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DRAFT

Summary of 2009
Corvid Monitoring Surveys
In The Santa Cruz Mountains

Prepared for

Command Oil Spill Trustee Council

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ABSTRACT

Monitoring of corvid populations at campgrounds and control areas continued in the Santa Cruz Mountains in 2009 at Big Basin Redwoods, Portola Redwoods, and Butano State Parks, and at San Mateo County Memorial Park. Numbers of Steller's Jays declined over the seven year period of study of 2003-2009, with significant trends for all parks combined, and for each individual park. Changes were most pronounced in campgrounds, and were primarily due to declining numbers of adults, with no trend for numbers of juveniles. The decrease in adult jays may be due to recently implemented management actions, mortality from West Nile Virus, or both. A lack of a corresponding decrease in juveniles may reflect the concentrating effect of the campgrounds, or immigration of young birds from areas outside the park unaffected by management. Negative trends for jays and very low numbers at some campgrounds suggest that improved garbage management and user education have had positive benefits. In contrast to the jay, Common Raven numbers showed no significant trends for 2003-2009. However, ravens decreased in 2009, and nesting efforts and success were low, likely due to lethal removal of individuals in 2009 and prior years. American Crows were again recorded in Big Basin and Memorial, and for the first time at Portola, although they did not reside through the nesting season in any of these parks. Continued efforts at park user education and improved garbage receptacles have reduced the amount of human foods available to corvids since the study began.

INTRODUCTION

In 2002 David Suddjian (unpubl. data) conducted a pilot study in Big Basin Redwoods State Park, Portola Redwoods State Park, Butano State Park, and San Mateo County Memorial Park (Figure 1) to compare relative abundance of corvids in areas of high human use with those well removed from areas of high use. In 2003 the Command Oil Spill Trustee Council (COSTC) initiated a corvid monitoring program in the same four parks that was patterned closely the 2002 pilot effort (Suddjian 2004). The COSTC study was to assist the Council in restoration planning for potential projects benefiting the Marbled Murrelet (*Brachyramphus marmoratus*), including corvid management. This report presents the results of corvid monitoring surveys conducted in 2009.

Corvids are among the most significant predators on eggs and chicks of marbled murrelets (Nelson 1997, Peery et al. 2004). Both Steller's Jay (*Cyanocitta stelleri*) and Common Raven (*Corvus corax*) have been documented to prey on murrelet eggs or chicks in the Santa Cruz Mountains (Singer et al. 1991, Suddjian 2003, 2003b, Perry et al. 2004), and Peery et al. (2004) demonstrated rates of nest predation as high as 61-87% in the region.

The Steller's Jay has apparently always been a prominent member of the avian community in old growth forests of the Santa Cruz Mountains. In contrast, Common Ravens are relatively new in those forests, and have only become numerous since the 1980s (Figures 2 and3; Kelly et al. 2002, Bousman 2007). Both species are attracted to campgrounds and other areas of parks with high human use, where human food is often readily available. Consequently, previous studies and general observations in the Santa Cruz Mountains have typically found both Steller's Jay and Common Raven to be much more numerous at campgrounds than away from campgrounds.

A third species of corvid, American Crow (*C. brachyrhynchos*), had been recorded only once prior to 2008 in the areas encompassed by this study. In 2008 crows were found several times in the interior region of Big Basin, and at Memorial Park, and in 2009 they were found in those parks and at Portola. The 2009 occurrences are described herein. Crows have not occurred at Butano as of 2009.

This study compares corvid populations in murrelet nesting habitat within campgrounds (treatment areas) to corvid populations in such habitat in areas located >300 meters from campgrounds (control areas). It also provides a baseline from which to judge future changes in numbers related to corvid management projects in the parks. Such projects were initiated in 2005.

METHODS

STUDY DESIGN

The 2002 pilot study sampled corvids in nine treatment areas and 19 control areas within the four parks and on adjacent private forest land (D. Suddjian unpubl. data). The monitoring program initiated by COSTC in 2003 established and surveyed one or more treatment and control areas in each park in 2003, except at Memorial, where no suitable control areas were identified (Table 1, and Figures 3 to 6). All of the treatment and control areas selected for the COSTC study overlapped entirely or partially with areas surveyed by Suddjian in 2002. Surveys from 2003 to 2009 sampled seven treatment areas and 12 control areas. All survey areas are in coast redwood (*Sequoia sempervirens*) forest known to support use by Marbled Murrelets, with nesting known or suspected to occur either in or immediately adjacent to each survey area. They range in size from 3.2 to 15.7 hectares (Table 1). Trees with potentially suitable nest platforms (Pacific Seabird Group 2003) were counted in each survey area to provide a measure of the structural habitat quality of each site for murrelets (Table 2).

Control areas are located a minimum of 300 meters from any campground, picnic area, or residential community, and are located along roads or trails to facilitate access. Treatment areas include standard campgrounds and their immediate surroundings. Group campgrounds were excluded because they were irregularly occupied, and they were often smaller than a minimum size criterion of 3.0 hectares (Suddjian 2004).

Management projects were initiated in 2005 in the three state parks to attempt to reduce corvid populations. These include lethal removal of ravens, increased emphasis on proper food storage, improvements in garbage receptacles and management, increased education for park users about Marbled Murrelets and about corvids as predators, and warnings and potential citations for campers feeding wildlife or improperly storing food or trash.

DESCRIPTION OF SURVEY AREAS

General Patterns Of Human Use

The campgrounds are used continuously throughout the survey period of June to August, although occupancy varies daily and through the season. Occupancy is typically at or near 100% on weekends, but often considerably less on weekdays, and is greater in July and August than in June. Campground occupancy during the surveys in 2009 ranged from 15% to 97% (Table 3). Overall occupancy for all sites combined was up 8% in 2009. A portion of Sempervirens Campground in Big Basin was closed during June 2009.

Human foods are continually available to corvids in varying degrees at occupied campgrounds. Food is occasionally (but regularly) offered directly to wildlife by

campers, but is also widely available as discarded or fallen scraps or fragments, garbage left at camp sites, dog food left in the open, food fragments stuck on grills at fire rings, and at water spigots where dishes are rinsed. Food left unattended during the day or improperly stored at night is commonly plundered by wildlife. Additionally, in some parks food is readily available at trash receptacles that permit animal access, spillage by animals, are left open, or are too full to close properly. Another human-related food source, although more rarely available than human food, was road killed mammals, such as squirrels, raccoons and skunks on campground roads or other park roads.

Human activity in the control areas is mostly limited to hiking, bike riding and jogging, with no established picnic sites. Although each control area receives daily use by people in June to August, no one other than the surveyor was evident during any of the morning surveys in control areas in 2003 to 2009, with the exception of one park maintenance vehicle that drove through once at one site in 2005, and one jogger at one site in 2006.

Big Basin Redwoods State Park

Treatment areas are Blooms Creek Campground (55 sites), Sempervirens Campground (31 sites), Huckleberry Campground (71 sites), and Wastahi Campground (27 sites) (Table 1, Figure 4). Two control areas are located along the upper reach of Opal Creek, and four are along Gazos Creek Escape Road west of Opal Creek (Table 1, Figure 4).

The only change in garbage receptacles at Big Basin in 2009 was the addition of two small dumpsters at Blooms Creek Campground, replacing sets of open trash cans that had been added there in 2009. The metal trash dumpsters with heavy lids were usually closed, but rarely were left open. Occasionally the lid of an overly full dumpster could not be closed, permitting birds and other animals to reach its contents.

Portola Redwoods State Park

The treatment area is the main campground, referred to here as Portola Campground (53 sites; Table 1, Figure 5). The control areas are along Peters Creek and a tributary north of the campground, and in two areas along the Iverson Trail (Table 1, Figure 5).

There were no changes in garbage receptacles at Portola in 2009. The campgrounds and picnic areas at Portola have metal trash receptacles with animal proof lids. No spillage was observed around the garbage receptacles in Portola in 2009.

Butano State Park

The treatment area is the Ben Ries Campground (38 sites; Table 1, Figure 6). The control areas are along the Butano Service Road extending northeast from the campground, Goat Hill Trial, and Doe Ridge Trail (Table 1, Figure 6).

There were no changes in garbage receptacles at Butano in 2009. Ben Ries Campground has animal-proof metal trashcans. No animal access or spillage was observed in 2009.

San Mateo Memorial County Park

The treatment area is the Sequoia Flat Campground (104 sites) (Table 1, Figure 7). No control areas with suitable habitat and sufficient distance from areas of high human use were identified, so control areas for this park were located in Big Basin instead (four areas along Gazos Creek Escape Road, Figure 4).

There were no new garbage receptacles at Memorial in 2009. Most of the smaller-size dumpsters with relatively light weight lids had been fitted with metal pats to increase the lid weight, making them less easy for animals to open. Open metal trash cans were still present in the campgrounds.

CORVID SURVEY METHODS

Each site was surveyed using the total area search method (Ralph et al. 1993). The search area at treatment areas included the entire area of campsites and extended outward 50 meters from the edge of the camp boundary. Control areas were established along roads and trails, and the search area extended outward for 50 meters from the center of the road or trail. Thus, the control areas were equivalent to 100-meter wide strip transects in which the total area searches were conducted. Fifty meters was selected as the outside distance to insure the best chance of visual detection of perched, silent birds. Vegetation obscured views too significantly beyond 50 meters. Movement off the road or trail was avoided in control areas to minimize noise made by the surveyor.

David Suddjian conducted all the surveys. Surveys were done by walking slowly through the survey site and pausing often for brief periods, listening for vocalizations and making visual scans to detect corvids. Although Luginbuhl et al. (2001) found that broadcasting taped calls enhanced detections of ravens, this method was not used in this study to avoid disturbance of campers and distraction to the surveyor when campers would inquire about the broadcast calls. Furthermore, the taped calls might attract ravens into the survey areas from outside the boundary during the survey.

Each jay and raven was recorded, indicating its age if known. Aging of ravens was straightforward through the season due to the status of molt of adults, feather wear, vocalizations, and the presence of a pale gape on the juveniles. Aging of jays was easy in June and most of July (using plumage pattern, begging behavior and vocalizations, and the pale gape of the juveniles), but it became more difficult in late July and August, when the juveniles more closely resembled adults and begging activity declined. Aging silent jays was sometimes difficult due to poor lighting conditions. Behavior of jays and ravens was recorded in notes, particularly as it related to foraging.

Other information recorded for each survey included date, start and end times, weather conditions, number of occupied campsites, number of opportunities to access human food

(i.e., spilled trash, unattended food, campers feeding wildlife), and details of foods consumed by corvids.

Survey Frequency and Timing

Four surveys were conducted at each site, with one survey in June, two in July, and one in August. Survey dates in 2009 for each site are given on Table 4. Each site was surveyed only once per day (or if surveyed more than once per day, then data from the first survey of the day was used for analyses here), but usually more than one site was surveyed on the same morning. Campgrounds were only surveyed on weekdays. An effort was made to sample each site on dates close to those when it was sampled in prior years.

Each survey occurred in a window beginning 35 minutes after sunrise and extending for up to four hours after sunrise. The rationale for selection of this window of time for the surveys was described in Suddjian (2004). The time required to cover each survey area varied with the size of the area, but the average rate of coverage was 3.1 minute per ha (± 0.6 minute). The time expended in each area was kept fairly consistent over each of the four replications, and each year.

ANALYSES

Analyses comparing abundance in treatment and control areas used only the maximum number of corvids detected on any of the four surveys of each area (Luginbuhl et al. 2001), although average counts are also presented in the tables. Both adult and juvenile corvids were lumped for analyses of overall abundance. Numbers of adult and juvenile jays were analyzed to evaluate changes in abundance of each age class over time. Adjusted counts of adults and juvenile jays were derived from the raw counts using the percentage of juveniles observed during each survey replication in each park. Values of $p < 0.05$ were considered statistically significant, while values $0.1 > p > 0.5$ were considered marginally significant.

Some comparisons are made to the results of the preliminary study of 2002 (D. Suddjian unpubl. data) for all sites pooled together, as the sites were either the same as those of the COSTC-sponsored surveys, or overlapped with them broadly, and the surveys methods were the same.

RESULTS

STELLER'S JAY

Survey results and statistical comparisons for each park in 2009 are given on Tables 5 and 6. Raw counts of jays for 2003 to 2009 are given in Appendix 1. Adjusted counts of adult and juvenile jays are given in Appendix 2. Steller's Jays were recorded at all but two survey sites in 2009, being missed at Gazos 2 and Goat Hill. Steller's Jays were recorded on all surveys in treatment areas, and on 65% of 48 surveys in control areas (Table 5). They were ubiquitous in treatment areas, where overall they were 7.3 times more numerous than in control areas, with the difference being highly significant (Table 6). The higher numbers in treatment areas compared to controls was significant for each park (Table 6, Appendix 1).

Overall, jay abundance (all parks combined) was lower in 2009 than in any prior year of this study (Table 9, Figure 8). There was a significant negative trend for treatment areas from 2003 to 2009 ($r^2 = 0.850$, $p = 0.002$), with jay abundance decreasing by 64% over the 7-year period. A negative trend for control areas ($r^2 = 0.629$) was also significant ($p = 0.017$), with jay abundance decreasing by 54% over the 7-year period, although changes in absolute numbers in control areas were small.

Among individual parks, the 7-year trend in total jay abundance showed significant declines in treatment areas at all four parks(Figure 9): Big Basin ($r^2 = 0.537$, $p = 0.030$), Portola ($r^2 = 0.833$, $p = 0.002$), Butano ($r^2 = 0.860$, $p = 0.001$), and Memorial ($r^2 = 0.783$, $p = 0.004$). In control areas the declining trend was significant at Big Basin ($r^2 = 0.549$, $p = 0.028$) and marginally significant at Butano ($r^2 = 0.335$, $p = 0.086$) (Figure 9).

Jays remained most abundant at Memorial in 2009, while Butano had fewer jays per hectare than the other parks (Figure 10). The maximum raw count for any area in 2009 was 79 jays at Sequoia Flat Campground at Memorial on July 22.

The percentage of juvenile jays in the overall study area has consistently exhibited an increase across the survey season; the percentage has increased geometrically in treatment areas, but with relatively small increases in control areas (Figure 11). This apparently reflects a movement of jays into the campgrounds from outlying areas, perhaps from long distances. Substantial numbers of juvenile jays congregate in some campgrounds (notably Sequoia Flat, Blooms Creek and Huckleberry). An increase in adult jays in treatment areas from June to late July (coincident with a decrease in numbers in control areas) suggests a similar movement may occur for adults, but to a lesser degree (Figure 12).

The annual maxima for adult jays in treatment areas in all parks combined exhibited a highly significant decline over the 7-year period, with numbers in 2009 being the lowest for this study ($r^2 = 0.895$, $p < 0.001$; Figure 13a). However, adults in control areas

showed a non-significant declining trend (Figure 13b). There were no trends in the numbers of juveniles jays in either treatment or control areas (all parks combined) over the 7-year period.

Adult jays exhibited significant declines at all four individual parks: Big Basin (r^2 = 0.793, p = 0.004, Portola (r^2 = 0.654, p = 0.014), Butano (r^2 = 0.913, p < 0.001, and Memorial (r^2 = 0.793, p = 0.004 (Figure 14). The same pattern of decline in adults was evident when 7-year trend analyses were limited just to the results of the June surveys, the period which more closely reflects the population of jays actually nesting in the treatment areas. Significant declines in June were evident in treatment areas at Big Basin, Butano and Memorial, and all parks combined, but not Portola (Figure 15). A significant decline in adults in control areas was observed at Butano (r^2 = 0.665, p = 0.013), with a marginally significant decline in adults in control areas at all parks combined (r^2 = 0.408, p = 0.058).

In contrast to trends for adult jays, the 7-year trend for juvenile jays was not significant in either treatment or control areas (Figures 13 and 14). Absolute numbers of adult and juvenile jays were far greater at Big Basin and Memorial, than at Portola and Butano (Figure 16), reflecting the much larger campground areas at Big basin and Memorial.

Jay behavior and interactions with people were similar to those observed in previous years (Suddjian 2004 et. seq.). Jays were frequently seen inspecting occupied campsites for food, and were quick to capitalize on opportunities to steal unattended food, or to search for food in just-vacated sites. Jays were observed taking advantage of spilled garbage, stealing unattended food in camps, being fed directly by campers, and picking food fragments from campfire grills and at water spigots. Human foods taken by jays during the surveys were similar to those mentioned in Suddjian (2004).

Jays typically began each morning with an active search of campsites for food scraps left from the previous night, and visited trash receptacles where nocturnal mammals had made food available (primarily at Memorial Park). Places where jays consistently sought and found scraps of food were at the campsite tables, grills of campsite fire rings, and at campground water spigots where campers rinse their dishes. Some individuals spent considerable time foraging by digging into the dirt and duff at campsites and consuming small items of undetermined identity. Natural foods frequently taken by jays in campgrounds included huckleberries and tanoak acorns. Young jays were especially attracted to ripening huckleberries.

COMMON RAVEN

Survey results and statistical comparisons for each park in 2009 are given on Tables 7 and 8. Raw counts for 2003 to 2009 are given in Appendix 1. Common ravens were recorded in all seven of the treatment areas in 2009, where they were detected on 61% of the 28 surveys (Table 7). The incidence of detection in Big Basin's campgrounds was lower in 2009 than in other years. Ravens were detected at just two (17%) of the 12 control areas, and were found on only 4% of 48 surveys in control areas (Table 7). Raven numbers in treatment areas exceeded those in control areas by 11.5 times when the data from all sites were pooled (Table 8). Ravens were significantly more numerous in treatment areas than control areas at all parks except Portola (Table 8).

Common Ravens decreased in overall abundance (all parks combined) in both treatment and control areas from 2008 to 2009 (Figure 17). In individual parks they decreased in treatment areas at Big Basin, Portola and Memorial, but increased at Butano, while changes in control areas were mixed (Figure 18). However, the changes in absolute numbers were small (Appendix 1), and the increase at Butano was due to the presence of a pair that nested successfully near Ben Ries campground in 2009.

The period of 2003-2009 had no trend for all treatment areas combined, but a non-significant declining trend for control areas. Among individual parks, there were no significant trends for the 7-year period for either treatment or control areas (Figure 18).

Ravens were generally uncommon, with just three aggregations observed in 2009. Most surveys recorded only one or two adults, and more rarely two adults. As in most past years raven numbers did not increase consistently over the season among the sites (Table 7). Most treatment sites had one pair of adults that was regularly or irregularly present, and in some cases their offspring. The only aggregations observed other than resident pairs or families were: at Portola on May 25 when six flew west over the campground, at Memorial on June 12 when a wandering group of seven ravens was roaming over the park, and at Big Basin on June 17 when a flock of 10 ravens flew up the Opal Creek drainage to the vicinity of Mattocks Creek, and then returned downstream. All these flocks were likely comprised of one year old ravens, as none showed wing molt evident in adults at that season, and they were not young of the year.

It was difficult to sort out the number of pairs residing at Big Basin in 209 as use of nesting territories seemed to be disrupted for some birds, and some were only occupied by single birds. No more than two family groups were confirmed in the region of the park covered by the corvid surveys in 2009, both in the Blooms Creek watershed, with a total of four juveniles. This was the lowest productivity observed since this study began. Known nests sites that had been found before 2009 were not used that year (or early efforts failed or were abandoned), and one new nest that was found did not appear to be active.

At Portola there was no evidence of any active nests in the region of the park covered by this study in 2009, although members of up to two pairs were evident from late May to

August. The nest found in prior years that was south of the park headquarters was not in use.

At Butano a pair of ravens nested just north of Ben Ries Campground in 2009, fledging two young. Other pairs resided in the park away from the area covered by this study.

At Memorial three pairs of ravens nested in or near the park in 2009, but fledging success was low with only three juveniles noted. Other adults sometimes visited the park.

Raven behavior and interactions with people were similar to those described previously (Suddjian 2004 et seq.). As in prior years, they remained wary and did not approach people or take handouts. But they regularly investigated campsites when people were absent, visited spilled garbage, and stole unattended food. The concentration of naïve fledgling jays at campgrounds continued to attract attention from ravens, and seemed to be a principal attraction for them at campgrounds.

AMERICAN CROW

Detections of American Crows in Big Basin in 2009 included one at Blooms Creek Campground on June 4, two flying west at Slippery Rock on June 19, one near the intersection of North China Grade and Highway 236 on July 4, and one at the east end of Gazos Creek Road near the day use picnic area on July 18. There was no indication of any resident crows in the interior region of the park during the 2009 breeding season.

Detections of American Crows in Portola in 2009 included one in the Evans Creek watershed (northwest of the main campground) on May 28. Two were about one mile north of the park along Portola State Park Road on June 23. These were the first reported detections of this species in and immediately near this park.

Detections of American Crows in Memorial Park in 2009 included one near Homestead Flat Group Campground on May 29, and one at Sequoia Flat Campground on July 8. The species was first recorded in the park in 2008. There was no suggestion that the species was resident in or near the park in 2009.

DISCUSSION

Steller's Jay continued its declining trend over the seven year period of study, with significant trends for all parks combined, and for all four individual parks. Changes were most pronounced in treatment areas, and were primarily due to declining numbers of adults, with no trend for numbers of juveniles. The decrease in adult jays may be due to management actions promulgated by the COSTC. Some of the decrease might also be related to mortality from West Nile Virus. The lack of a corresponding decrease in juveniles may reflect the concentrating effect of the campgrounds, where they attract sufficient numbers of juvenile jays from outlying areas to mask changes in the number of young produced in the vicinity of the campgrounds. Or juveniles may be entering the parks from outside areas where breeding populations are not affected by management actions.

Very low numbers of jays were recorded at Ben Ries Campground in Butano for the third year in a row, with a peak count there in 2009 of just eight jays. Jay numbers in that campground were on a par with those in control areas. Thus, campgrounds do not always support elevated numbers of jays. Similarly impressive low counts were obtained at Portola's campground in June (just five jays) and at Memorial's Sequoia Flat Campground in June (only 17). These low counts are reflective of the reduced populationof adults, and may also indicate that improved garbage management and user education has had positive benefits.

In contrast to the jay, Common Raven showed no significant trends for the 2003-2009 period. However, ravens decreased in 2009, with fewer nesting pairs and relatively low success. It appeared likely that shooting of ravens in 2009 and prior years had led to reduced numbers of breeding birds and disruption of use of nesting territories and nesting efforts.

The presence of American Crows in three of the parks in 2009 continued a new pattern of presence in the forest parks, and was was likely related to expanding ranges and populations of this species in both San Mateo and Santa Cruz counties, and in particular to range expansions in the Boulder Creek watershed southeast of Big Basin, and the Pescadero area west of Memorial. However, they have yet to establish any season-long presence in the parks.

Continued efforts at park user education and improved garbage receptacles have reduced the amount of human foods available to corvids since the study began. Continued improvements were evident in 2009, notably at Memorial and Big Basin

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Table 1. Attributes of the corvid survey areas.

Survey Area	Type	Human Use	Access[1]	Area (ha)	Slope Position[2]	Approx. Elevation	*Canopy Composition*[3] RW	DF	TO	FLO	MA	Other
Big Basin Redwoods SP												
Blooms Creek	Treatment	Camp	1	15.7	B	900–1,120’	1	2	1	2	3	3
Sempervirens	Treatment	Camp	1	7.2	B	960-1,080’	1	2	1	2	3	--
Huckleberry	Treatment	Camp	1,2	13.4	B	980-1,160’	1	2	1	1	2	--
Wastahi	Treatment	Camp	1,3	7.2	B	1,020-1,250’	1	2	1	--	--	--
Opal Creek 2	Control	Hiking	1	10.2	B	1,050-1,180’	1	2	1	3	3	3
Opal Creek 3	Control	Hiking	3	6.6	B	1,075-1,225’	1	2	1	3	3	3
Gazos Creek Road 1	Control	Hiking	2	9.4	S	1,120-1,280’	1	2	1	2	2	--
Gazos Creek Road 2	Control	Hiking	2	6.7	S	1,240-1,350’	1	1	1	2	2	--
Gazos Creek Road 3	Control	Hiking	2	7.5	S	1,140-1,320’	1	2	1	2	2	--
Gazos Creek Road 4	Control	Hiking	2	7.5	S	960-1,180’	1	2	1	2	2	--
Portola Redwoods SP												
Portola	Treatment	Camp	1	8.4	B	350-560’	1	2	1	1	3	3
Peters Creek	Control	Hiking	1,3	7.7	B	400-600’	1	2	1	2	3	3
Iverson Trail 1	Control	Hiking	3	7.1	B	320-520’	1	2	1	2	2	3
Iverson Trail 2	Control	Hiking	2,3	6.9	B	350-520’	1	2	1	3	3	3

Continued on next page,

Table 1, continued

Survey Area	Type	Human Use	Access[1]	Area (ha)	Slope Position[2]	Approx. Elevation	*Canopy Composition*[3] RW	DF	TO	FLO	MA	Other
Butano SP												
Ben Ries	Treatment	Camp	1,3	9.6	B	400-650’	1	2	1	3	3	--
Butano Service Road	Control	Hiking	2	8.1	B	500-670’	1	2	1	3	3	3
Goat Hill Trail	Control	Hiking	3	3.2	S	620-840’	1	2	1	2	3	--
Doe Ridge Trail	Control	Hiking	3	15.7	S	880-1,120’	1	1	1	2	3	--
Memorial CP												
Sequoia Flat	Treatment	Camp	1	12.6	B	180-280’	1	2	1	2	--	3

1. Access: 1 (paved road), 2 (unpaved road), 3 (trail).
2. Slope position: B (bottom of valley), S (mid-slope), R (ridgeline).
3. Approximate canopy cover by each tree species, classed as 1 (50-100%), 2 (11-49%), 3 (1-10%). Tree species: RW (coast redwood), DF (Douglas-fir), TO (tan oak), FLO (Forest (Shreve) live oak), MA (madrone), other (includes California bay, red alder, white alder, and big leaf maple)

Table 2. Number of trees with platforms in each survey area[1].

Survey Area	Area (ha)	# RW[2]	# DF	# All	# RW / ha	# DF / ha	# All / ha
Big Basin							
Blooms	15.7	11	38	49	0.7	2.4	3.1
Sempervirens	7.2	7	16	23	1.0	2.2	3.2
Huckleberry	13.4	28	31	59	2.1	2.3	4.4
Wastahi	7.2	9	8	17	1.3	1.1	2.4
Opal 2	10.2	16	11	27	1.6	1.1	2.7
Opal 3	6.6	6	12	18	0.9	1.8	2.7
Gazos 1	9.4	11	13	24	1.2	1.4	2.6
Gazos 2	6.7	10	9	19	1.5	1.3	2.8
Gazos 3	7.5	13	3	16	1.7	0.4	2.1
Gazos 4	7.5	7	4	11	0.9	0.5	1.5
Portola							
Portola	8.4	21	33	54	2.5	3.9	6.4
Peters	7.7	4	22	26	0.5	2.9	3.4
Iverson 1	7.1	16	29	45	2.3	4.1	6.4
Iverson 2	6.9	11	18	29	1.6	2.6	4.2
Butano							
Ben Ries	9.6	17	44	61	1.8	4.6	6.4
Service	8.1	3	20	23	0.4	2.5	2.8
Goat Hill	3.2	2	8	10	0.6	2.5	3.1
Doe Ridge	15.7	9	25	34	0.6	1.6	2.2
Memorial							
Sequoia	12.6	39	45	84	3.1	3.8	6.7

1. “Platforms” were features in the live crown of a conifer that offered potentially suitable nest sites for Marbled Murrelets; “a relatively flat surface at least 10 cm (4 in) in diameter and 10 m (33 ft) high” Pacific Seabird Group (2003, p. 2).

2. “RW” (coast redwood), “DF” (Douglas-fir).

Table 3. Campground occupancy (%) during the 2009 corvid surveys, and average occupancy from 2003-2009.

Survey Area	# of Sites	2009 Run 1	Run 2	Run 3	Run 4	2003-2009 Avg occupancy 03	04	05	06	07	08	09
Big Basin												
Blooms	55	82	93	87	87	75	67	53	61	73	77	87
Sempervirens	31	16	84	77	52	79	72	49	52	63	70	57
Huckleberry	71	59	82	75	62	66	52	36	42	52	54	69
Wastahi	27	33	59	44	56	43	30	18	22	46	31	48
Portola												
Portola	53	13	19	40	15	44	24	20	22	20	26	22
Butano												
Ben Ries	38	39	87	89	97	73	88	82	73	66	58	78
Memorial												
Sequoia	104	29	38	38	37	53	43	44	29	29	39	35
All Areas Combined	379	40	61	61	54	61	50	42	41	46	50	54

Table 4. Dates of the 2009 corvid surveys.

	Survey Dates			
Survey Area	*Run 1*	*Run2*	*Run 3*	*Run 4*
Big Basin				
Blooms Creek	June 18	July 3	July 15	August 14
Sempervirens	June 18	July 3	July 15	August 14
Huckleberry	June 18	July 3	July 15	August 14
Wastahi	June 18	July 3	July 15	August 14
Opal Creek 2	June 15	July 4	July 17	August 12
Opal Creek 3	June 15	July 4	July 17	August 12
Gazos Creek Road 1	June 15	July 4	July 17	August 12
Gazos Creek Road 2	June 15	July 4	July 17	August 12
Gazos Creek Road 3	June 15	July 4	July 17	August 12
Gazos Creek Road 4	June 15	July 4	July 17	August 12
Portola				
Portola	June 24	July 9	July 27	August 25
Peters Creek	June 24	July 9	July 27	August 25
Iverson Trail 1	June 25	July 10	July 28	August 25
Iverson Trail 2	June 25	July 10	July 28	August 25
Butano				
Ben Ries	June 11	July 1	July 21	August 11
Butano Service Road	June 10	July 1	July 20	August 11
Goat Hill Trail	June 10	July 1	July 20	August 11
Doe Ridge Trail	June 10	July 1	July 20	August 11
Memorial				
Sequoia Flat	June 12	July 8	July 22	August 14

Table 5. Number of Steller's Jays per hectare on the 2009 surveys.

Survey Area	Run 1	Run 2	Run 3	Run 4	Max	Avg
Big Basin						
Blooms	0.64	1.21	2.29	2.99	2.99	1.78
Sempervirens	0.14	0.56	1.94	1.25	1.94	0.97
Huckleberry	0.60	1.12	1.94	2.31	2.31	1.49
Wastahi	0.14	0.56	0.14	0.42	0.56	0.31
Opal 2	0.20	0.10	0.00	0.00	0.20	0.07
Opal 3	0.00	0.30	0.15	0.15	0.30	0.15
Gazos 1	0.21	0.00	0.00	0.11	0.21	0.08
Gazos 2	0.00	0.00	0.00	0.00	0.00	0.00
Gazos 3	0.27	0.53	0.00	0.13	0.13	0.03
Gazos 4	0.13	0.00	0.00	0.00	0.13	0.03
Portola						
Portola	0.60	2.26	1.19	1.90	2.26	1.49
Peters	0.39	0.13	0.26	0.26	0.39	0.26
Iverson 1	0.42	0.28	0.28	0.56	0.56	0.39
Iverson 2	0.58	0.14	0.43	0.43	0.58	0.40
Butano						
Ben Ries	0.42	0.21	0.83	0.83	0.83	0.57
Service	0.25	0.62	0.25	0.12	0.62	0.31
Goat Hill	0.00	0.00	0.00	0.00	0.00	0.00
Doe Ridge	0.06	0.19	0.13	0.06	0.19	0.11
Memorial						
Sequoia	1.35	4.05	6.27	5.24	6.27	4.23

Table 6. Comparison of numbers of Steller's Jays in treatment and control areas in 2009

Survey Area	Avg/ha[1]	S.E.	N	Statistical Significance
All parks combined				
Treatment	2.5	1.89	7	$P^{(1\text{-tailed})} < 0.001$
Control	0.3	0.22	12	
Big Basin				
Treatment	2.0	1.03	4	$P^{(1\text{-tailed})} < 0.002$
Control	0.2	0.10	6	
Portola				
Treatment	2.3	0.00	1	$P^{(1\text{-tailed})} = 0.004$
Control	0.5	0.11	3	
Butano				
Treatment	0.8	0.00	1	$P^{(1\text{-tailed})} = 0.045$
Control	0.3	0.32	3	
Memorial				
Treatment	6.3	0.00	1	$P^{(1\text{-tailed})} < 0.001$
Control[2]	0.3	0.14	4	[2]see note

1. Average of maximum counts from each survey area.
2. Controls for Memorial CP were located in Big Basin Redwoods SP.

Table 7. Number of Common Ravens per hectare on the 2009 surveys.

Survey Area	Run 1	Run 2	Run 3	Run 4	Max	Avg
Big Basin						
Blooms	0.19	0.32	0.13	0.00	0.32	0.16
Sempervirens	0.00	0.00	0.00	0.28	0.28	0.07
Huckleberry	0.07	0.00	0.07	0.00	0.07	0.04
Wastahi	0.14	0.00	0.00	0.00	0.14	0.03
Opal 2	0.00	0.00	0.00	0.00	0.00	0.00
Opal 3	0.00	0.00	0.00	0.00	0.00	0.00
Gazos 1	0.00	0.00	0.00	0.00	0.00	0.00
Gazos 2	0.00	0.00	0.00	0.00	0.00	0.00
Gazos 3	0.00	0.00	0.00	0.00	0.00	0.00
Gazos 4	0.00	0.00	0.00	0.00	0.00	0.00
Portola						
Portola	0.12	0.00	0.00	0.12	0.12	0.06
Peters	0.00	0.00	0.00	0.00	0.00	0.00
Iverson 1	0.00	0.00	0.14	0.00	0.14	0.04
Iverson 2	0.14	0.00	0.00	0.00	0.14	0.04
Butano						
Ben Ries	0.10	0.10	0.42	0.21	0.42	0.21
Service	0.00	0.00	0.00	0.00	0.00	0.00
Goat Hill	0.00	0.00	0.00	0.00	0.00	0.00
Doe Ridge	0.00	0.00	0.00	0.00	0.00	0.00
Memorial						
Sequoia	0.32	0.40	0.16	0.24	0.40	0.28

Table 8. Comparison of numbers of Common Ravens in treatment and control areas in 2009

Survey Area	Avg/ha[1]	S.E.	N	Statistical Significance
All parks combined				
Treatment	0.25	0.14	7	$p^{(1\text{-tailed})} < 0.001$
Control	0.02	0.06	12	
Big Basin				
Treatment	0.20	0.12	4	$p^{(1\text{-tailed})} = 0.003$
Control	0.00	0.00	6	
Portola				
Treatment	0.12	0.00	1	n.s.
Control	0.10	0.08	3	
Butano				
Treatment	0.42	0.00	1	$p^{(1\text{-tailed})} < 0.001$
Control	0.00	0.00	3	
Memorial				
Treatment	0.40	0.00	1	$p^{(1\text{-tailed})} < 0.001$
Control[2]	0.00	0.00	4	[2]see note

1. Average of maximum counts from each survey area.
2. Controls for Memorial CP were located in Big Basin Redwoods SP.

Table 9. Number of corvids per hectare in treatment and control areas in the four parks from 2002 to 2009

Species	2002[1]	2003	2004	2005	2006	2007	2008	2009
Steller's Jay								
Treatment	5.4 ± 1.5	6.8 ± 3.7	4.5±2.9	4.4±3.9	4.1±2.0	3.1±2.5	3.1±2.4	2.5±1.9
Control	0.6 ± 0.3	0.7 ± 0.3	0.5±0.3	0.5±0.4	0.5±0.4	0.4±0.2	0.5±0.6	0.3±0.2
Com. Raven								
Treatment	0.6 ± 0.3	0.2 ± 0.2	0.4±0.3	0.3±0.2	0.2±0.1	0.4±0.2	0.3±0.1	0.25±0.1
Control	0.1 ± 0.1	0.1 ± 0.1	0.1±0.1	0.1±0.04	0.1±0.1	0.1±0.2	0.4±0.1	0.02±0.1

1. 2002 surveys (D. Suddjian unpublished data)

Figure 1. General location of survey areas.

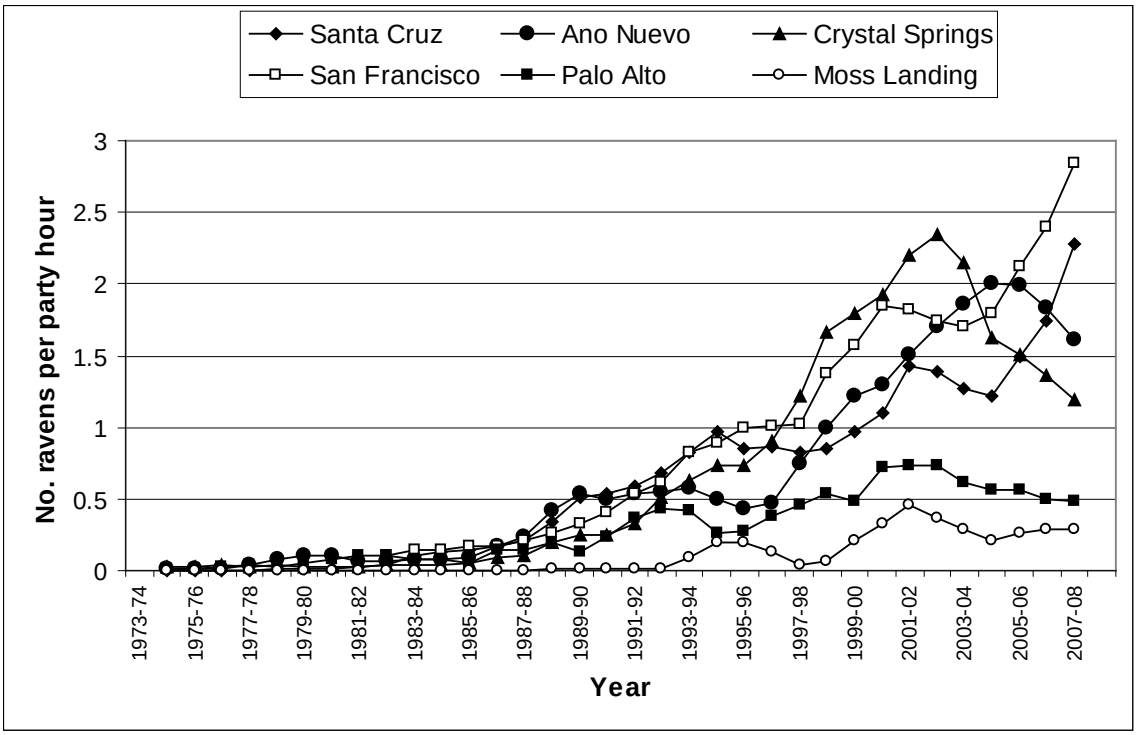


Figure 2. Common Ravens have increased dramatically in all six Christmas Bird Count circles in the Santa Cruz Mountains region. (Note: data presented as a 3-year running mean.)

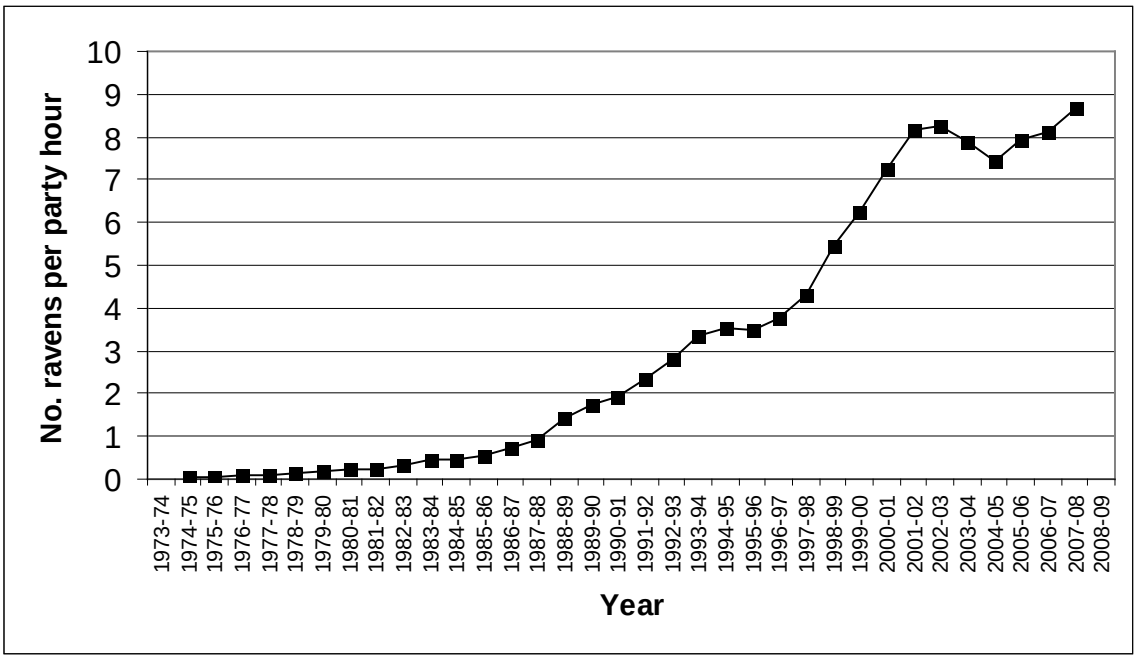


Figure 3. Increase in Common Raven as recorded by all six Santa Cruz Mountains region CBCs combined. (See Figure 2 for listing of individual counts.)

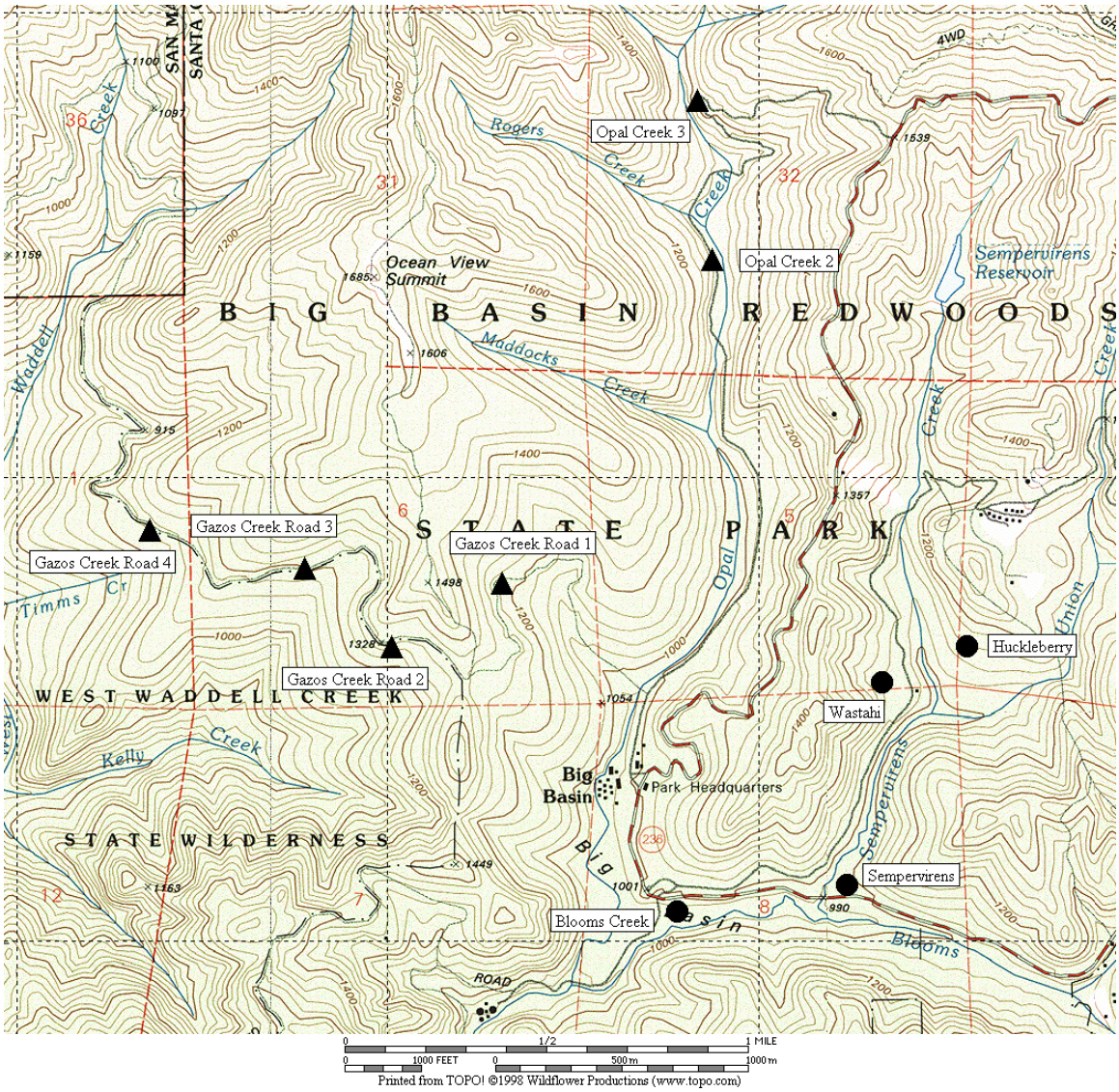


Figure 4. General location of corvid surveys area at Big Basin Redwoods State Park.

● treatment sites ▲ control sites

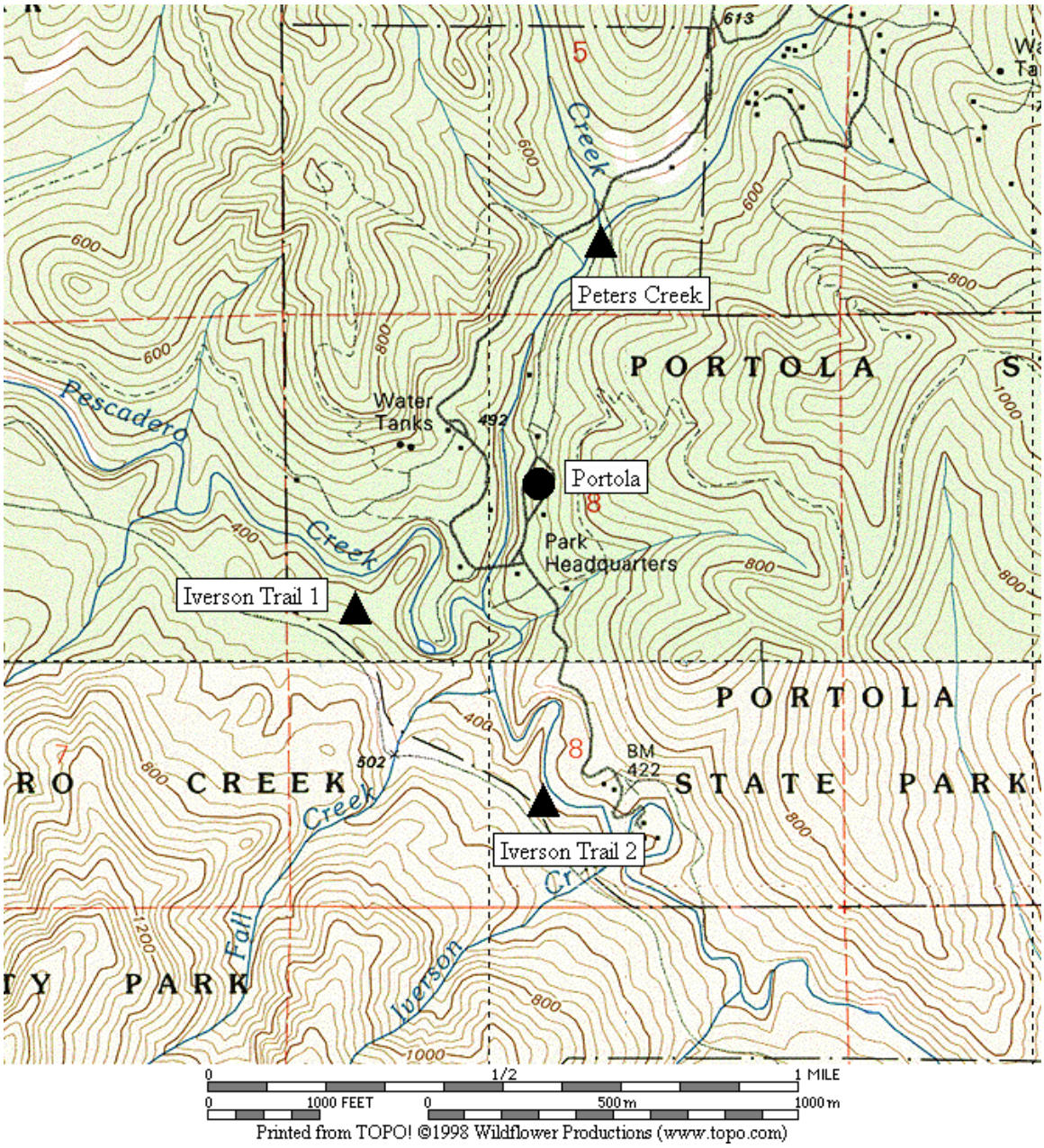


Figure 5. General location of corvid surveys area at Portola Redwoods State Park.

● treatment sites ▲ control sites

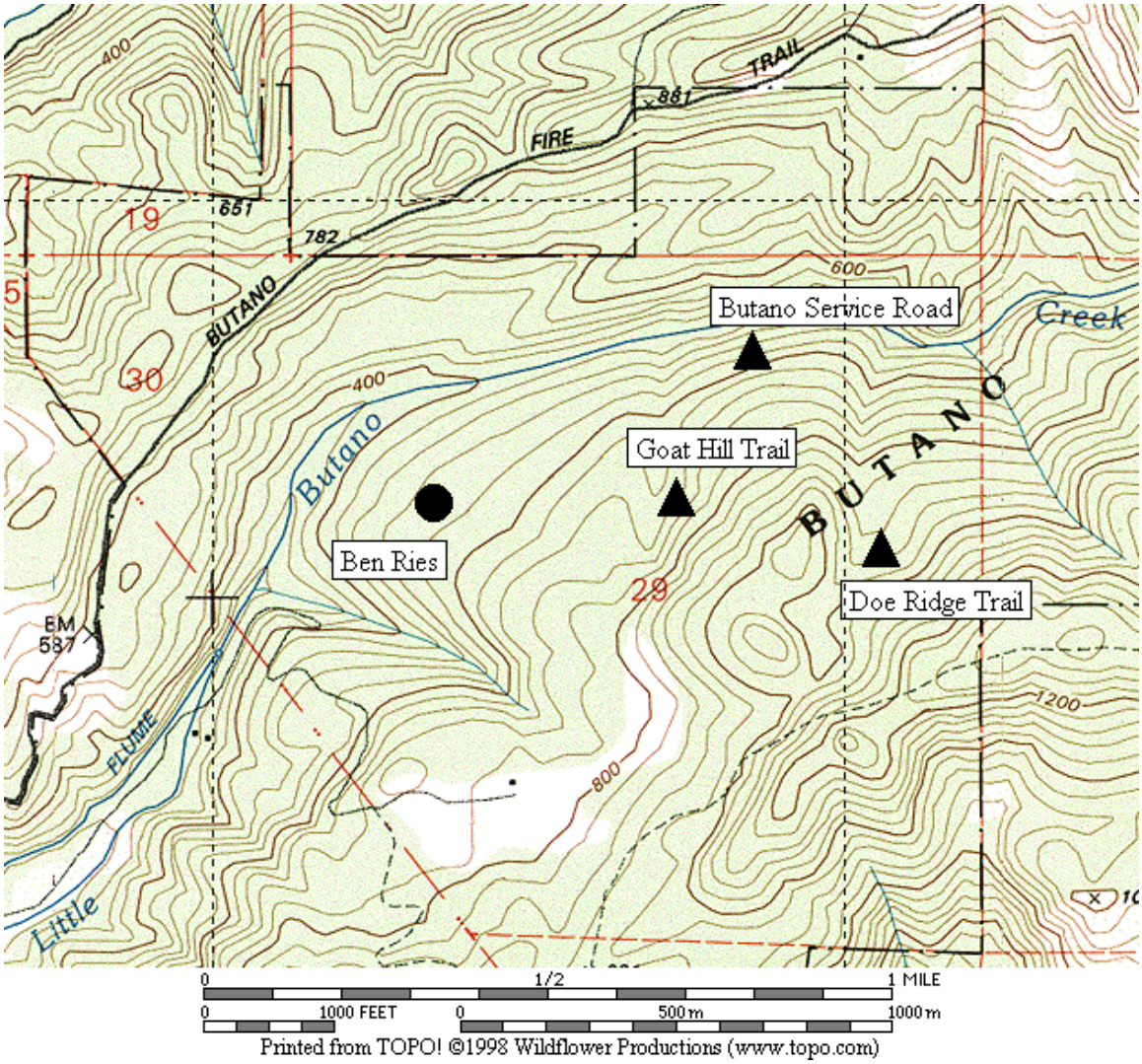


Figure 6. General location of corvid surveys area at Butano State Park.

● treatment sites ▲ control sites

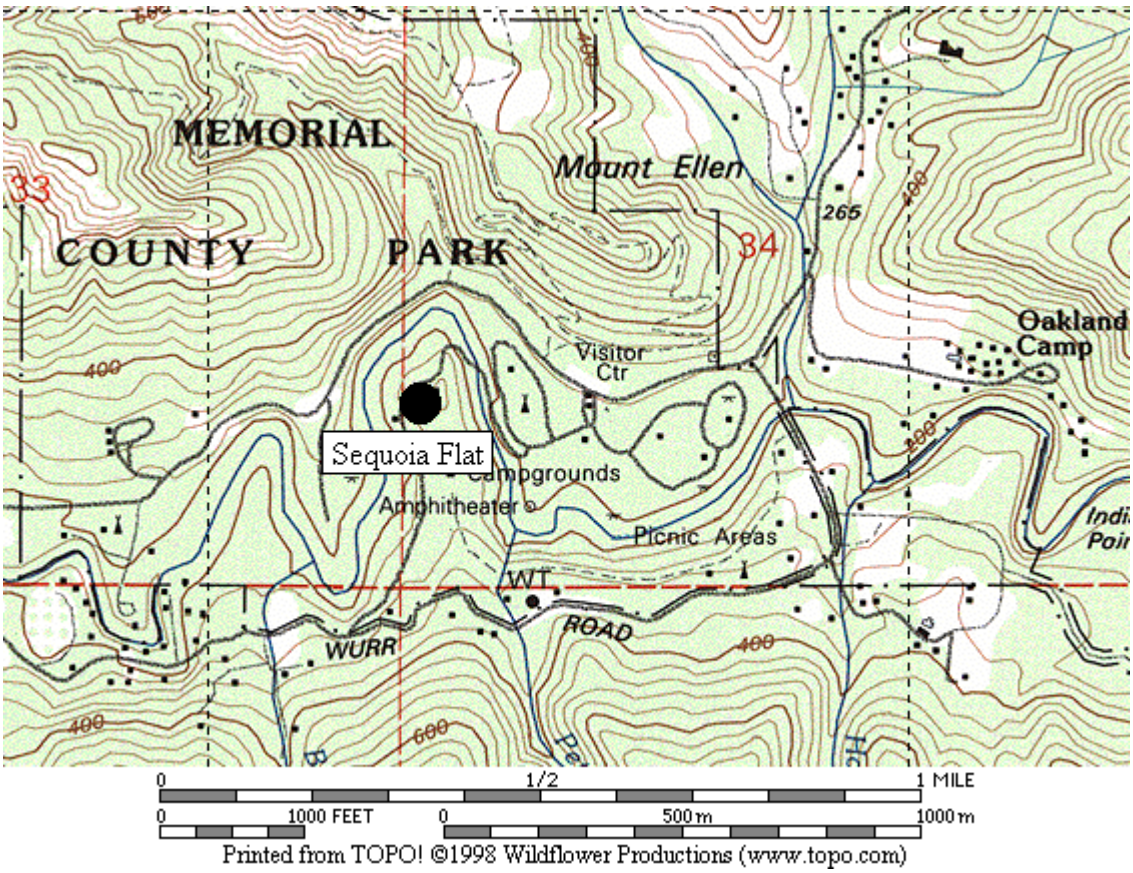


Figure 7. General location of corvid surveys area at San Mateo County Memorial Park.

● treatment site

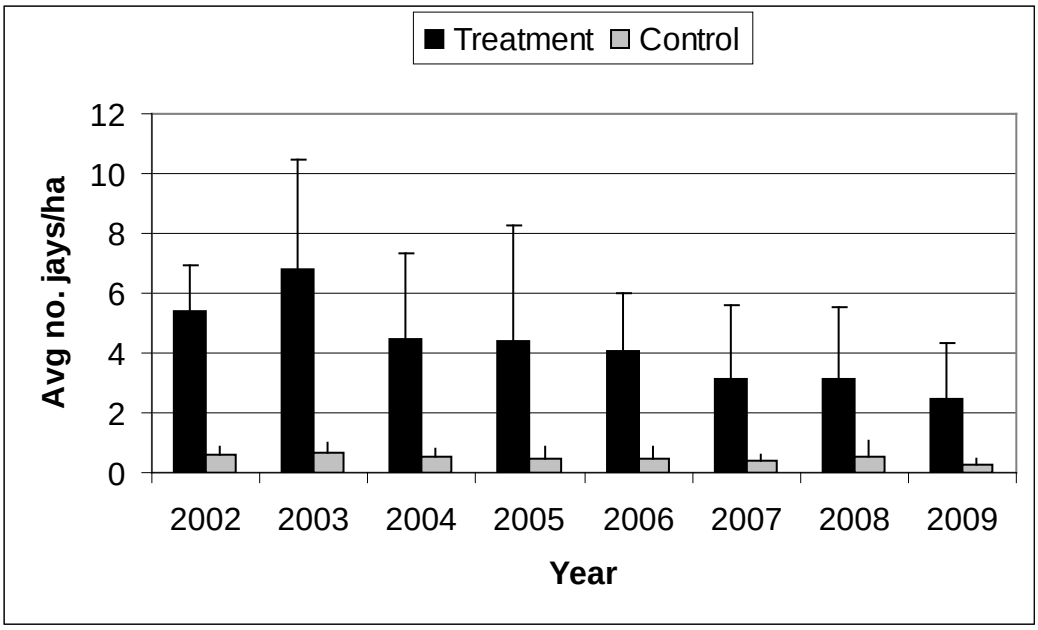
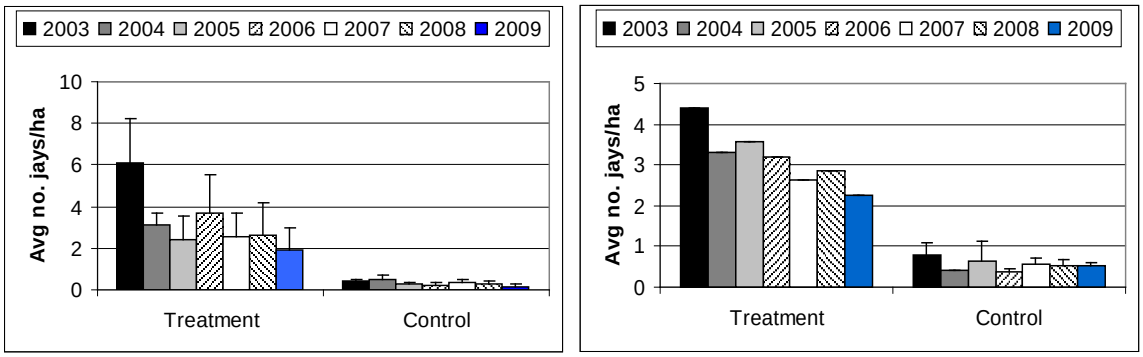
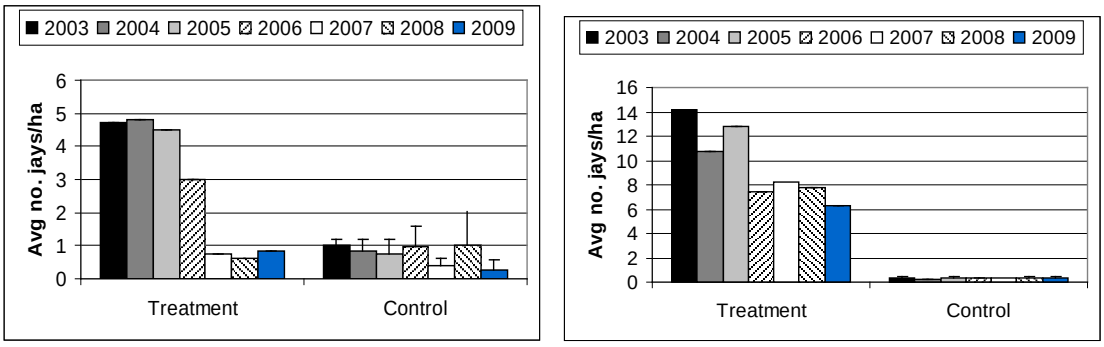


Figure 8. Abundance of Steller's Jay at all sites combined from 2002 to 2009.



A. Big Basin B. Portola



C. Butano D. Memorial

Figure 9. Abundance of Steller's Jay in each park from 2003 to 2009.

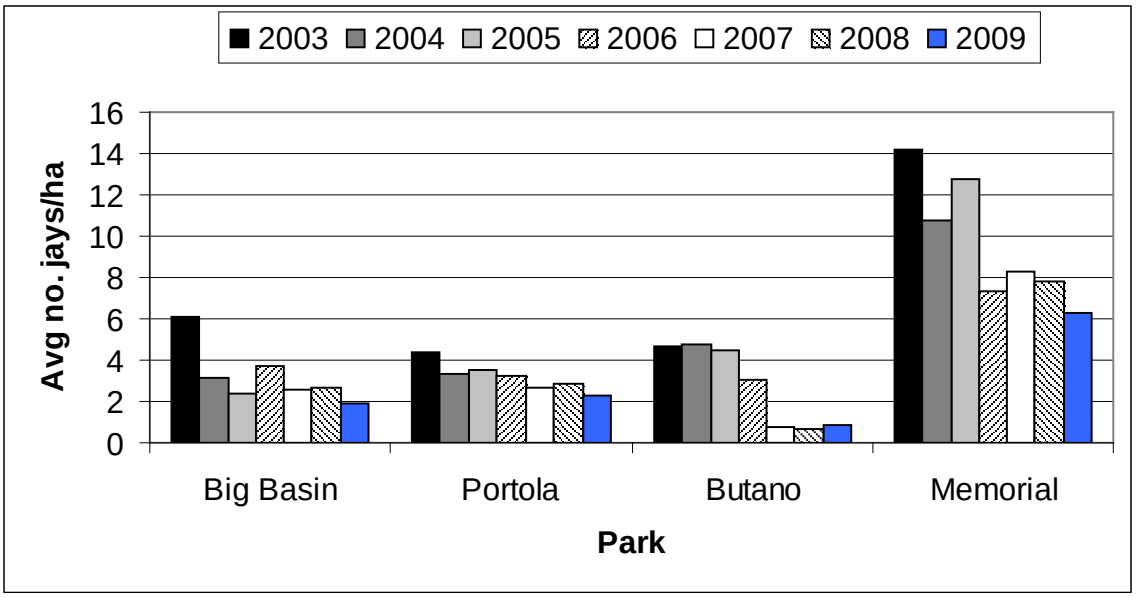


Figure 10. Relative abundance of Steller's Jays in treatment areas in each park from 2003-2009.

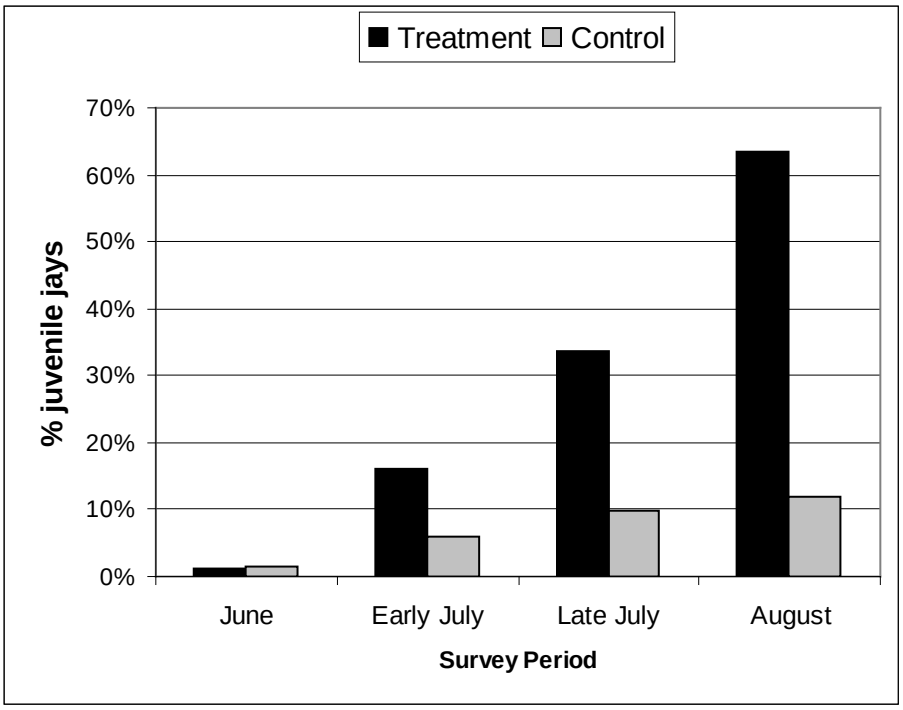
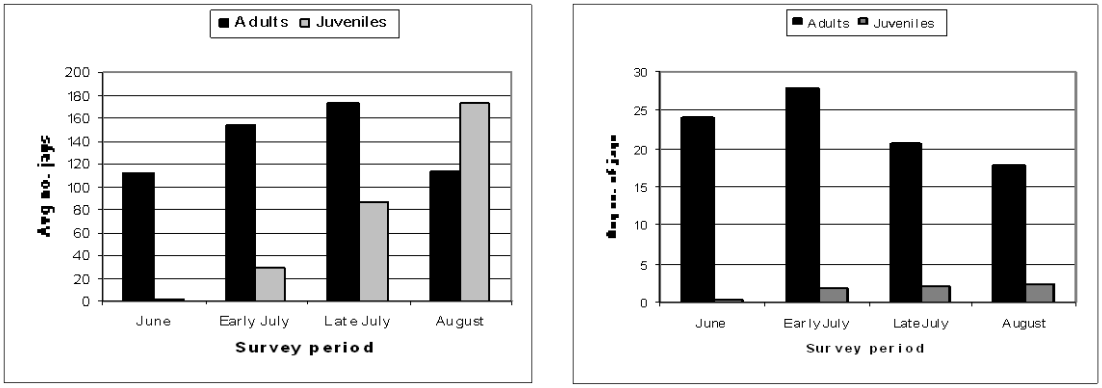
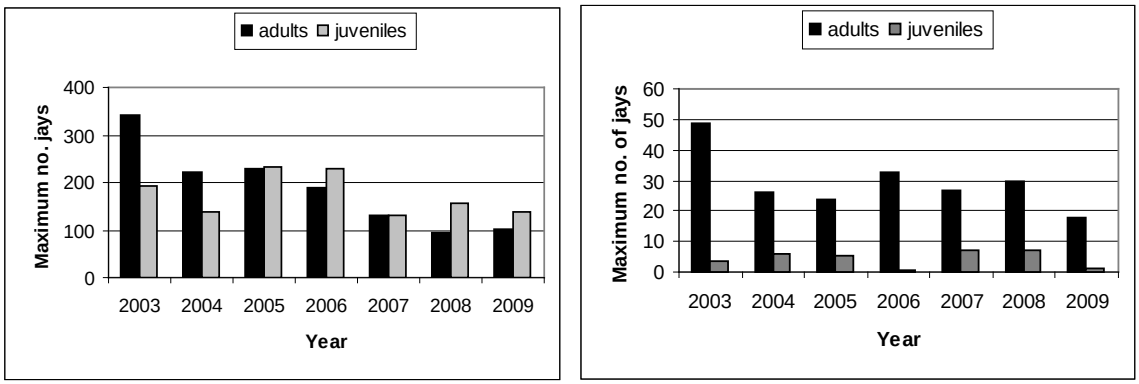


Figure 11. Comparison of seasonal increase in % juvenile Steller's Jays in treatment and control areas, all parks combined (using average values from 2003-2009).



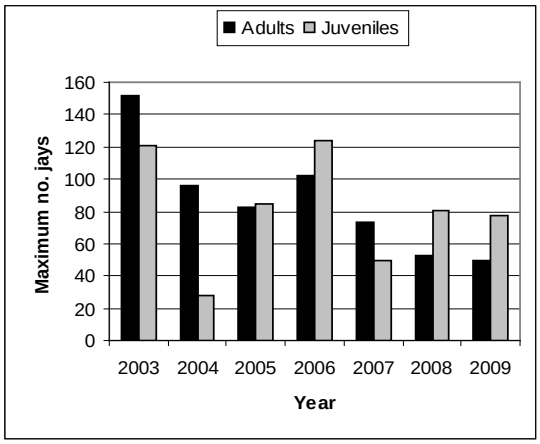
A. Treatment Areas B. Control Areas

Figure 12. Seasonal increase in number of adult and juvenile Steller's Jays in treatment and control areas, all parks combined (using average values from 2003-2009).

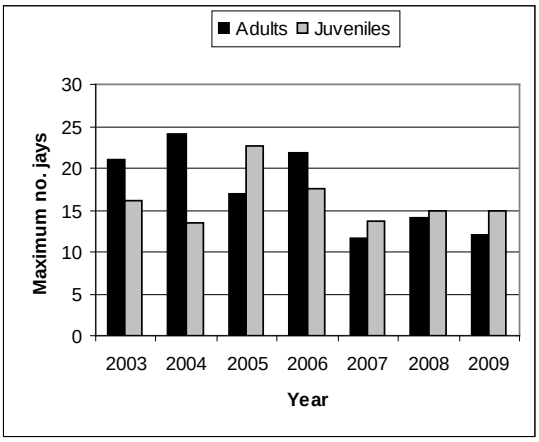


A. Treament Areas B. Control Areas

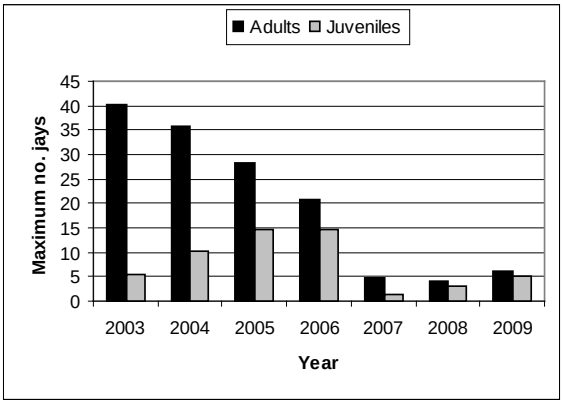
Figure 13. Number of adult and juvenile Steller's Jays in treatment and control areas per year, all parks combined, 2003-2009 (using adjusted raw maxima).



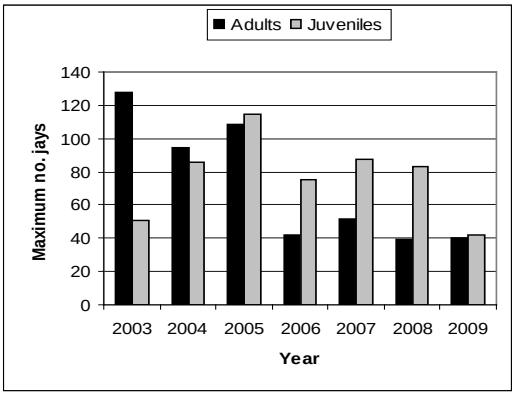
A. Big Basin



B. Portola

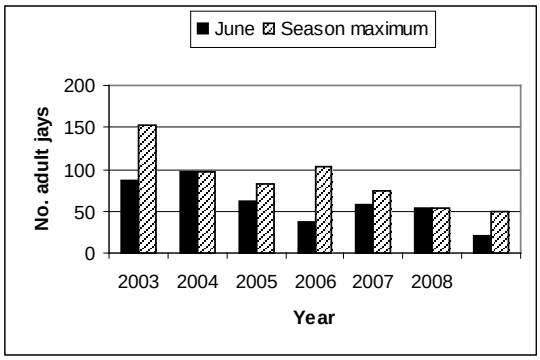


C. Butano

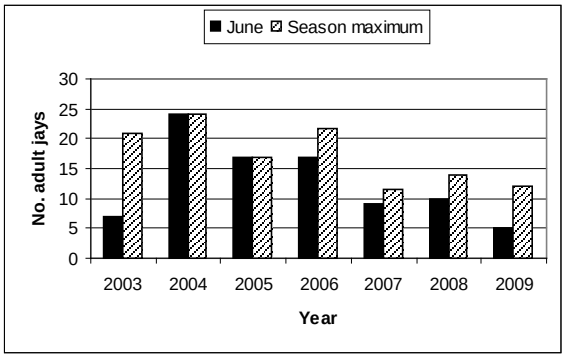


D. Memorial

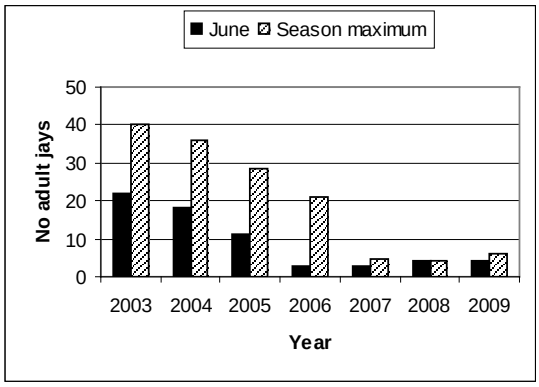
Figure 14. Abundance of adult and juvenile Steller's Jay in **treatment areas** of each park from 2003 to 2009 (using adjusted raw counts).



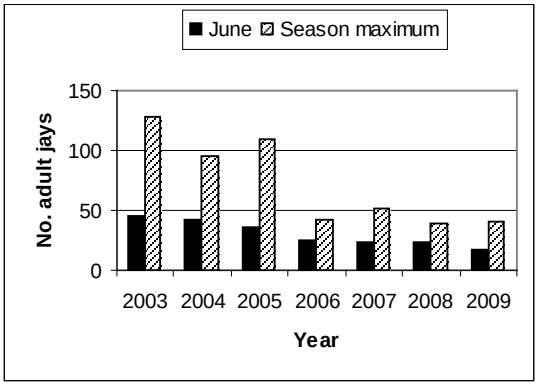
A. Big Basin



B. Portola



C. Butano



D. Memorial

Figure 15. Abundance of **adult** Steller's Jay in June compared to the seasonal maximum in each park from 2003 to 2009 (using adjusted raw counts).

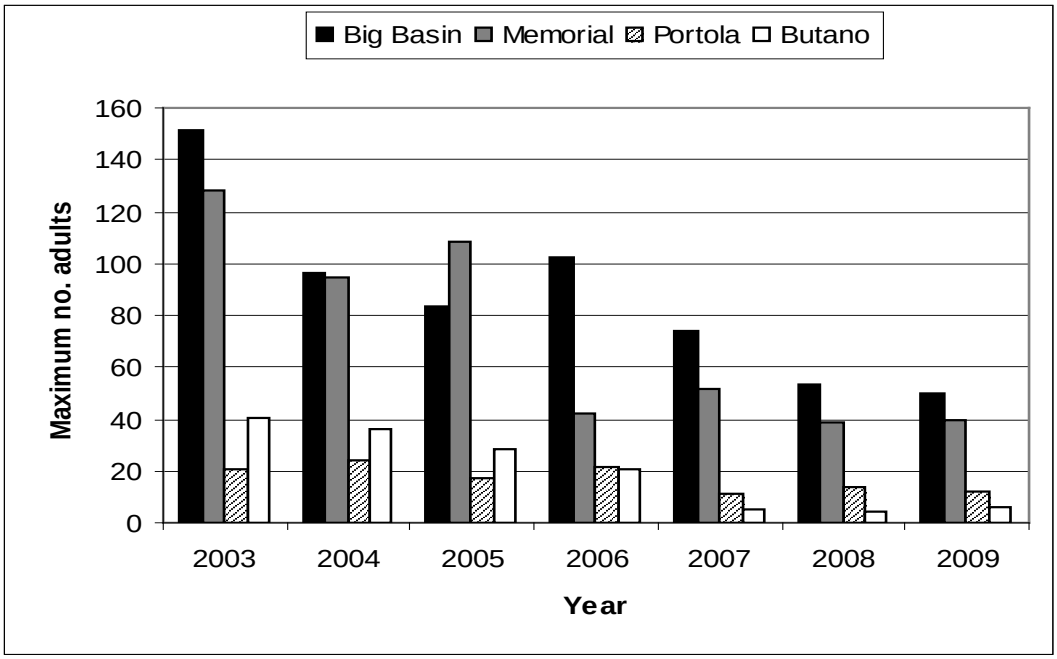


Figure 16a. Absolute number of **adult** Steller's Jays in treatment areas of each park from 2003-2009 (using adjusted raw counts).

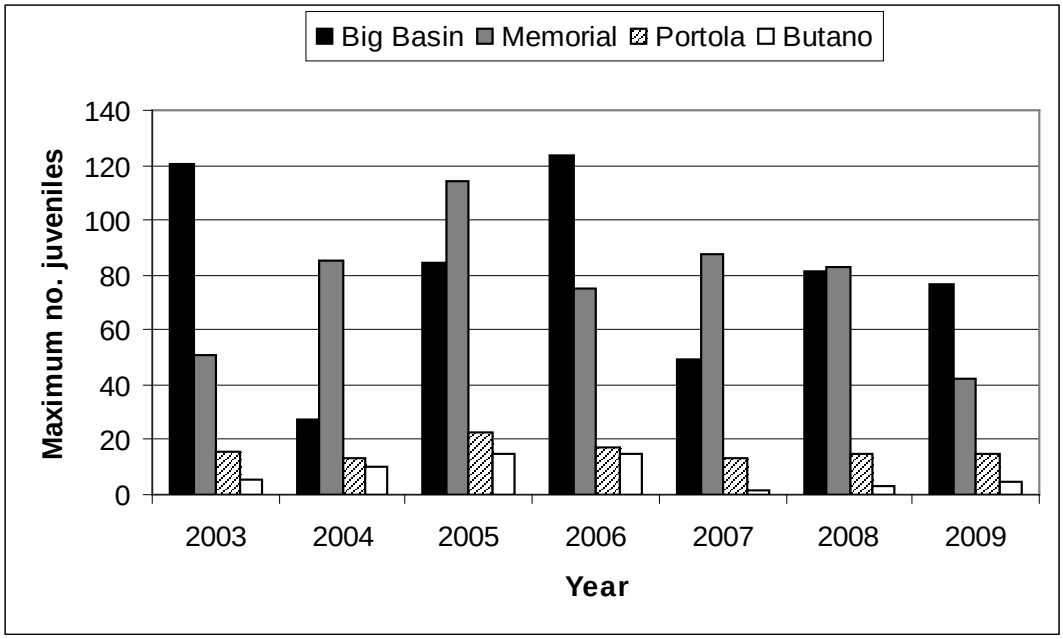


Figure 16b. Absolute number of **juvenile** Steller's Jays in treatment areas of each park from 2003-2009 (using adjusted raw counts).

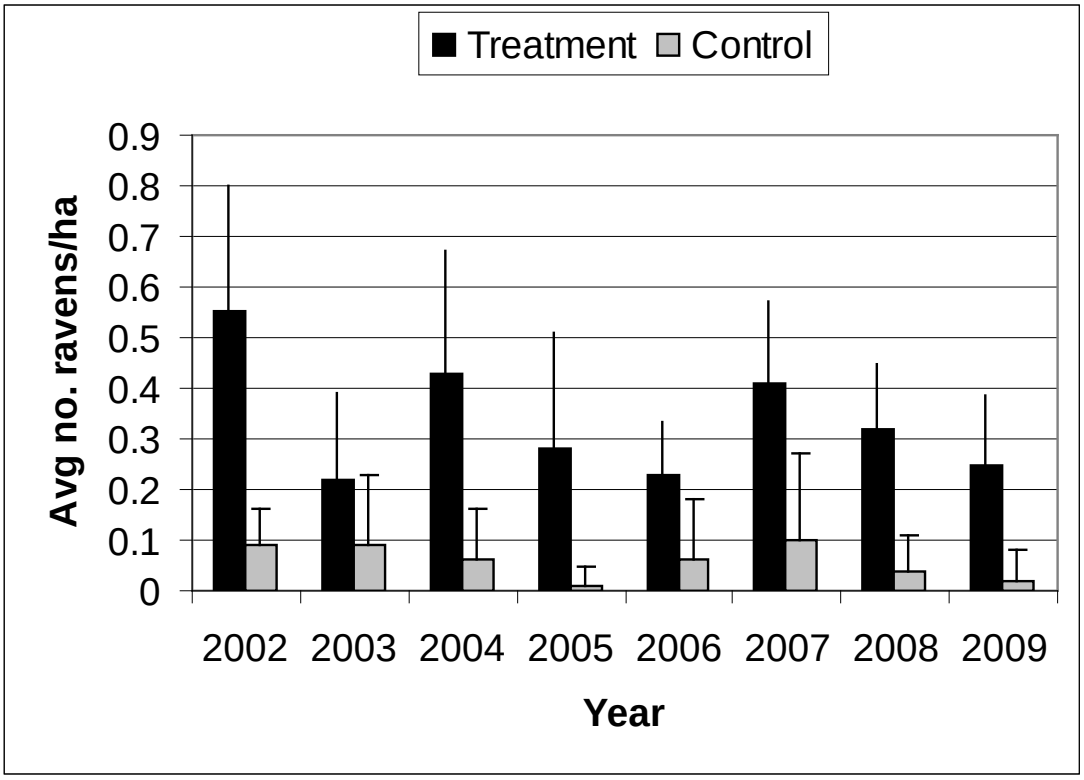
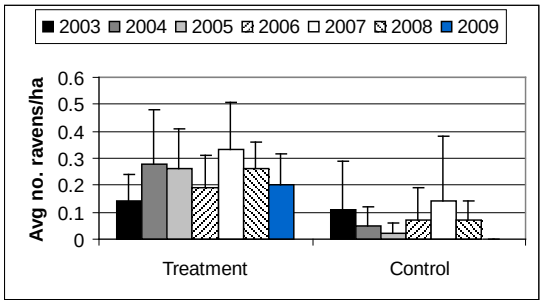
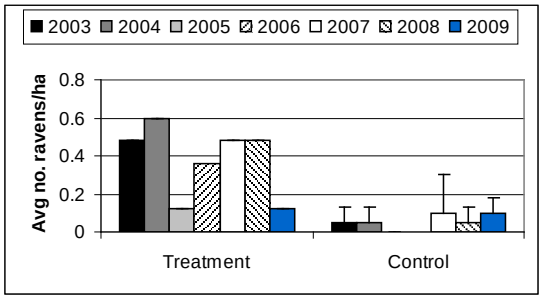


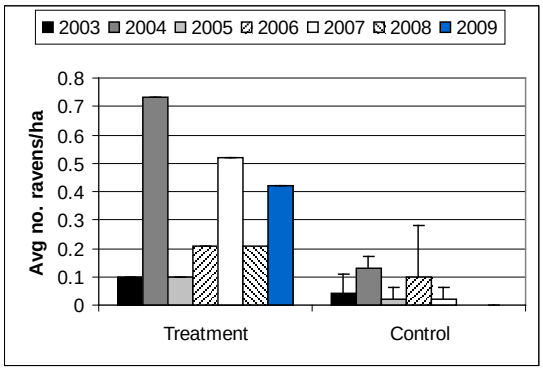
Figure 17. Abundance of Common Raven at all sites combined from 2002 to 2009.



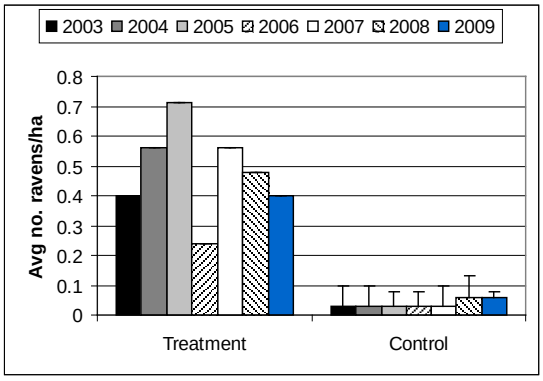
A. Big Basin
(Note: no ravens recorded in control areas at Big Basin in 2009)



B. Portola
(Note: no ravens recorded in control areas at Portola in 2005 or 2006)



C. Butano
(Note: no ravens recorded in control areas at Butano in 2008 or 2009)



D. Memorial

Figure 18. Abundance of Common Raven in each park from 2003 to 2009.

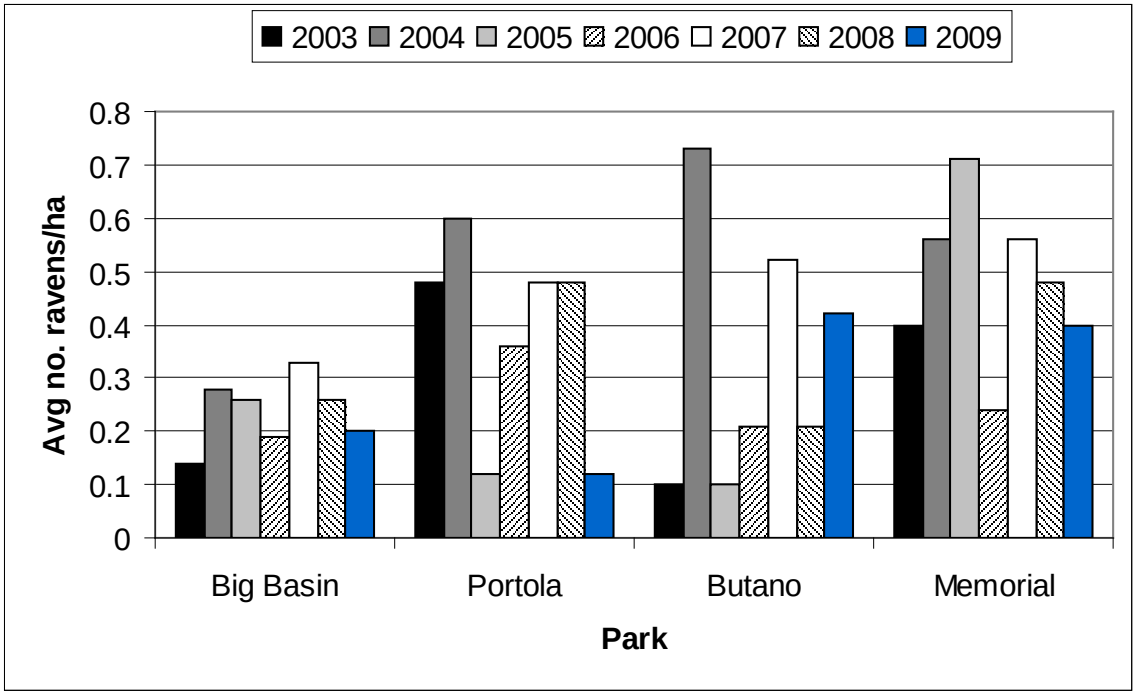


Figure 19. Relative abundance of Common Raven in treatment areas in each park from 2003-2009.

Appendix 1. Raw numbers of Steller's Jays and Common Ravens on each survey, 2003-2009.

STELLER'S JAY

Year	03				04				05				06				07				08				09			
Run #	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Big Basin																												
Blooms	25	47	57	93	27	18	47	36	22	48	43	53	18	44	68	85	17	27	46	25	20	21	57	30	10	19	36	47
Sempervirens	11	25	33	54	17	19	18	25	11	19	14	19	5	13	28	9	9	10	15	8	6	8	21	23	1	4	14	9
Huckleberry	41	45	48	102	48	39	23	32	27	26	39	37	12	34	41	58	27	33	53	19	27	42	45	10	8	15	26	31
Wastahi	10	2	4	23	4	10	15	16	2	5	4	6	2	8	7	5	4	3	9	7	3	2	2	0	1	4	1	3
Opal 2	3	3	2	1	0	2	1	3	1	1	0	2	0	2	1	2	5	2	4	0	0	2	2	1	2	1	0	0
Opal 3	4	0	2	0	1	4	2	2	0	2	0	0	0	0	0	0	2	2	2	2	2	2	2	1	0	2	1	1
Gazos 1	4	4	3	1	2	2	1	1	1	3	0	0	2	4	2	2	0	2	3	1	2	2	2	1	2	0	0	1
Gazos 2	0	2	2	1	1	1	0	1	3	0	0	0	0	1	1	2	1	0	1	0	1	0	2	0	0	0	0	0
Gazos 3	1	4	3	0	2	0	2	2	0	2	0	0	1	2	2	2	2	0	1	1	2	4	4	2	0	0	0	1
Gazos 4	3	2	2	3	1	1	0	0	0	1	0	1	0	2	1	1	4	1	4	1	2	2	1	0	1	0	0	0
Portola																												
Portola	7	24	24	37	28	19	20	23	17	16	30	27	17	21	27	21	9	11	19	22	10	24	24	14	5	19	10	16
Peters	3	4	3	3	1	2	0	3	2	0	1	5	1	2	3	2	3	3	0	1	2	2	3	2	3	1	2	2
Iverson 1	8	5	6	6	1	3	2	1	0	4	0	8	2	1	2	1	3	2	5	4	3	2	3	2	3	2	2	4
Iverson 2	3	2	5	2	0	2	3	2	1	0	0	1	3	2	3	1	2	3	3	4	3	5	2	2	4	1	3	3
Butano																												
Ben Ries	22	32	35	45	18	34	40	46	11	16	43	20	3	15	22	29	3	4	4	6	4	4	5	6	4	2	8	8
Service	4	8	3	4	2	2	5	4	2	2	4	0	4	8	4	6	1	3	0	1	2	4	3	4	2	5	2	1
Goat Hill	4	3	2	3	4	2	2	2	2	4	1	3	1	5	3	3	1	2	2	0	1	7	1	1	0	0	0	0
Doe Ridge	6	12	5	5	11	7	7	4	7	5	1	2	2	5	4	3	3	2	2	0	2	5	2	1	1	3	2	1
Memorial																												
Sequoia	46	71	107	179	46	79	136	133	36	76	161	142	25	42	48	93	23	61	68	104	24	60	96	98	17	51	79	66

Appendix 1, continued.

COMMON RAVEN

Year	03				04				05				06				07				08				09			
Run #	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Big Basin																												
Blooms	3	3	0	0	2	2	2	2	2	0	0	2	1	2	0	2	2	4	4	2	4	4	4	2	3	5	2	0
Sempervirens	1	0	0	0	1	0	4	4	1	0	0	0	0	1	0	0	1	0	0	1	0	1	1	1	0	0	0	2
Huckleberry	3	3	3	3	2	3	2	4	2	2	5	1	3	5	4	1	4	5	5	0	2	1	5	0	1	0	1	0
Wastahi	0	0	0	0	1	1	1	1	1	3	2	0	0	1	1	0	2	0	4	1	0	0	0	2	1	0	0	0
Opal 2	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Opal 3	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	1	4	0	0	0	1	0	0	0	0	0
Gazos 1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0
Gazos 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gazos 3	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Gazos 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Portola																												
Portola	0	4	3	3	1	5	4	2	1	0	0	0	2	2	3	1	1	3	4	2	1	4	1	0	1	0	0	1
Peters	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iverson 1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0
Iverson 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0
Butano																												
Ben Ries	1	0	0	1	2	1	6	7	1	0	0	0	2	2	1	2	1	2	5	4	0	0	0	2	1	1	4	2
Service	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goat Hill	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Doe Ridge	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Memorial																												
Sequoia	2	3	4	5	7	5	7	5	5	5	9	2	2	3	0	0	7	4	5	7	3	6	1	4	4	5	2	3

Appendix 2. Adjusted numbers of adult and juvenile Steller's Jays, 2003-2009.

2003	Treatment Areas				Control Areas			
Big Basin	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 1**	**Run 2**	**Run 3**	**Run 4**
Adults	87	108	120	152	15	15	14	5
Juveniles	0	11	22	120	0	0	0	0
% Juveniles	0.0%	9.3%	15.7%	44.2%	0.0%	0.0%	0.0%	0.0%
Portola								
Adults	7	21	20	21	14	11	14	9
Juveniles	0	3	4	16	0	0	0	2
% Juveniles	0.0%	13.0%	18.2%	43.3%	0.0%	0.0%	0.0%	14.3%
Butano								
Adults	22	27	30	40	14	23	10	10
Juveniles	0	5	5	5	0	0	0	2
% Juveniles	0.0%	15.6%	15.6%	10.8%	0.0%	0.0%	0.0%	14.3%
Memorial								
Adults	46	65	88	128	--	--	--	--
Juveniles	0	6	19	51	--	--	--	--
% Juveniles	0.0%	8.1%	18.1%	28.5%	--	--	--	--
All Parks								
Adults	162	221	257	341	43	49	38	25
Juveniles	0	25	51	192	0	0	0	3
% Juveniles	0.0%	10.1%	16.7%	36.1%	0.0%	0.0%	0.0%	11.7%

Appendix 2, continued.

2004	Treatment Areas				Control Areas			
Big Basin	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 1**	**Run 2**	**Run 3**	**Run 4**
Adults	96	79	82	81	7	8	6	9
Juveniles	0	7	21	28	0	2	0	0
% Juveniles	0.0%	8.3%	20.5%	25.3%	0.0%	22.2%	0.0%	0.0%
Portola								
Adults	24	19	15	9	2	7	4	6
Juveniles	4	0	5	14	0	0	1	0
% Juveniles	14.3%	0.0%	25.0%	58.8%	0.0%	0.0%	20.0%	0.0%
Butano								
Adults	18	32	30	36	17	9	9	8
Juveniles	0	2	10	10	0	2	5	2
% Juveniles	0.0%	6.5%	25.8%	22.2%	0.0%	18.2%	35.7%	22.2%
Memorial								
Adults	43	71	95	48	--	--	--	--
Juveniles	3	8	41	85	--	--	--	--
% Juveniles	7.3%	10.6%	30.4%	64.2%	--	--	--	--
All Parks								
Adults	181	200	221	174	26	24	19	23
Juveniles	7	18	78	137	0	4	6	2
% Juveniles	3.9%	8.1%	26.0%	43.9%	0.0%	15.1%	24.0%	8.9%

Appendix 2, continued.

2005	Treatment Areas				Control Areas			
Big Basin	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 1**	**Run 2**	**Run 3**	**Run 4**
Adults	62	83	82	30	5	9	0	3
Juveniles	0	15	18	85	0	0	0	0
% Juveniles	0.0%	15.2%	18.0%	73.5%	0.0%	0.0%	#DIV/0!	0.0%
Portola								
Adults	17	13	10	4	3	4	1	9
Juveniles	0	3	20	23	0	0	0	5
% Juveniles	0.0%	18.8%	68.0%	84.2%	0.0%	0.0%	0.0%	36.4%
Butano								
Adults	11	16	28	10	11	11	6	5
Juveniles	0	0	15	10	0	0	0	0
% Juveniles	0.0%	0.0%	34.1%	50.0%	0.0%	0.0%	0.0%	0.0%
Memorial								
Adults	36	72	109	28	--	--	--	--
Juveniles	0	4	52	114	--	--	--	--
% Juveniles	0.0%	5.9%	32.4%	80.6%	--	--	--	--
All Parks								
Adults	126	184	229	72	19	24	7	17
Juveniles	0	22	105	232	0	0	0	5
% Juveniles	0.0%	10.9%	31.5%	76.2%	0.0%	0.0%	0.0%	23.1%

Appendix 2, continued.

2006	Treatment Areas					Control Areas		
Big Basin	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 1**	**Run 2**	**Run 3**	**Run 4**
Adults	37	91	102	34	3	11	6	7
Juveniles	0	8	42	123	0	0	0	0
% Juveniles	0.0%	7.7%	29.0%	78.6%	0.0%	0.0%	0.0%	0.0%
Portola								
Adults	17	18	22	4	6	5	8	4
Juveniles	0	3	5	18	0	0	0	0
% Juveniles	0.0%	15.0%	19.2%	83.3%	0.0%	0.0%	0.0%	0.0%
Butano								
Adults	3	14	21	15	7	17	11	8
Juveniles	0	1	1	15	0	1	0	0
% Juveniles	0.0%	7.7%	5.0%	50.0%	0.0%	3.7%	0.0%	0.0%
Memorial								
Adults	25	35	42	18	--	--	--	--
Juveniles	0	7	6	75	--	--	--	--
% Juveniles	0.0%	17.8%	11.6%	80.5%	--	--	--	--
All Parks								
Adults	82	158	187	70	16	33	25	19
Juveniles	0	19	54	230	0	1	0	0
% Juveniles	0.0%	11.0%	22.3%	76.8%	0.0%	1.9%	0.0%	0.0%

Appendix 2, continued.

2007	Treatment Areas					Control Areas		
Big Basin	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 1**	**Run 2**	**Run 3**	**Run 4**
Adults	57	64	74	30	14	7	10	4
Juveniles	0	9	49	29	0	0	5	1
% Juveniles	0.0%	12.5%	40.2%	49.0%	0.0%	0.0%	35.7%	25.0%
Portola								
Adults	9	10	12	8	8	8	6	7
Juveniles	0	1	7	14	0	0	2	2
% Juveniles	0.0%	10.0%	38.9%	61.9%	0.0%	0.0%	25.0%	22.2%
Butano								
Adults	3	4	4	5	5	7	4	1
Juveniles	0	0	0	1	0	0	0	0
% Juveniles	0.0%	0.0%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%
Memorial								
Adults	23	52	33	16	--	--	--	--
Juveniles	0	9	35	88	--	--	--	--
% Juveniles	0.0%	15.1%	50.8%	84.2%	--	--	--	--
All Parks								
Adults	92	130	123	60	27	22	20	12
Juveniles	0	19	91	131	0	0	7	3
% Juveniles	0.0%	13.0%	42.7%	68.8%	0.0%	0.0%	27.2%	21.7%

Appendix 2, continued.

2008	Treatment Areas				Control Areas			
Big Basin	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 1**	**Run 2**	**Run 3**	**Run 4**
Adults	53	43	44	15	9	10	11	4
Juveniles	3	30	81	48	0	2	2	0
% Juveniles	5.4%	41.1%	64.8%	76.2%	0.0%	16.7%	15.4%	0.0%
Portola								
Adults	10	14	9	4	6	9	8	5
Juveniles	0	10	15	10	2	0	0	1
% Juveniles	0.0%	41.7%	62.5%	71.4%	25.0%	0.0%	0.0%	16.7%
Butano								
Adults	4	4	2	3	5	11	6	6
Juveniles	0	0	3	3	0	5	0	0
% Juveniles	0.0%	0.0%	60.0%	50.0%	0.0%	31.3%	0.0%	0.0%
Memorial								
Adults	24	31	39	15	--	--	--	--
Juveniles	0	29	57	83	--	--	--	--
% Juveniles	0.0%	48.3%	59.4%	84.7%	--	--	--	--
All								
Adults	91	92	94	37	20	30	25	15
Juveniles	3	69	156	144	2	7	2	1
% Juveniles	3.2%	42.9%	62.4%	79.6%	9.1%	18.9%	7.4%	6.3%

Appendix 2, continued.

2009	Treatment Areas				Control Areas			
Big Basin	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 1**	**Run 2**	**Run 3**	**Run 4**
Adults	20	40	50	13	5	3	1	3
Juveniles	0	2	27	77	0	0	0	0
% Juveniles	0.0%	4.8%	35.1%	85.6%	0.0%	0.0%	0.0%	0.0%
Portola								
Adults	5	12	5	1	10	3	7	9
Juveniles	0	7	5	15	0	1	0	1
% Juveniles	0.0%	36.8%	50.0%	93.8%	0.0%	25.0%	0.0%	10.0%
Butano								
Adults	4	2	6	3	3	8	4	2
Juveniles	0	0	3	5	0	0	0	0
% Juveniles	0.0%	0.0%	33.3%	62.5%	0.0%	0.0%	0.0%	0.0%
Memorial								
Adults	17	32	39.5	24	--	--	--	--
Juveniles	0	19	39.5	42	--	--	--	--
% Juveniles	0.0%	37.3%	50.0%	63.6%	--	--	--	--
All								
Adults	46	86	100.5	41	18	14	12	14
Juveniles	0	28	74.5	139	0	1	0	1
% Juveniles	0.0%	24.6%	42.6%	77.2%	0.0%	6.7%	0.0%	6.7%