2006 BIANNUAL REPORT

GAZOS CREEK MARBLED MURRELET MONITORING PROGRAM

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INTRODUCTION

This is a report of the 2006 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. The approved project includes funding for radar surveys in alternate years, but the funding for ground observer surveys has been exhausted. However "pro bono" ground surveys are conducted whenever possible and six were conducted in 2006. This report contains the results of both radar surveys and ground observer surveys conducted in 2006.

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 (see map, page 10). Ground observer surveys were conducted in the meadow at Gazos Mountain Camp, which is located at the end of pavement of Gazos Creek Road, about 4.2 kilometers upstream from the mouth of Gazos Creek (see map, page 10). Survey stations are described in Singer and Hammer (2002, 2001, and 1999). A review of the 17 murrelet nest sites that have been documented in the Santa Cruz Mountains and habitat conditions required for nesting can be found in Baker, et al. (2006).

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 some 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. The property included a 10-acre old-growth stand, a second-growth stand with some residuals, a large area of young second-growth, and a 12-acre developed camp area that does not contain potentially suitable murrelet nest trees, but does have buildings and other facilities. It was understood that the old-growth area would be preserved as nesting habitat for the marbled murrelet and the developed portion of the property would be used for environmental education, scientific studies, or some other use that would be appropriate for the setting and compatible with both the purpose of the park and the intentions of the Sempervirens Fund donors, whose contributions allowed purchase of the property. To be sure that uses on the developed portion of the property did not harm any nesting marbled murrelets, a set of habitat management guidelines was prepared by the Sempervirens Fund and the Apex Houston Trustee Council in 1999 (Singer, 1999).

Gazos Mountain Camp was transferred from the Sempervirens Fund to the State Parks Department in 2001 and is now a part of Butano Redwoods State Park. The 12-acre developed portion of the Gazos Mountain Camp property was then leased to the Pescadero Conservation Alliance (PCA) who will be operating a scientific field station and environmental education program on the developed portion of the site. This is exactly the type of land use that the Apex Houston Trustee Council had in mind for the developed area when it contributed funds toward purchase of the property, but arriving at this point was not easy. PCA received a coastal development and use permit from the County in 2003, however, due to an appeal, it was not granted until after an additional hearing before the California Coastal Commission in 2006. During the appeal process it became apparent that some members of the local community did not have a clear understanding of the intentions and/or goals of the Apex Houston Trustee Council or the Sempervirens Fund for the property nor did they have a good understanding of the nesting ecology of the murrelet and the various threats to nesting murrelets. A large amount of misinformation was disseminated during this time by the appellants and their allies which had to be debunked by local murrelet experts. Ironically, the presence of so

much misinformation during this debate served to emphasize the need for the kind of science-based environmental education programs and biological studies that PCA will be providing.

METHODS

Ground observer surveys were used to determine general murrelet detection levels and types of murrelet activities in the meadow across from 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 with the antenna mounted onto the camper roof of a 4x4 Ford pickup 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 will 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 2010.

Ground Observer Surveys

During 2006, six ground observer protocol surveys were conducted in July in the lower meadow area of Gazos Mountain Camp, formerly known as the ball field. This area was previously used as a ball field, but is now off-limits for all activities that would be disruptive to murrelets during the murrelet breeding season. 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

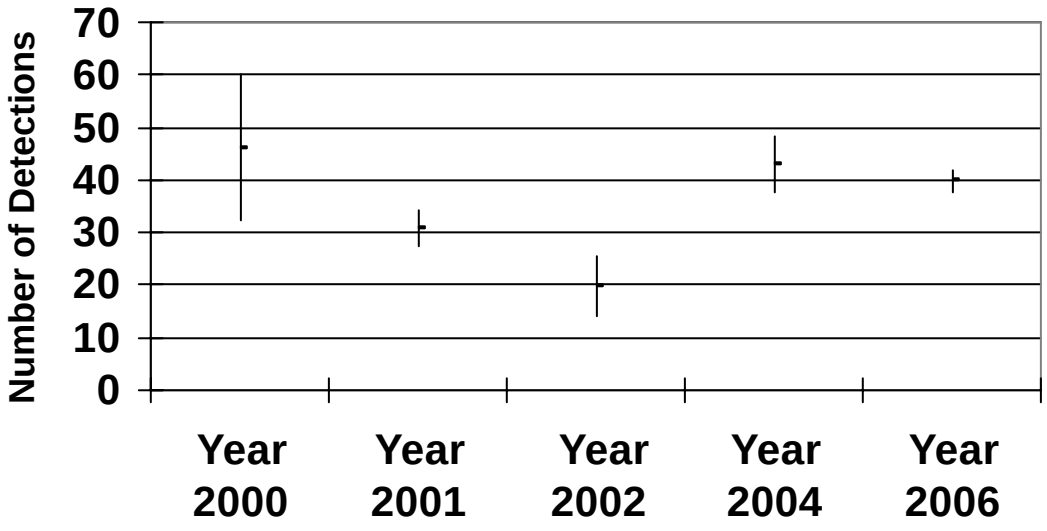
Seven radar surveys were conducted during July of 2006 at the Double Low Gazos site downstream of Gazos Mountain Camp. The total number of murrelets detected by radar in 2006 was close to the number detected in 2004, with a 7-day total of 279 detections in 2006 versus 300 detections in 2004. Results of the 2006 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 2006 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 rows.

Date	% Overcast	Total Number of Detections	In-bound Detections	Out-bound Detections	Other Detections
7/02/06	100	39	10	18	11
7/03/06	100	40	10	25	5
7/04/06	100	38	15	15	8
7/05/06	100	38	18	16	4
7/06/06	100	40	21	16	3
7/07/06	0	40	14	17	9
7/08/06	0	44	14	28	2
Totals		279	102	135	42
Mean		x = 39.86	x = 14.57	x = 19.29	x = 6.00
s.d.		s.d. = 2.04	s.d. = 3.99	s.d. = 5.09	s.d. = 3.37
C.V.		C.V.= 0.051	C.V. = 0.274	C.V. = 0.264	C.V. = 0.561

The daily 2006 radar total detection values ranged from 38 to 44, which contrasts with ranges from 2001 (27 – 36), 2002 (11 – 27), and, 2000 (30 – 68); but is comparable with the range found in 2004 (35 – 52).

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, 2004, and 2006 radar surveys at Double Low Gazos.

Detection Type	Parameter	2000	2001	2002	2004	2006
All Detections	Total (all 7 days)	323	217	138	300	279
	Mean	46.14	31.00	19.71	42.86	39.86
	Standard Deviation	13.80	3.27	5.82	5.31	2.04
	Coefficient of Variation	0.299	0.105	0.295	0.124	0.051
In-bound Detections	Total (and % of All)	85 (26%)	52 (24%)	26 (19%)	106 (35%)	102 (37%)
	Mean	12.14	7.43	3.71	15.14	14.57
	Standard Deviation	4.30	2.64	1.89	3.72	3.99
	Coefficient of Variation	0.353	0.354	0.509	0.245	0.274
Out-bound Detections	Total (and % of All)	144 (45%)	68 (31%)	65 (47%)	127 (42%)	135 (48%)
	Mean	20.57	9.71	9.29	18.14	19.29
	Standard Deviation	10.24	5.25	4.86	4.38	5.09
	Coefficient of Variation	0.498	0.540	0.523	0.241	0.264
Other Detections	Total (and % of All)	94 (29%)	97 (45%)	47 (34%)	67 (22%)	42 (15%)
	Mean	13.43	13.86	6.71	9.57	6.00
	Standard Deviation	7.32	8.59	2.98	2.99	3.37
	Coefficient of Variation	0.545	0.619	0.444	0.313	0.561

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 (McShane et al. 2005, Peery et. al. 2004a; Peery et al. 2004b). In a two-year study, Peery et. al. (2004a) 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. This natural variation will tend to mask changes in population size and explains why this study must collect data over a many year period.

Ground Observer Protocol Surveys

In 2006, five ground observer surveys were conducted at Gazos Mountain Camp in July and one in early August. All surveys were done in the lower meadow. Results are presented in Table 3. For comparison, the results from surveys done in 2004 are presented in Table 4.

Table 3. Year 2006 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 rows.

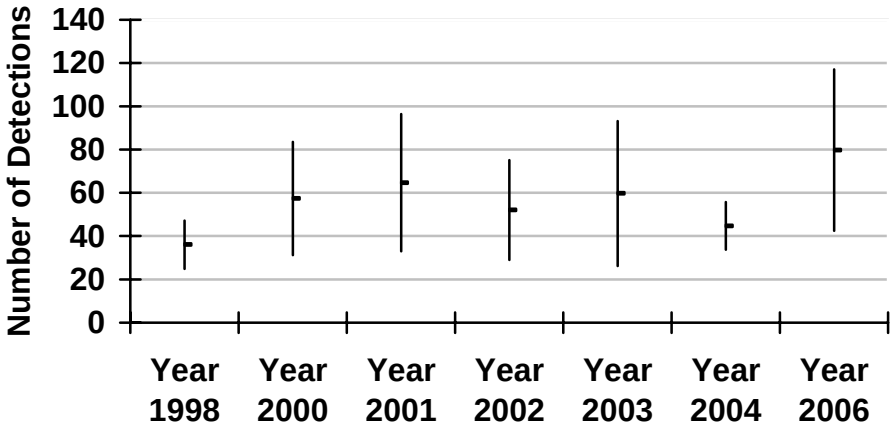
Date	%Overcast	Number of Detections (# visuals)	Number of Occupied Behaviors	Number of Single Silent Birds Below Canopy
7/6/06	80 – 100	98 (62)	41	11
7/8/06	0	71 (43)	17	3
7/12/06	60 – 100	107 (49)	21	0
7/19/06	0 – 35	52 (19)	16	1
7/28/06	75 – 100	125 (48)	23	2
8/4/06	80 – 100	25 (3)	1	0
Mean		x = 79.7	x = 19.8	x = 2.8
s.d.		s.d. = 37.33	s.d. = 12.94	s.d. = 4.16
C.V.		C.V.= 0.469	C.V.= 0.652	C.V. = 0.588

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 rows.

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 bar represents one standard deviation)

Table 5. Comparison of the total detections and visual detections (in parentheses) of Marbled Murrelets by ground observers – 1998, 2000, 2001, 2002, 2003, 2004, and 2006 at Gazos Mountain Camp. Results ranked high to low by number of total detections. No surveys were done in 1999 and 2005. The mean number (x) of total detections is presented in the bottom row.

1998 Total Detections (# of Visuals)	2000 Total Detections (# of Visuals)	2001 Total Detections (# of Visuals)	2002 Total Detections (# of Visuals)	2003 Total Detections (# of Visuals)	2004 Total Detections (# of Visuals)	2006 Total Detections (# of Visuals)
49 (22)	100 (66)	105 (79)	75 (34)	127 (38)	59 (21)	125 (48)
42 (11)	67 (46)	85 (60)	72 (18)	56 (20)	53 (16)	107 (49)
41 (17)	59 (31)	85 (43)	71 (23)	46 (9)	47 (24)	98 (62)
38 (14)	57 (22)	53 (25)	38 (9)	45 (17)	44 (18)	71 (43)
28 (10)	36 (15)	34 (16)	31 (7)	45 (10)	36 (2)	52 (19)
18 (6)	25 (13)	26 (3)	25 (4)	39 (5)	29 (2)	25 (3)
x = 36.0	x = 57.3	x = 64.6	x = 52.0	x = 59.7	x = 44.7	x = 79.7

Table 6. Comparison of the number of occupied behaviors, designated as Occ. Beh., and single silent birds below canopy (SSBBC) detected by ground observers - 1998, 2000, 2001, 2002, 2003, 2004, and 2006 at Gazos Mountain Camp. Results were ranked from high to low by the number of occupied behaviors, which included birds circling above canopy. No surveys were conducted in 1999 or 2005.

1998 Detections Occ. Beh. & (SSBBC)	2000 Detections Occ. Beh. & (SSBBC)	2001 Detections- Occ. Beh. & (SSBBC)	2002 Detections Occ. Beh. & (SSBBC)	2003 Detections Occ. Beh. & (SSBBC)	2004 Detections Occ. Beh. & (SSBBC)	2006 Detections Occ. Beh. & (SSBBC)
16 (10)	31 (1)	43 (2)	18 (0)	15 (0)	18 (7)	41 (11)
13 (4)	21 (0)	29 (3)	14 (2)	15 (0)	15 (5)	23 (2)
13 (3)	15 (0)	19 (1)	8 (7)	10 (0)	11 (1)	21 (0)
10 (3)	10 (0)	7 (2)	7 (0)	9 (0)	11 (0)	17 (3)
7 (3)	7 (4)	6 (2)	5 (0)	5 (2)	1 (0)	16 (1)
5 (1)	6 (1)	3 (0)	3 (0)	4 (0)	1 (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 the only appropriate 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, it may indicate that nesting is occurring in the nearby old-growth stand during the survey period, although the timing of these below-canopy flights would also need to be taken into considerations. Flights during the early part of the activity period are more likely to represent incubation exchanges.

CONCLUSIONS

A comparison of Figures 1 and 2 shows the value of radar surveys over ground surveys if trying to determine the number of murrelets using an area. Both year to year variation and day to day variation are significantly less when using radar (i.e., note the difference in the scale of the Y axis between the two tables). However ground observer surveys are useful for other reasons. They can provide evidence of nesting at Gazos Mountain Camp through the detection of occupied behaviors and the detection of single silent murrelets flying below the canopy. Radar surveys cannot detect birds flying below canopy in forests with small openings or meadows such as at Gazos Mountain Camp. What radar surveys can do is to provide an index of murrelet abundance in the Gazos Creek Watershed. Since non-breeding birds are not believed to consistently fly inland (Peery et al 2004) and since the number that nest will vary from year to year based on prey availability or other conditions (McShane et al., 2004, Peery et al. 2004b),

there will be year-to-year variation in the number of murrelets flying inland. Consequently, to detect long-term trends, even radar studies need to be of a sufficient duration to overcome this source of variability. This study will provide two more years of radar data (2008 and 2010), and when it ends in 2010 should be able to answer the question, are the number of murrelets that use the Gazos Creek Watershed increasing, decreasing, or remaining stable?

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Fig. 1. Gazos Mtn. Camp & Survey Sites
Ground survey sta.
Gazos Mtn. Camp
Radar survey sta.
Pomponio Ranch
Deer Park Ridge
Rodgers Gulch
The Potato Patch
Big Dipper Ranch
Horseshoe Ranch
Burns Ranch
Tahana Gulch
Chandler Gulch
Shaw Gulch
Little Chicken Hollow
Goat Hill
Mt Ellen
Memorial Park
Lane Hill
Martin Ridge
Loma Mar
Worley Flat
Indian Point
China Flat
Dark Gulch
Round Hill
Roy Gulch
Dearborn Park
Windmill Gulch
Newell Gulch
Pescadero
Coyote Ridge Trail
Pomponio Trail
Summit Trail
Portola State Park
Butano Ridge
Butano Park
Butano State Park
The Mesa
Yankee Jim Gulch
Guard Station
Ocean View Summit
Big Basin Redwoods State Park
Pigeon Point Light Station
Big Basin
Chalk Mountain
Pine Mountain
Little Basin
Eagle Rock
Franklin Point
Locatelli Ranch
Point Ano Nuevo
Point Ano Nuevo
Ano Nuevo Island
Ano Nuevo State Park
Ano Nuevo Island
Ano Nuevo Bay
Wilson Gulch
Deadman Gulch
Las Trancas
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