelet use of Gazos Mountain Camp and the Gazos Creek Watershed. The ground observer surveys can provide evidence of nesting at the Gazos Mountain Camp through the detection of occupied behaviors and the detection of single silent murrelets flying below the canopy. Radar surveys provide information on the numbers of murrelets using the watershed. Since non-breeding birds are not believed to consistently fly inland (Peery et al 2004) and since the number of breeding birds can vary from year to year, our tallies will ultimately reveal changes in the size of the potential breeding population over time. This will serve as an index of murrelet abundance in the Gazos Creek Watershed. At the end of the study period we should know if the index of murrelets using the Gazos Creek Watershed is increasing, decreasing, or remaining stable over time.

A recently published study by Peery et al (2004a) reports that a high proportion of the Santa Cruz Mountains murrelet population did not fly inland in the 2000 breeding season. This would seem to conflict with our inland detection numbers for the Gazos Creek Watershed for that season (see Figure 1). Their conclusion was based on a radio-telemetry study of 46 tagged murrelets in 2000 and 2001. Based on foraging behavior and other observations (Peery et al 2004b), they attribute the reported reduction in inland flights to reduced prey availability at sea. However, at the Farallon Islands, the reproductive success of common murres was not substantially different from 2000 to 2001 (Sydeman, pers. comm..), and murres have a summer diet similar to that of marbled murrelets. These facts suggest that interpretations drawn from the behavior of radio-tagged murrelets might not be correct. Attaching subcutaneously-anchored backpack radio transmitters to birds is a traumatic process that can cause sub-lethal effects including changes in bird behavior (Guthery and Lusk 2004, Paquette et al 1997) thus leaving questions about the observed behavior. Hepp et al (2002) suggest that with all types of radio-transmitters short-term effects on behavior should be expected, and they go on to state, "studies using radiotelemetry should always attempt to evaluate whether transmitters influence the parameter of interest, because it often is not reasonable to assume that transmitters have no effect". It's likely that radiotelemetry studies of marbled murrelets would be enhanced if they were augmented with before and after observations of murrelet movements. Unlike radio-tagging efforts, radar observations are passive and completely benign, (i.e., no capture, handling, or surgery of birds). Consequently, birds tracked by radar can be assumed to be behaving normally.

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