MARBLED MURRELETS IN THE SANTA CRUZ MOUNTAINS
2014 FOREST SURVEY RESULTS

by

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ABSTRACT

Simultaneous A-V survey were conducted at the Butano, Gazos Camp, Portola, Big Basin, and Memorial breeding areas on 3 days in 2014. All stations had some nesting-related behaviors and one had probable tree landings. The highest murrelet activity levels were found at Gazos Camp and Butano, which had a record number of wing sound detections. Data were compared with existing prior year data, and all stations continued to show high day-to-day variability in total detection numbers. Opportunities for further data analysis and interpretation would be enhanced if some additional simultaneous surveys were done at all stations that were being monitored.

INTRODUCTION

This report discusses the results of 2014 Marbled Murrelet A-V surveys at five breeding areas in the Santa Cruz Mountains. This effort is the continuation, on a much reduced scale, of two long-term inland murrelet monitoring programs. One was administered by the California State Parks Department and ended in 2011. That effort included 11 stations and 3 – 5 surveys at each station. Results of that effort can be found in Shaw (2011). The other long-term study was the Gazos Mountain Camp study which continued through 2013. Results of that effort can be found in Singer (2013). It consisted of 6 – 7 A-V surveys per year at one station.

Both researchers arrived independently at similar working hypotheses about murrelet activity in the Santa Cruz Mountains. These hypotheses are:

- Seasonal timing of surveys has a large impact on the number of murrelet detections with the highest number of detections at any station usually occurring in July.
- Weather conditions influence murrelet detection numbers with more detections occurring on mornings with a consistent low overcast than on sunny and clear mornings.
- Murrelets may change the inland sites that they visit from year to year. Singer (2013) has also found evidence that murrelets (presumably non-breeders) may change the sites they visit from day-to-day within the same season.
- There is a large amount of variability in murrelet detection numbers from day to day, week to week, year to year, and, of course, station to station. Singer (2013, 2010) has found evidence that there is less variability in certain types of murrelet A-V detections than in others.

A good long-term murrelet monitoring program should strive to obtain information that will eventually provide answers to the following questions:

(1) Which sites are the most important murrelet breeding areas and how does breeding effort (as indicated by nesting-associated-behaviors) vary from year to year?
(2) What is the long-term trend for murrelet use at each site, and for the Santa Cruz Mountains as a whole?
(3) How does murrelet use or murrelet breeding effort correlate to corvid control efforts or lack of same at each site?
(4) Do murrelets in the Santa Cruz Mountains population divide themselves into subgroups that regularly use specific watersheds/flyways/breeding areas or do the non-breeders use all the watersheds, flying into different sites on different days?

A-V surveys at breeding sites are an important component of any comprehensive Marbled Murrelet monitoring program. Such a program might also include at-sea surveys and radar surveys in murrelet flyways.

METHODS

Audio-visual (A-V) Survey Methodology

Survey procedures followed the 1994 Pacific Seabird Group (PSG) protocol for forest surveys (Evans et al. 2003), starting 45 minutes before sunrise and lasting for a minimum of two hours, or 15 minutes from the last detection. Occupied behavior consisted of flights below one-canopy or circling above one-canopy height but below two-canopy height. This definition is slightly different than that used in the protocol, in Shaw (2011), and in Singer (2013), but the resulting values are very similar and the raw data from Shaw were not available.

Three surveys were conducted in 2014 at each of five sites. The surveys were conducted simultaneously on June 11, July 9, and July 23 (Note: simultaneous surveys remove the variability associated with the same birds visiting different sites on different days). One additional survey was conducted at the Butano station on July 29. In 2011 and prior years A-V surveys were not conducted simultaneously and the number of surveys per season (normally 3) was different at Portola and Gazos Camp. Portola had 5 surveys per season and Gazos Camp had 7 surveys per season. No surveys were done at Gazos in 2005, and in the two-year period of 2012 and 2013, no surveys were done at any of the other four stations.

Observations were recorded live into tape or digital recorders and later transcribed onto standard forest survey forms. The maximum number of Common Ravens detected simultaneously and the maximum number of Steller's Jays detected simultaneously were also recorded. It should be noted that corvid detections can't be collected in the same manner as murrelet detections. This is because a single raven or jay, unlike a murrelet, can perch in a branch nearby and make intermittent calls all morning long. Corvid sampling was more comprehensive in 2011 and prior years, and those findings can be found in Shaw (2011). In 2014 the maximum number of murrelets seen in the sky at the same time was also recorded.

Station Location and Viewing Conditions

Five stations were selected for A-V surveys in 2014 with all but one being located in different watersheds. The four watersheds sampled were Pescadero Creek, Little Butano Creek (tributary to Butano), Gazos Creek, and Waddell Creek (see Map 1 at end of report). All stations had been part of a previous monitoring program and criteria used for their selection can be found in Shaw (2011) and Singer (2010). Station locations are depicted in Map 1. These stations are:

- Big Basin – Located within the state park on the edge of Redwood Meadow near Park Headquarters. It is located at the end of the Waddell Creek murrelet flyway.
- Butano – Located within the state park on a hillside above Little Butano Creek. It is one of only two stations not located near a campground or picnic area.
- Gazos Camp – Located in the old Gazos Mountain Camp property which is now part of Butano Redwoods State Park. Despite the name, it is not near a campground or picnic area. It is in the restored meadow (formerly used as a playing field) close to Gazos Creek. It lies within the Gazos Creek murrelet flyway.
- Memorial – Located in the Legionnaire Flats Picnic Area in Memorial County Park and bordering Pescadero Creek. It lies within the Pescadero Creek murrelet flyway and is situated about four miles downstream from the Portola station.
- Portola – Located on the highway bridge above Peters Creek near the campground and trailhead parking lot. It lies near the end of the Pescadero Creek murrelet flyway.

Relative viewing conditions at each station were determined by calculating the Index of Visibility and modifying it to represent the Effective Visibility. This is a new technique and the methodology is described fully in the Appendix.

RESULTS AND DISCUSSION

Relative Visibility at Survey Stations

The amount of visible sky overhead and the size and arrangement of viewing gaps through the surrounding screen of trees varied significantly between survey sites. The Index of Visibility values and Effective Visibility values for each survey station are shown in Table 1.
The best observer visibility was found at Gazos Mountain Camp and Big Basin. The worst visibility was found at Butano and Portola. The situation at Portola is so difficult that this site should probably be moved to the nearby parking lot.

Number of Murrelets Detected at Each Station

In 2014, more murrelets were detected at Butano than at any other station, and surveys at this site also had the lowest C.V. values (Table 2 and Graph 1). Because of the consistent high number of detections at Butano, one additional survey was done there on July 29. That survey yielded similar results – 78 total detections (17 of which were visuals) and 41 below-canopy detections (12 of which were single silent birds below canopy).

The second most important site for murrelets was Gazos Mountain Camp. Seventy-one percent (71%) of the total of all detections at every site occurred at these two stations. The least used site was Memorial. At Memorial the mean number of total detections was skewed high due to the one-day observation of a bird making practice landings on a tree visible from the station.

Butano had the third-highest mean number of total detections in 2011 with 32, behind Gazos Camp with 44.3, and Portola with 55 (Graph 1).

In 2014, more occupied behaviors were detected at Butano than at any other station, and surveys at this site also had the lowest C.V. values. (Table 4 and Graph 2). Sixty percent (60%) of the total of occupied behaviors observed at all sites in 2014 were noted at the Butano station. The fewest number of occupied detections occurred at Portola, although Memorial would have been lower was it not for the one day that a bird was making practice landings and doing fly-bys and therefore flying low (Table 4). The Portola station, which had a low number of occupied behavior detections in 2014, had the highest number of such detections in 2011 (Graph 2).

When all five sites are combined, the mean for total detections in 2014 and 2011 are very similar, with 484 being recorded in 2014 and 474 in 2011 (Table 3). The same is not true of the mean for occupied behaviors, with the 2014 value of 144 being almost twice as high as the 82 recorded in 2011. However, the 2014 value is skewed high by both the occupied behaviors observed on one day at Memorial as well as an extremely high number of Marbled Murrelet wing sounds heard on one day at Butano and confirmed by a fourth-day visit on July 29.

Long-term Trend of Murrelet Numbers at the Various Stations

It can be seen that there is very high year-to-year viability in total detection numbers (Graph 3). A trend line (the dashed line in Graph 3) is shown for Gazos Mountain Camp which was the station with the greatest number of data points. An R^2 value of 0.0932 indicates that the trend is not statistically significant. Some sites, even with high annual variability, were consistently better than others. Butano and Gazos fell into this category. In contrast, Memorial was consistent in having the fewest detections every survey year since 2003 (Graph 3).

The number of occupied behaviors was also highly variable from year to year. The Butano station had more occupied behaviors in 2014 than ever before, comprising nearly 60% of the total occupied behaviors at all five stations (Graph 4). During the 2003 to 2014 period, the vast majority of occupied behavior detections were recorded at Gazos and Butano. The fewest were recorded at Memorial and Big Basin (Graph 4).

Evidence of Nesting Nearby

Below-canopy detections (occupied behaviors) are indicators of nesting nearby and single silent birds seen flying below canopy even more so. Other evidence of breeding nearby that we observed were apparent tree landings (seen at Memorial on July 9) and the distinctive murrelet wing-sounds which were heard at Gazos Camp and Butano. These two stations presented the strongest evidence that

murrelets were nesting nearby (Table 4). Butano and Gazos would appear to be the strongholds for murrelet nesting activity in the Santa Cruz Mountains although some nesting behaviors were found at all survey stations (Graph 4).

Single Silent Bird Below Canopy (SSBBC) detections occur much less frequently than other occupied behavior detections. Among all the stations, only 60 SSBBC detections were made in 2014 – this figure was 12% of the total detections that year (Table 3). Forty (40) of those 60 detections were associated with one day at Butano and one day at Gazos (Table 4).

One can surmise that SSBBC detections, especially when occurring in the early part of the survey period, are associated with an active nest. This kind of behavior is known to occur with nest exchange and nestling feeding visits (Nelson and Peck 1995, Singer et al. 1995). At Memorial, 20 SSBBC detections occurred on July 9, 2014, when a bird was making practice landings in a tree along with fly-bys, while the two other survey days at Memorial, with no landings observed, had zero SSBBCs (Table 4). Occupied behaviors, being more common, might be indicative of previous nesting in the area or a future intent to nest in the area; but further research is needed on the more precise meaning of this behavior. However it is widely recognized as being associated with nesting areas.

Wing sounds are also an uncommon type of detection and are another type of occupied behavior. Only 24 wing sound detections were recorded on all surveys in 2014, which was only 5% of the total recorded detections of all types (Table 3). Twenty-three (23) of these occurred at the Butano station. These figures do not include the extra survey of July 29 which detected 28 wing sounds. The exact meaning of this behavior is unclear, but it is known to be associated with nesting sites.

Common Raven and Steller's Jay Numbers

Although individual raven or jay detections were not recorded, the maximum number of ravens and jays detected at any one moment was recorded. The greatest simultaneous number of ravens was 5, which were detected at Memorial on July 23. Bill Webb, who did his dissertation on ravens under Professor John Marzluff, believes that these were part of a larger group of at least 12 ravens that came from a communal roost somewhere to the east and were heading to foraging areas somewhere to the west. Bill's observations on the previous two surveys included adult and juvenile raven vocalizations about 200 m to the northeast that were likely associated with a raven nest.

The second-highest number of simultaneous raven detections was four (2 adults and 2 juveniles calling) which occurred at Big Basin on July 23. The observer there, Bryan Mori, reported that he would expect ravens to be present there on a regular basis. At Portola, ravens were present every survey day and a maximum of two birds was noted on July 23. The observer there, Kathy Kuyper, felt that two ravens were regularly present in the area. The fewest ravens were found at Butano and at Gazos Mountain Camp. At Butano where 3 surveys plus one extra survey were done, only one day had a raven detection, and that detection was just one bird. At Gazos, one detection of one bird on two mornings was the tally. The highest number of jays detected at one time was 5 at Portola on the July 23 survey. On two occasions 4 ravens were detected simultaneously. This happened on another survey at Portola and a single survey at Big Basin. The fewest simultaneous jay detections were at Memorial where one survey

had two birds and the other surveys detected only one bird. Next lowest was Gazos, where each survey found only a maximum of 2 jays detected simultaneously.

RECOMMENDATIONS

1. Continue to do site surveys simultaneously at all stations. This provides a clearer estimate of the relative levels of murrelet activity at each site.
2. Continue to manage the Butano survey site and the Gazos Camp survey site in such a manner as to maintain the relatively high levels of murrelet activity there and the low levels of raven activity.
3. Increase the number of A-V surveys done each season at each site to 5 if possible in order to counter some of the high variability.

ACKNOWLEDGEMENTS

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APPENDIX I – Tables and Graphs

Table 1. Effective Visibility at Survey Stations

Station	Location	Index of Visibility	Factors Modifying Index Value	Effective Visibility
Big Basin	NE edge of Redwood Meadow – tall trees around perimeter	34.6	Minor head movement needed to see breadth of meadow.	30
Portola	Peters Creek Bridge – no one patch of open sky, but small gaps in 4 directions each 90 degrees apart	41.7	Impossible to see all gaps at the same time. Only half the gaps can be covered at the same time.	15 - 20
Butano	Butano Service Road on slope above Little Butano Creek – no one patch of open sky.	37.4	Must turn head to cover all gaps, so all cannot be covered simultaneously.	20
Gazos Camp	NE edge of meadow	55.5	One big gap, but requires some slight head movement to see all sky patches.	50
Memorial	Legionnaire Flats Picnic Area, standing on the sandy "beach". Viewing gaps are large but 180 degrees apart.	48.8	Biggest gaps are to the west and east and overhead requiring 180 degree head movement.	25 - 30

Table 2. 2014 Total Detections and (Visual Detections)

Table 2 provides the number of total detections and visual detections (shown in parentheses) on every 2014 survey at all sites and provides the Coefficient of Variation (CV) for each site. CV values were high for all sites except Butano.

Date	Big Basin	Portola	Memorial	Gazos Camp	Butano
June 11	6 (2)	1 (1)	3 (0)	59 (34)	60 (36)
July 9	15 (2)	64 (23)	27 (23)	28 (11)	74 (38)
July 23	4 (1)	18 (8)	1 (0)	24 (2)	100 (42)
MEAN	**8.3 (1.7)**	**27.7 (10.7)**	**10.3 (2.7)**	**37.0 (15.7)**	**78.0 (38.7)**
STDEV	5.9 (0.6)	32.6 (10.7)	14.5 (13.3)	19.2 (16.5)	20.3 (3.1)
CV	0.70 (0.35)	1.18 (1.05)	1.40 (1.73)	0.52 (1.05)	0.26 (0.08)

Table 3. Frequency of Detection Types in 2014 and 2011 – All Stations Combined*

Type of Detection	June 11	July 9	July 23	Total All Days 2014	Total All Days 2011**
All types combined	129	208	147	484	474
Occupied behaviors	43	62	39	144	82
Single Silent Birds Below 1-Canopy	25	31	3	59	N.A.
Wing Sounds	0	2	22***	24	N.A.

Notes: * Excludes extra survey done at Butano on July 29 which had 28 wing sounds

** Surveys were not conducted simultaneously

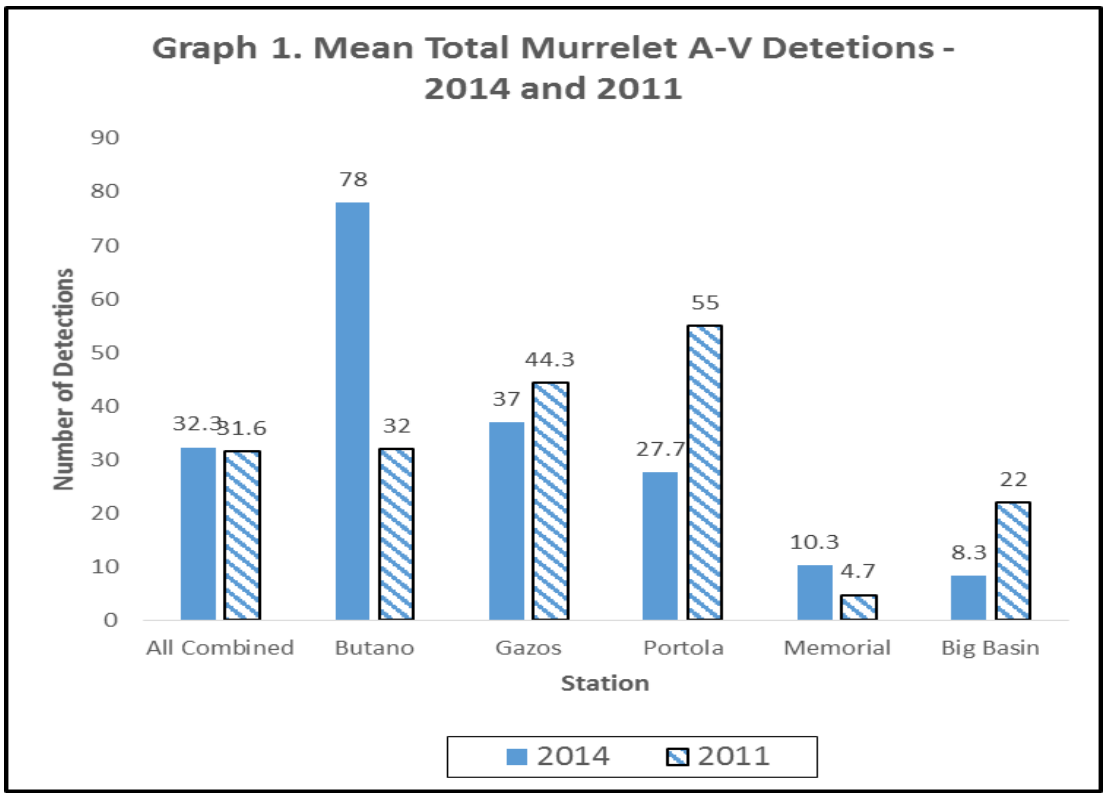
*** All but one wing sound was recorded at Butano

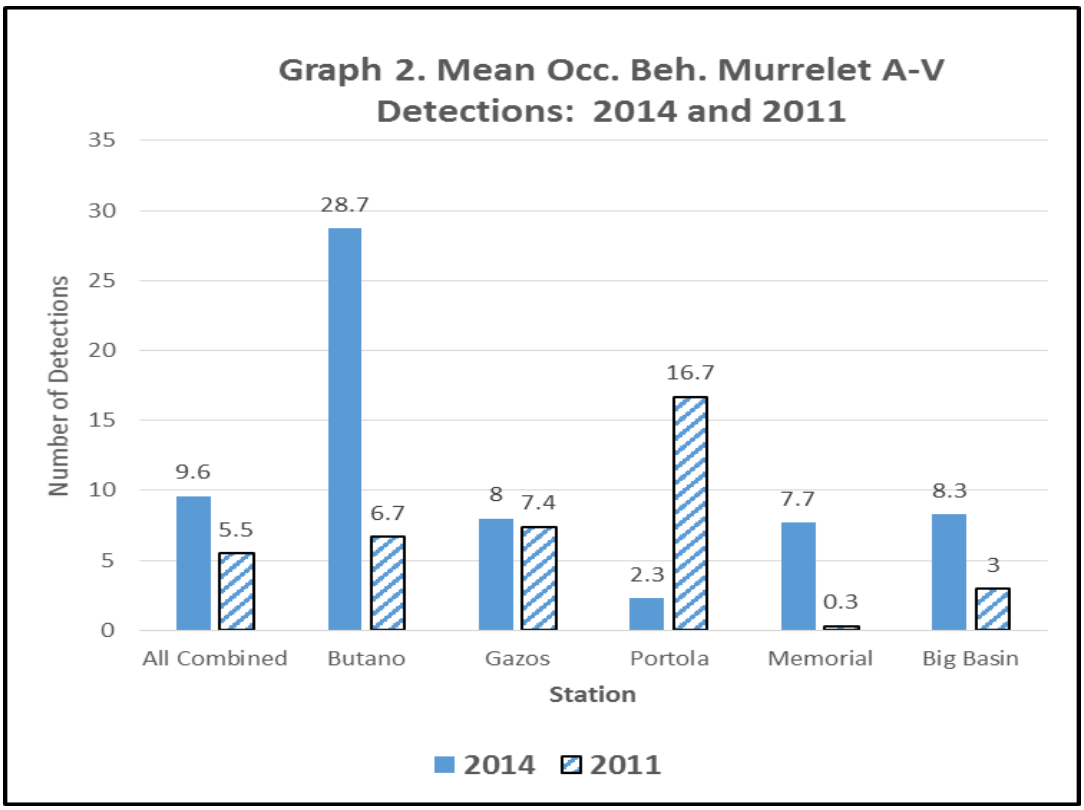
Table 4. 2014 Occupied Behavior Detections and Detections of Single Silent Birds Below Canopy (SSBBC)

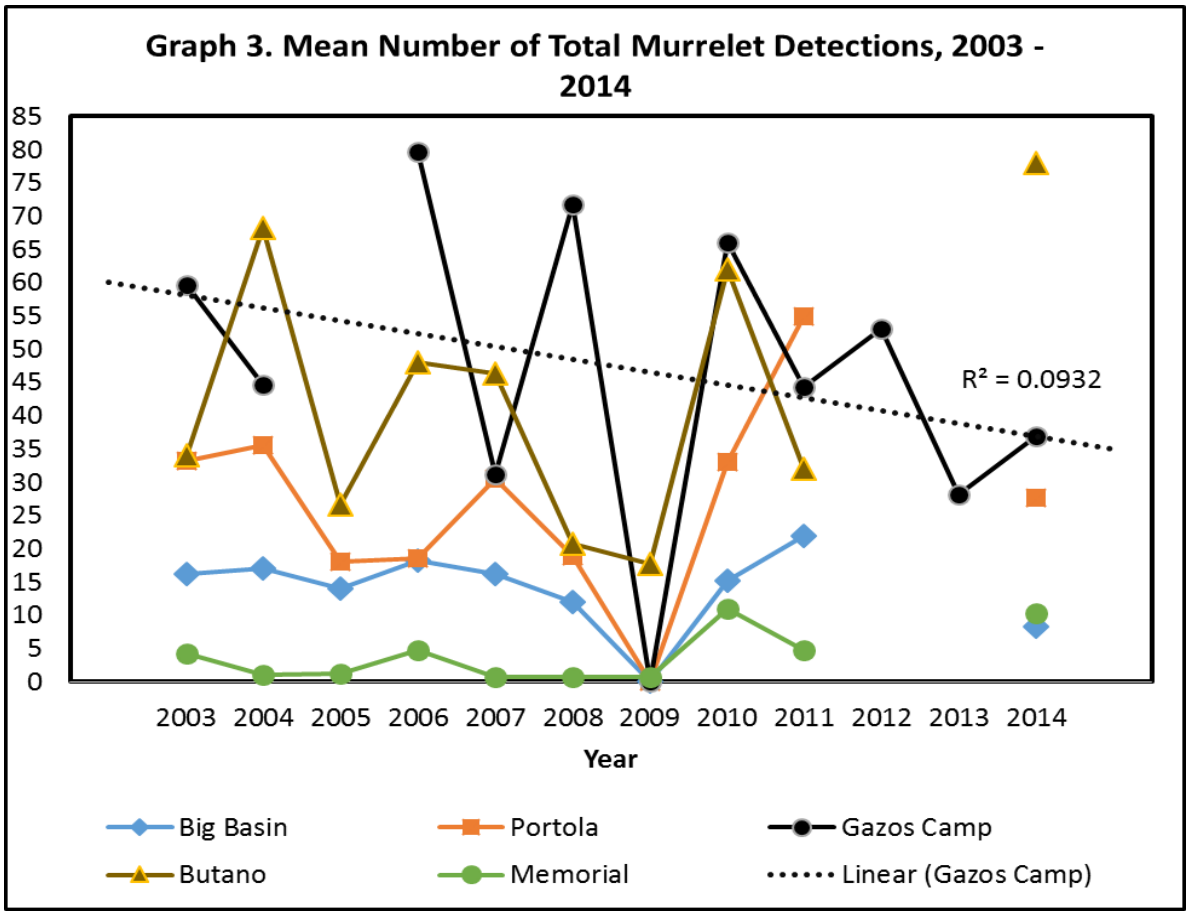
SSBBC detections are shown in parentheses. The vast majority of Occupied behavior (Below-Canopy) and SSBBC detections were found at the Butano station.

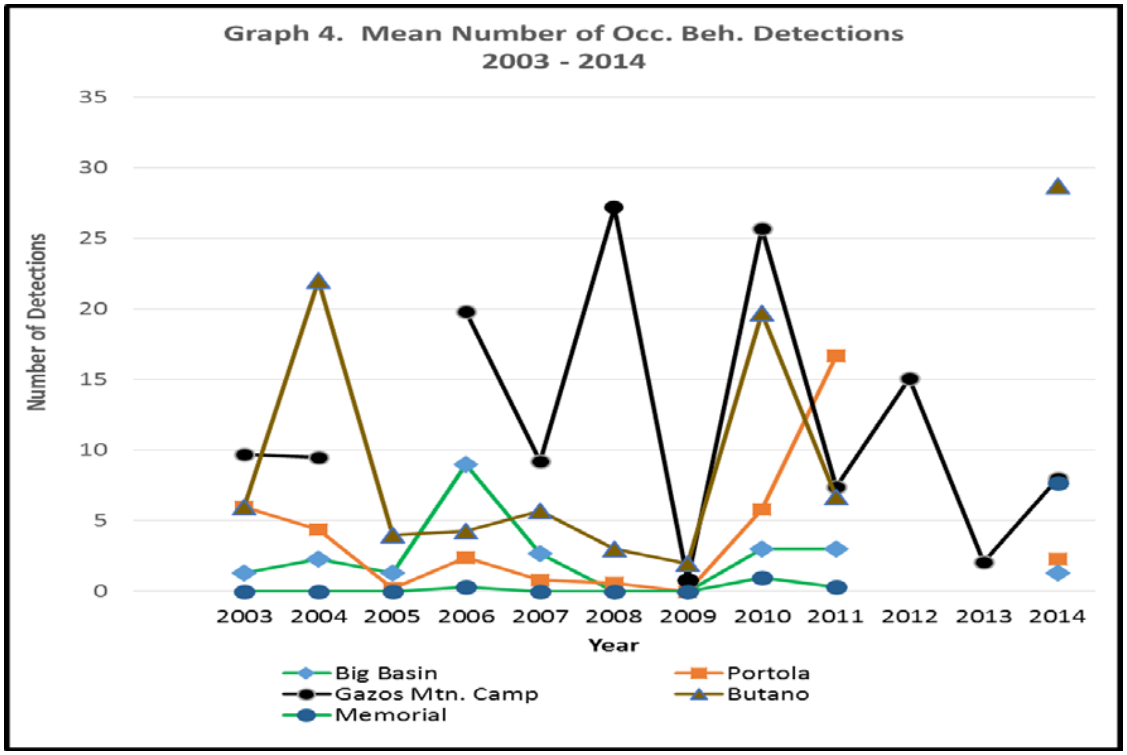
Date	Big Basin	Portola	Memorial	Gazos Camp	Butano
June 11	1 (1)	0 (0)	0 (0)	5 (4)	23 (20)
July 9	0 (0)	3 (0)	23 (20)	5 (3)	29 (8)
July 23	0 (0)	3 (2)	0 (0)	0 (0)	31 (1)
MEAN	**0.33 (0.33)**	**2.00 (0.67)**	**7.67 (6.67)**	**3.33 (2.33)**	**27.67 (9.67)**
STDEV	0.58 (0.58)	1.73 (1.15)	13.28 (11.55)	2.89 (2.08)	4.96 (9.61)
CV	1.73 (1.73)	0.87 (1.73)	1.73 (1.73)	0.87 (0.89)	0.15 (0.99)

Note: CV stands for Coefficient of Variation


Graph 1. Mean Total Murrelet A-V Detetions - 2014 and 2011
Number of Detections
90
80
70
60
50
40
30
20
10
0
32.3
31.6
78
32
37
44.3
27.7
55
10.3
4.7
8.3
22
All Combined
Butano
Gazos
Portola
Memorial
Big Basin
Station
2014
2011


Graph 2. Mean Occ. Beh. Murrelet A-V Detections: 2014 and 2011
Number of Detections
35
30
25
20
15
10
5
0
9.6
5.5
28.7
6.7
8
7.4
2.3
16.7
7.7
0.3
8.3
3
All Combined
Butano
Gazos
Portola
Memorial
Big Basin
Station
2014
2011


Graph 3. Mean Number of Total Murrelet Detections, 2003 - 2014
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
R² = 0.0932
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
Big Basin
Portola
Gazos Camp
Butano
Memorial
Linear (Gazos Camp)


Graph 4. Mean Number of Occ. Beh. Detections
2003 - 2014
Number of Detections
35
30
25
20
15
10
5
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
Big Basin
Portola
Gazos Mtn. Camp
Butano
Memorial

APPENDIX 2 - Interpretation of Observations Made at Different Stations in 2014

BUTANO: This station on the Butano Service Road had the greatest number of daily detections and the least variation in detection numbers from day to day. Total detections ranged from 60 to 100. It also had the highest number of below-canopy detections, ranging from 23 to 34 each day, and by far the greatest number of wing sound detections. On July 28 it yielded an incredible 28 wing sound detections – the most ever recorded in the Santa Cruz Mountains, and probably the most for any one murrelet survey in California. The meaning of such a high number of wing sounds is unknown although it may be related to good habitat for nesting and sloping topography at this station, which allow murrelets to fly low and relatively close to the observer without being seen.

MEMORIAL: Memorial County Park had very few detections and no below-canopy detections except for one day (July 9, 2014) with 27 total detections, 23 of which were birds flying below one canopy. On that morning Bill Webb also saw two probable landings in a tall redwood that had potentially suitable nest platforms in it. In both cases a single bird was seen flying into the tree at a speed and flight angle consistent with landing, than flying out from the same spot about one second later. These events occurred at 15 minutes prior (5:42 AM) and 8 minutes prior (5:49AM) to official sunrise and fell within the normal time frame for fly-ins to a nest site.

To determine if this was a nest, the tree was scoped out on July 11 from the same side that the birds had been seen flying into. Several potentially suitable nest platforms were seen but no nest. However some of the platforms were screened from view by intervening foliage, so there still could have been a nest present. Consequently it was determined that a dawn stake-out of the tree would be needed to determine if a nest was present.

The tree was staked out on July 14. There was a full moon that morning, so the stake-out started early to avoid missing a fly-in that might occur before the normal start of the survey period. The stake-out began 25 minutes before normal start time and focused solely on the area of the crown where the landings had been observed. It lasted for one hour and forty minutes but had no detections of any bird flying near the tree. There was one below canopy bird flying from the southeast to the west, but it was flying by the tree and not particularly close to it. The only other murrelet detection made that morning was of a heard-only bird distant to the west. So if a regular protocol survey had been done, the detection number would have been similar to the two other mornings with very few detections. It was concluded that there was not an active nest in this tree at this time. Of course, there may have been a nest that failed between July 9 and July 14, or more likely, Bill observed a bird that was making practice landings in the tree. The author has seen this type of behavior before in the Purisima Creek watershed where a murrelet made repeated landings on the same branch of a small tree– a tree that lacked any suitable nest platforms.

BIG BASIN: The Big Basin station is located on the edge of Redwood Meadow near Park Headquarters. In 2013, several A-V surveys or partial surveys were conducted there under a different program. One full survey on July 16 had 76 detections and another full survey on July 31 had only one detection (Singer, 2013). Five partial surveys on July 11, 12, 13, 15, and 19 had from 23 to 76 total detections with an average of 43 (Kuiper, pers. comm. cited in Singer, 2013). These values hinted at a possible recovery

of murrelet activity levels at Big Basin. However, the range of total detections in 2014 was much lower, ranging from 4 to 15, with an average of only 8.3 .

PORTOLA: The Portola station is located on the highway bridge over Peters Creek and is close to the campground and the trailhead parking lot. One full survey conducted here in 2013 had 11 total detections and one below-canopy detection (described in Singer, 2013). The last surveys done under the previous state park sponsored monitoring program in 2011 yielded an average of 55 total detections and 16.7 below-canopy detections (Shaw 2011). The range of total detections in 2014 was quite wide, extending from 1 (June 11) to 64 (July 9), and with a 3-survey average of 27.7 . The average number of below-canopy detections was only 2.

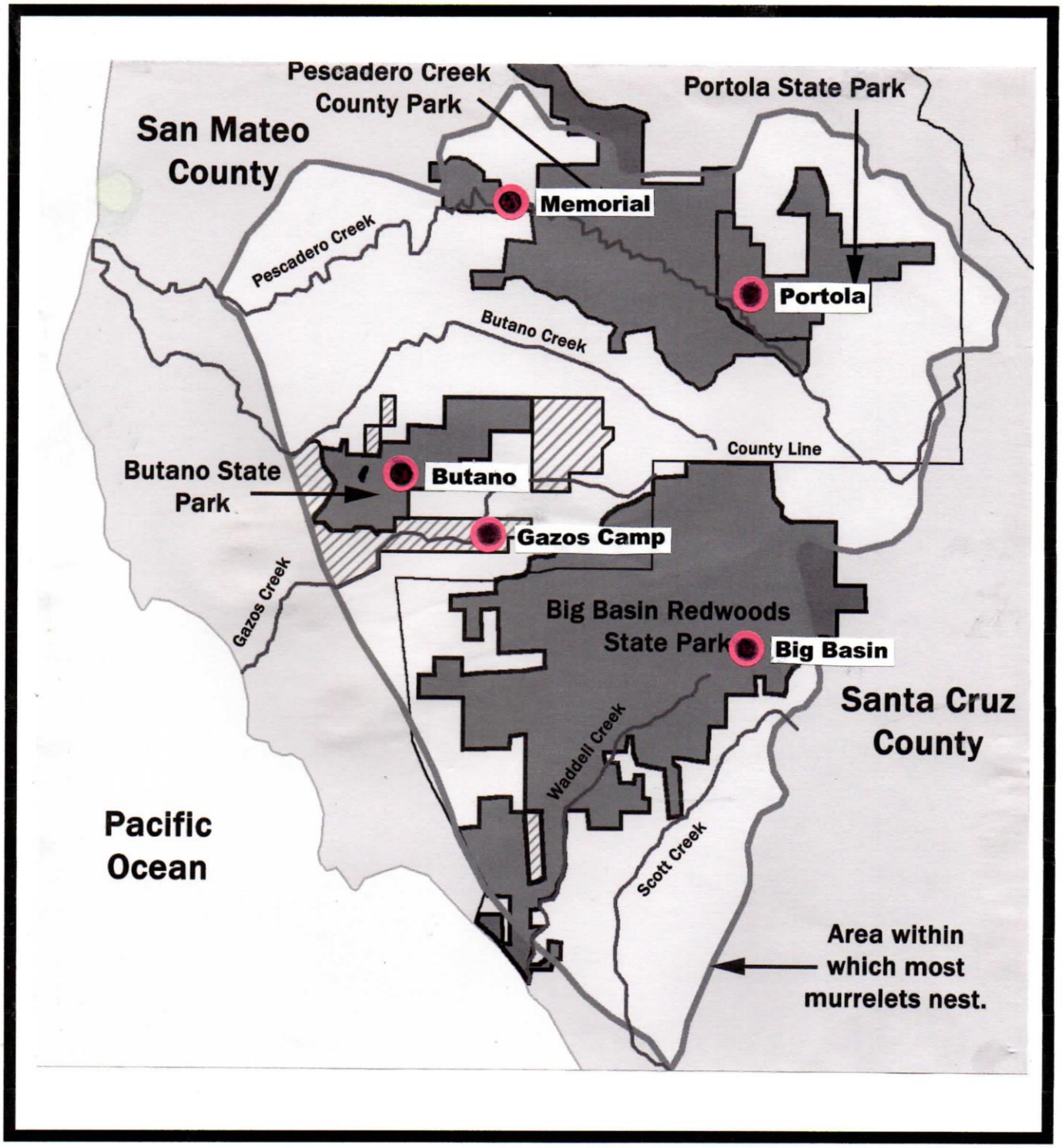
GAZOS CAMP: This station is located on the meadow in Gazos Mountain Camp within Butano Redwoods State Park and near Gazos Creek. A long-term and more intensive A-V survey program exists for this site and in 2013 seven surveys were conducted there. Those surveys found total detections to range from 14 to 50 with a mean of 28.1 (Singer 2013). In 2014 the total detections ranged from 24 (July 23) to 59 (June 11) with a mean of 37. This site, along with the Butano site, appear to be the most important breeding areas in the Santa Cruz Mountains.

APPENDIX 3 –Method for Computing the Index of Visibility and Effective Visibility of a Survey Station

(1) Stand at the survey station location. (2) Use a clinometer to measure the vertical angle of visibility at all tree gaps greater than one typical crown-width wide and record the bearing of each using a compass. For example, if sky is visible all the way down to the ground, the reading would be 0 degrees. For wide gaps measure the arc width (in degrees), and if 20 degrees or more, record as two separate gaps. (3) Next, use the compass (to get a bearing) and clinometer to measure the tree height angles at all cardinal and intermediate directions (i.e., N, NE, E, SE, S, SW, W, and NW), but don't repeat readings for any of the gaps already measured. In each case measure the angle to the top of the tallest tree within a span of 10 horizontal degrees to either side of the compass bearing. (4) Record all measurements in a table. (5)Subtract each angle reading taken, from 90, and, the resulting number (converted from negative to positive if necessary) is the visibility value for that compass bearing. (6) Add up the visibility values and compute the average. (7) Then divide the average by 90 to get the visibility index value for that station. Once the Index of Visibility is obtained, it needs to be modified to reflect the percentage of gaps that are visible when the observer is facing in the most favored direction. For example, if there are two big gaps and they are oriented 180 degrees apart from each other, the observer can watch only one at a time, so the Visibility Index Value should be reduced by half. The resulting value is the Effective Visibility value for that station. (Note: sample visibility index calculation forms are available from the author.)

APPENDIX 4 – Station Location Map
(on following page)

Map 1. Location of Marbled Murrelet Audio-Visual Survey Stations



Map by L. Robinson, modified by S. Singer