

Redwood

National and State Parks

National Park Service
US Department of the Interior

Department of Parks and Recreation
State of California

Forest and Beach Corvid Monitoring and Management Trail and Backcountry Management Plan Implementation 2010 Annual Progress Report



December 2010

Title page photographs, left to right, top to bottom: Steller's jay foraging at Big Tree day use area parking lot, common raven foraging at Redwood Creek Overlook day use area, radio tagged common raven – habitat use study, biological technician Kelly Breen monitoring corvids on Redwood Creek, radio tagged Steller's jay – habitat use

study, lower Redwood Creek gravel bar – closed to dispersed backcountry camping in 2010, park visitors being interviewed about corvid-marbled murrelet education program at Jedediah Smith Redwoods State Park visitor center. All photos taken in Redwood National and State Parks in 2010.

INTRODUCTION

This report is divided into three interrelated sections concerning the monitoring and management of common ravens (*Corvus corax*), American crows (*Corvus brachyrhynchos*) and Steller's jays (*Cyanocitta stelleri*) (collectively known as corvids) in Redwood National and State Parks (RNSP or parks). Section I covers forest and beach corvid monitoring results for 2007-2010. Section II describes corvid management activities that took place in RNSP in 2010. Section III reports on the progress of any projects that were described in the proposed action section of the RNSP Trail and Backcountry Management Plan biological assessment (Bensen 2006). This report also satisfies the reporting requirements stipulated under the terms and conditions of the RNSP Trail and Backcountry Management Plan biological opinion (USFWS 2007a). A comprehensive description of the purpose, policy, scientific background, management history, objectives and methods of corvid monitoring and management in RNSP is described in the parks' Corvid Management Strategy (RNSP 2008a).

The following paragraphs provide a brief overview of corvid predation of federally threatened and state endangered marbled murrelets (*Brachyramphus marmoratus*) and federally threatened western snowy plovers (*Charadrius alexandrinus*) and the parks' response:

The marbled murrelet was federally listed as threatened and California state listed as endangered in 1992. The Marbled Murrelet Recovery Plan (USFWS 1997) specifically identified RNSP as key to species conservation and recovery in California. Section 1.4 of the recovery plan states that nest predation by Steller's jays and common ravens is a threat to the species. Recovery action 3.1.2 in the recovery plan directs agencies to "decrease adult and juvenile mortality." This recovery action is given the highest priority rating. The most recent marbled murrelet five year conservation status review (McShane et al. 2004) revealed that nest predation is now the primary cause of current and future murrelet population decline, particularly in California. High rates of murrelet nest predation by corvids in RNSP have been conclusively recorded (Hebert and Golightly 2006). RNSP contains 62% of all the suitable murrelet nesting habitat in California and approximately 75% of the murrelets detected during at-sea surveys in California were off the coast of RNSP (McShane et al. 2004). Murrelets have been found to forage at sea primarily right off the coast of their inland nesting grounds (Raphael et al. 2004, Hebert and Golightly 2006). The California population represents roughly a third of the listed population. Current murrelet fledging success (percentage of chicks leaving the nest alive) within RNSP is estimated to be 0.3% - 2% (Hebert and Golightly 2006). To just maintain the current population size, RNSP fledging rates need to be between 18% and 28% (McShane et al. 2004). Thus, predation of murrelets by corvids in RNSP has the potential to have a significant negative impact on the listed murrelet population.

Numerous studies (e.g. Suddijan 2004, Leibzeit and George 2002, , Luginbuhl et al. 2001, George et al. 2001, Wallen et al. 1999) in and near national and state parks in Washington and California have tied increases in localized corvid densities and nest predation rates to supplemental food provided by park visitors. Many of RNSP's high-use visitor areas (i.e. campgrounds, visitor centers, picnic areas, trailheads) are located within high quality marbled murrelet nesting habitat. Recent studies in RNSP have revealed that Steller's jay densities in park campgrounds located in murrelet nesting habitat are two to six times greater than in murrelet nesting habitat away from campgrounds (George et al. 2001., Wallen et al. 1999). Conversely, murrelets have been found to have higher chick productivity in old growth forest

areas located away from campgrounds that have lower corvid densities (Marzluff and Neatherlin 2006, Luginbuhl et al. 2001, Marzluff et al. 1996).

The western snowy plover was federally listed as threatened in 1993. The Western Snowy Plover Recovery Plan (USFWS 2007b) repeatedly states that American crows and common ravens are significant snowy plover nest predators throughout California, Oregon and Washington. Regionally, predation by crows and ravens has been cited as a major cause of plover nest failure in Oregon (Lauten et al. 2006). Colwell et al. (2006, 2010) found that predation by common ravens was the primary factor limiting snowy plover productivity in breeding areas just to the south of RNSP in Humboldt county. The recovery plan (USFWS 2007b) repeatedly states that reducing or eliminating corvid attracting human food waste in or near plover breeding and wintering areas is an important task for the recovery of the species. The RNSP Staff Responsibilities and Management Strategy for Western Snowy Plovers (RNSP 2008b) also recommends the proper disposal of human food waste in and near snowy plover habitat areas in order to lower corvid predation pressure on plovers.

Due to the potential negative impact of visitor activities and their influence on corvid predation of marbled murrelets and western snowy plovers within RNSP, the park developed a Corvid Management Strategy (RNSP 2008a). The aim of the strategy is to decrease the density of corvids surrounding visitor use developments in the parks.

SECTION I. FOREST AND BEACH CORVID MONITORING

A. Introduction

The RNSP Corvid Management Strategy (RNSP 2008a) is adaptive. Effectiveness monitoring is central to the success of the strategy. Monitoring how and whether jay, crow and raven populations are responding to management actions is central to determining whether the goal of reducing corvid densities near high use visitor areas is being met. As the monitoring information is collected, it is hoped that it will assist the park in directing corvid management activities to the most impacted areas and to using the most effective management techniques. At the least, the monitoring program is designed to determine whether the corvid management actions implemented by RNSP are successfully decreasing the density of corvids near park visitor use areas. Again, for more detail on the monitoring system's design, rationale and corvid population targets (for forest corvids only), please refer to the RNSP Corvid Management Strategy (RNSP 2008a).

B. Methods

1) Forest Corvid Surveys

The point count survey protocol used for the RNSP forest corvid monitoring program is described in Appendix III of the RNSP Corvid Management Strategy (RNSP 2008a). Forest corvid surveys were conducted from May 2010 to September 2010. The 30 monitoring station locations are shown in Figure 1. The stations are grouped according to one of two types control areas or type of visitor use area they sample. Four control stations are located in marbled murrelet habitat areas at least 0.25 miles away from any visitor development (stations marked "FC" in Figure 1). Six control stations are located in

marbled murrelet habitat areas along trails but at least 0.25 miles from any other visitor development (stations marked "TC" in Figure 1). Five stations are located within front country campgrounds in marbled murrelet habitat (stations marked "JS" and "PC" in Figure 1). Eight stations are located in picnic or major trailhead areas in or immediately adjacent to suitable marbled murrelet habitat (stations marked "PN" in Figure 1). Finally, seven stations are located along Redwood Creek downstream of the Bond Creek junction where dispersed backcountry camping is allowed (stations marked "RC" in Figure 1).

In 2007 and 2008 the data were analyzed by treating each individual visit to each monitoring station location as a discrete data point (Bensen 2007, 2008a). Recommendations made by the USFWS in a March, 2009 memo written after a review of the Bensen (2008a) report suggested that the analysis may be erroneous. The gist of the critique was that sampling location independence was not the same as temporal sampling independence. Therefore, in order to maintain consistency between survey years and address this critique, this and past years data have been analyzed in two ways 1) using the past analysis method of treating each station location visit as discrete and 2) treating each station location as discrete thus eliminating the temporal aspect of the data; a mean of means method was used to cluster the data for this second analysis. A normal distribution was assumed for both analyses.

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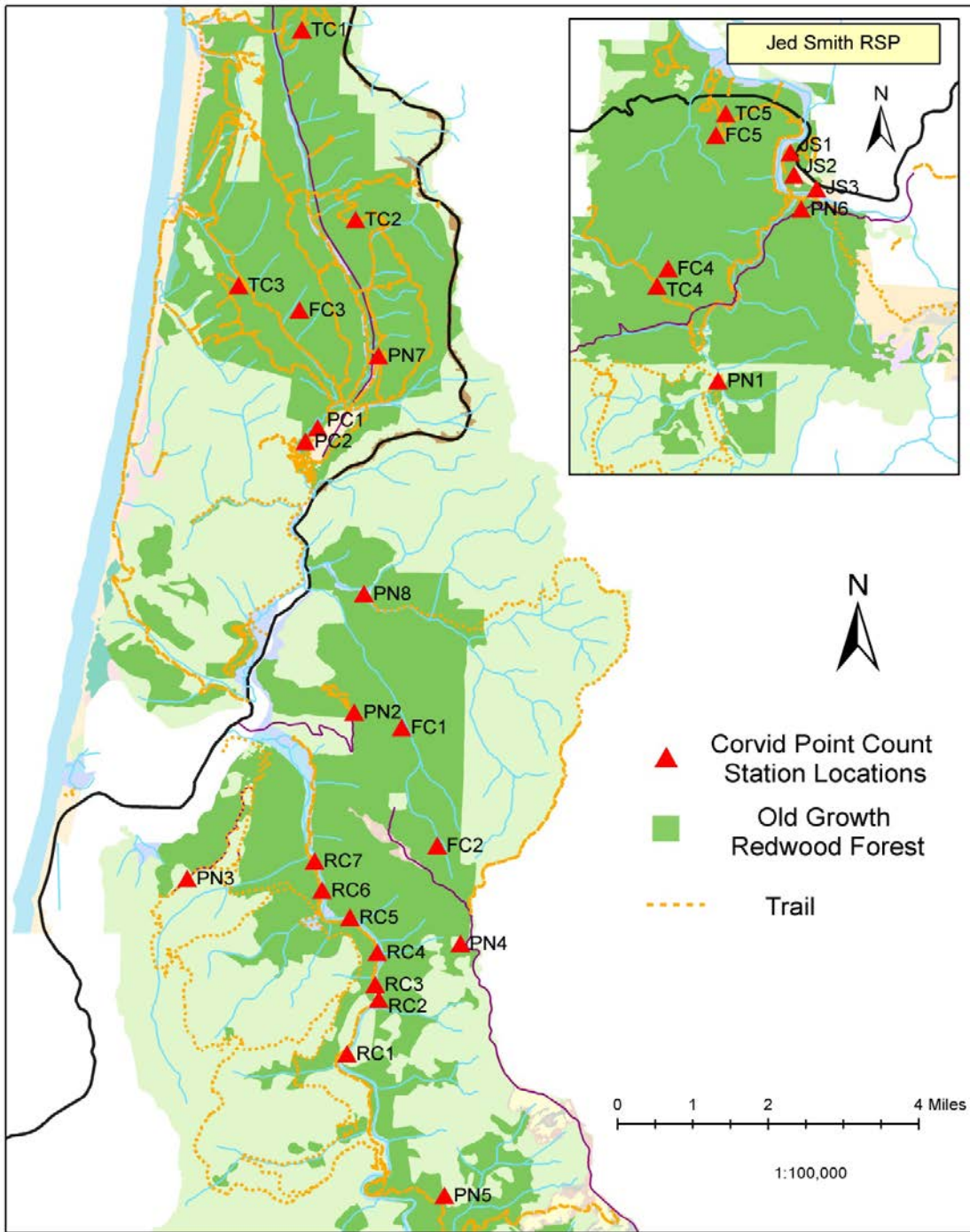


Figure 1. Location of point count survey stations within Redwood National and State Parks. FC = forest control station (n = 4), TC = trail control station (n = 6), JS = Jedediah Smith campground station (n = 3), PC = Elk Prairie campground station (n = 2), PN = picnic area station (n = 8), RC = Redwood Creek dispersed camping area station (n = 7). Please note that FC3 was moved in 2007 approximately 0.5 miles to the southwest and is now TC6 and is not shown on the map.

2) Beach Corvid Surveys

The instantaneous point count survey protocol used for the RNSP beach corvid monitoring program is described in Appendix III of the RNSP Corvid Management Strategy (RNSP 2008a) and is the same as is used throughout the western snowy plover Recovery Unit Two area. The “survey year” for snowy plovers was from October 2009 to September 2010 and so the beach corvid surveys spanned the same period of time. Instantaneous point counts were made “on the twenty minute mark” for all corvids within 500 meters of the surveyor while conducting western snowy plover surveys along monitored park beach reaches. Due to the survey methodology, there were no set point count stations and no control stations. The surveys provide an index of relative corvid abundance and frequency but not density. Only the north Gold Bluffs Beach, south Gold Bluffs Beach and Freshwater Spit survey reaches were analyzed because only those reaches were surveyed during all months of the year and on the same schedule. The locations of the three beach survey reaches are described in the RNSP Staff Responsibilities and Management Strategy for Western Snowy Plovers (RNSP 2008b).

C. Results

1) Forest Corvid Surveys

The 30 point count survey stations scattered throughout RNSP were visited twice a month from May through September of 2010 for a total of 272 surveys or ten visits to each station except for those on Redwood Creek which were visited only six times due to high water early in the survey season. Approximately 1,000 person hours were spent in the field completing the surveys.

The results for Steller’s jays are shown in Table 1 (two analysis methods) and Figures 2 and 3 (two analysis methods, respectively). Only detections made within 50m of the survey station were analyzed because it is only within 50m that a high detection probability can be assumed according Luginbuhl et al. (2001) - the methodology that this monitoring program is based upon (RNSP 2008a).

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Table 1. Mean number of Steller’s jays detected within 50m of point count stations in RNSP during May through September of 2007-2010. Note that the first figures are an analysis which treated each visit to each point count station as a discrete sampling unit; the figures in parentheses are the results of a mean of means analysis of the same data in order to make each point count station the discrete sampling unit.

		Forest Control	Trail Control	Campgrounds	Picnic Areas	Redwood Creek
n (n)		40 (4)	60 (6)	50 (5)	80 (8)	42 (6) ¹
mean	2010	0.20 (0.21)	0.05 (0.05)	1.46 (1.46)	0.66 (0.66)	0.45 (0.45)
	2009	0.08 (0.08)	0.07 (0.07)	1.22 (1.26)	0.69 (0.72)	0.69 (0.34)
	2008	0.31 (0.31)	0.07 (0.07)	1.57 (1.57)	0.55 (0.2)	0.24 (0.24)
	2007	0.30 (0.30)	0.16 (0.15)	1.18 (1.18)	0.66 (0.71)	0.22 (0.23)
SD	2010	0.46 (0.16)	0.22 (0.03)	1.96 (0.82)	1.06 (0.32)	0.77 (0.37)
	2009	0.27 (0.15)	0.32 (0.16)	1.61 (1.06)	1.05 (0.65)	1.05 (0.14)
	2008	0.66 (0.19)	0.31 (0.08)	1.99 (0.78)	0.88 (0.42)	0.70 (0.32)
	2007	0.81 (0.30)	0.51 (0.17)	1.40 (0.51)	1.02 (0.50)	0.58 (0.18)
Range	2010	0-2 (0.1-0.4)	0-1 (0-0.2)	0-9 (0.2-2.2)	0-5 (0.3-1.2)	0-2 (0-1.2)
	2009	0-1 (0-0.3)	0-2 (0-0.4)	0-7 (0.1-2.9)	0-5 (0-1.7)	0-3 (0.1-0.5)
	2008	0-2 (0.1-0.4)	0-2 (0-0.2)	0-7 (0.5-2.5)	0 – 3 (0.1-0.9)	0–3 (0-0.7)
	2007	0-4 (0-0.8)	0-3 (0-0.4)	0-5 (0.4-1.8)	0-4 (0.2-1.7)	0-3 (0-0.5)

¹Stations along Redwood Creek could not be visited during four survey rounds because high water made surveys unsafe.

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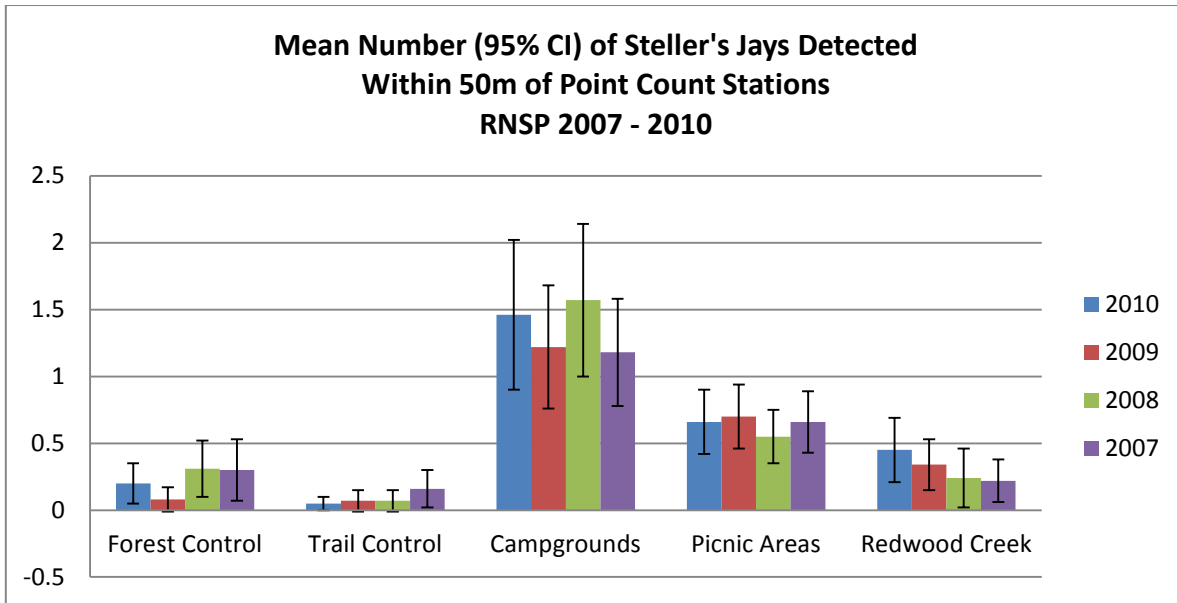


Figure 2. Mean number of Steller’s jays detected within 50m of point count stations in RNSP 2007-2010. Error bars represent a 95% confidence interval. Graph results represent an analysis which treated each visit to each point count station as a discrete sampling unit.

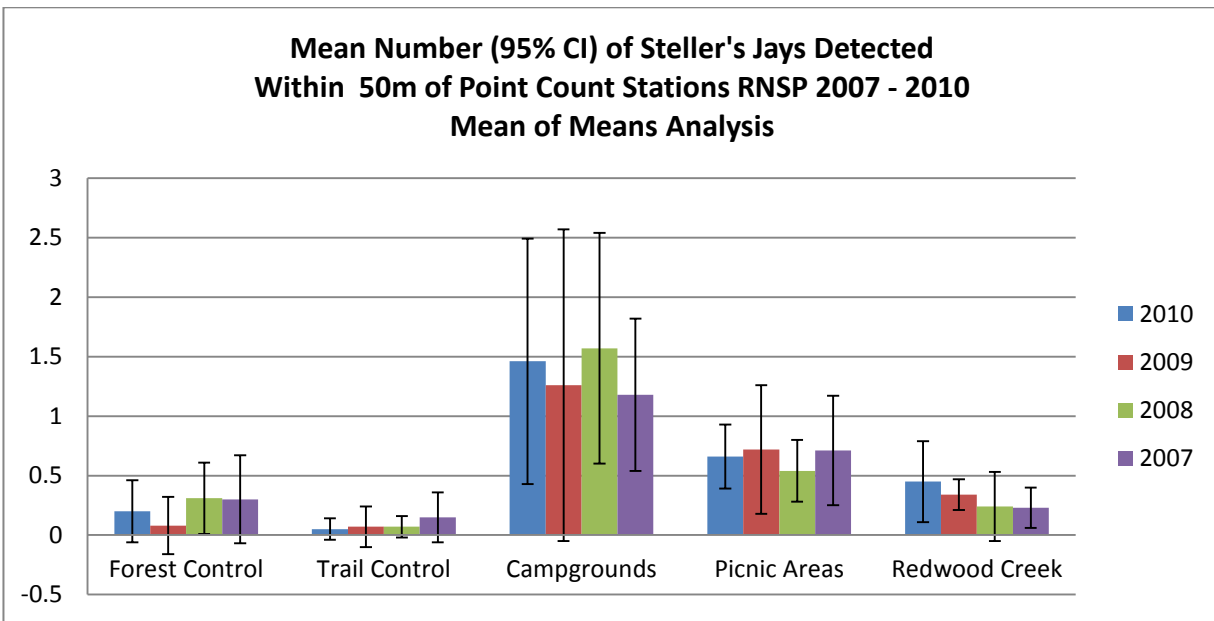


Figure 3. Mean number of Steller’s jays detected within 50m of point count stations in RNSP 2007-2010. Error bars represent a 95% confidence interval – mean of means analysis. Graph results represent a mean of means analyses which treated each point count station as a discrete sampling unit.

The large home ranges and long distance daily movements of common ravens violate the assumptions of the point count sampling methodology used as part of this monitoring program. This problem was anticipated during the design of the monitoring program (J. Marzluff, J. Black, L. George pers. comm.) and was amply demonstrated by the results in Bensen (2010), Bensen (2008a) and Bensen (2007). None or virtually no ravens were detected within 50m of monitoring stations, except within the campgrounds. The same lack of detections occurred during the 2010 survey year and so a presentation of raven detections within 50m of point count station results were not included in this year's report. The relative abundance of common ravens can be roughly represented, however, by looking at the "no boundary" plot results, as shown in Table 2 (two analysis methods) and Figures 4 and 5 (two analysis methods, respectively). These results represent all detections at each station, regardless of how far away the individual ravens were from the station. Raven population numbers cannot be estimated with this method nor can a high probability of detection be established, making the results inconclusive.

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Table 2. Mean number of common ravens detected at any distance of point count stations in RNSP during May through September of 2007 - 2010. Note that the first figures are an analysis which treated each visit to each point count station as a discrete sampling unit; the figures in parentheses are the results of a mean of means analyses of the same data in order to make each point count station a discrete sampling unit. Results indicate relative abundance only.

		Forest Control	Trail Control	Campgrounds	Picnic Areas	Redwood Creek
n (n)		40 (4)	60 (6)	50 (5)	80 (8)	42 (6) ¹
mean	2010	0.32 (0.32)	0.15 (0.15)	0.57 (0.60)	0.10 (0.10)	0.38 (0.38)
	2009	0.15 (0.15)	0.12 (0.12)	0.98 (0.98)	0.09 (0.09)	0.39 (0.42)
	2008	0.18 (0.18)	0.15 (0.15)	0.90 (0.90)	0.28 (0.28)	0.38 (0.38)
	2007	0.2 (0.2)	0.18 (0.12)	0.72 (0.72)	0.24 (0.24)	0.54 (0.52)
SD	2010	0.65 (0.08)	0.41 (0.17)	0.69 (0.25)	0.31 (0.10)	0.70 (0.21)
	2009	0.36 (0.13)	0.33 (0.16)	1.28 (0.45)	0.29 (0.09)	0.87 (0.43)
	2008	0.50 (0.22)	0.4 (0.14)	1.29 (0.38)	0.71 (0.32)	0.96 (0.40)
	2007	0.61 (0.16)	0.33 (0.11)	0.86 (0.19)	0.60 (0.25)	1.02 (0.42)
Range	2010	0-3 (0.2-0.4)	0-2 (0-0.4)	0-2 (0.4-1)	0-1 (0-0.3)	0-2 (0.2-0.7)
	2009	0-1 (0-0.3)	0-1 (0-0.4)	0-7 (0.6-1.6)	0-1 (0-0.2)	0-4 (0.1-1.3)
	2008	0-2 (0-0.5)	0-2 (0-0.3)	0-5 (0.4-1.4)	0-3 (0-1)	0-5 (0-1.2)
	2007	0-3 (0-0.4)	0-1 (0-0.2)	0-3 (0.5-1)	0-3 (0-0.7)	0-5 (0-1)

¹Stations along Redwood Creek could not be visited during four survey rounds because high water made surveys unsafe.

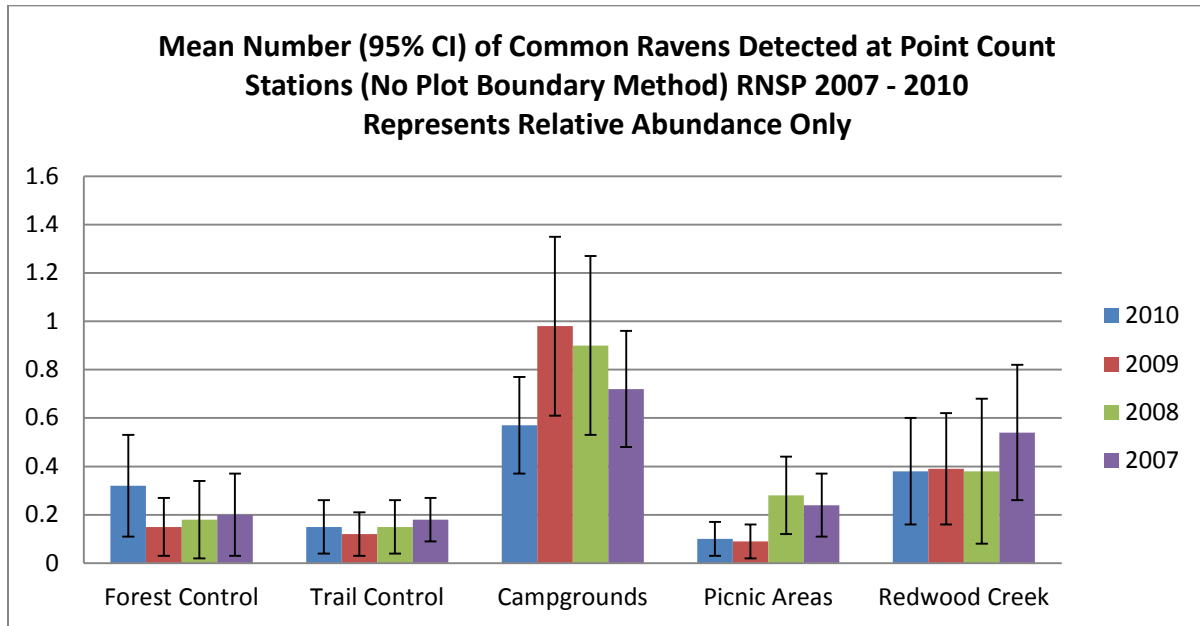


Figure 4. Mean number of common ravens detected at any distance of point count stations (infinite plot size) in RNSP during May to September, 2007 - 2010. Error bars represent 95% confidence interval. Graph results represent an analysis which treated each visit to each point count station as a discrete sampling unit.

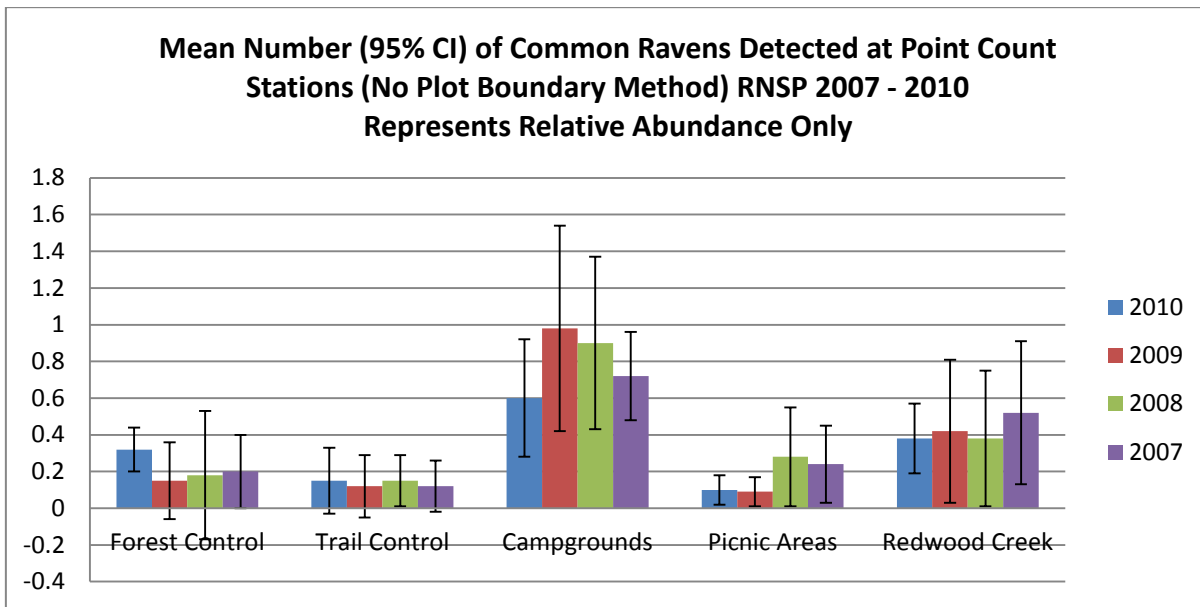


Figure 5. Mean number of common ravens detected at any distance of point count stations (infinite plot size) in RNSP during May to September, 2007 - 2010. Error bars represent a 95% confidence interval – mean of means analysis. Graph results represent a mean of means analyses which treated each point count station as a discrete sampling unit.

2) Beach Corvid Surveys

The instantaneous corvid point counts conducted during western snowy plover surveys between October 2007 - September 2008, October 2008 – September 2009, and October 2009 – September 2010 on three select reaches of RNSP beaches only provide an index of relative corvid abundance between the three reaches. American crows have been marginally most abundant on Freshwater Spit. Common ravens have shown no pattern difference among the three reaches over the past three years but are the most common corvid species detected on all three reaches. The only significant change within a reach is for ravens on north Gold Bluffs Beach with a measureable and possibly significant drop between 2008/9 and 2010. Only a very small number of corvids were unidentifiable to species and these results are reflected in the very low overall abundance of them on the three select survey reaches (Table 4 and Figure 6).

Table 4. Mean number and proportion of common ravens, American crows and unknown corvids observed within 500m per instantaneous point count on select reaches of beach in Redwood National and State Parks 2008 - 2010. Surveys were conducted between October of the previous year and September of the year listed. Results indicate relative abundance only.

		Freshwater Spit			North Gold Bluffs Beach			South Gold Bluffs Beach		
Year		2008	2009	2010	2008	2009	2010	2008	2009	2010
n		64	82	74	179	208	176	133	156	112
mean	Common Ravens	0.40	0.32	0.47	0.83	0.85	0.37	0.64	0.35	0.54
	American Crows	0.28	0.22	0.35	0.03	0.06	0.03	0.11	0.21	0.02
	Unknown Corvids	0.06	0.02	0.03	0.03	0.03	0	0.02	0.02	0.01
SD	Common Ravens	0.20	0.66	1.05	0.22	2.03	1.09	0.26	0.70	1.85
	American Crows	0.18	0.67	1.07	0.03	0.32	0.24	0.08	0.67	0.19
	Unknown Corvids	0.07	0.22	0.16	0.03	0.35	0	0.02	0.14	0.09
Proportion of survey points with at least one detection	Common Ravens	25%	22%	22%	33%	32%	19%	29%	26%	21%
	American Crows	17%	13%	20%	2%	4%	2%	7%	13%	<1%
	Unknown Corvids	5%	1%	1%	2%	1%	0%	2%	1%	<1%

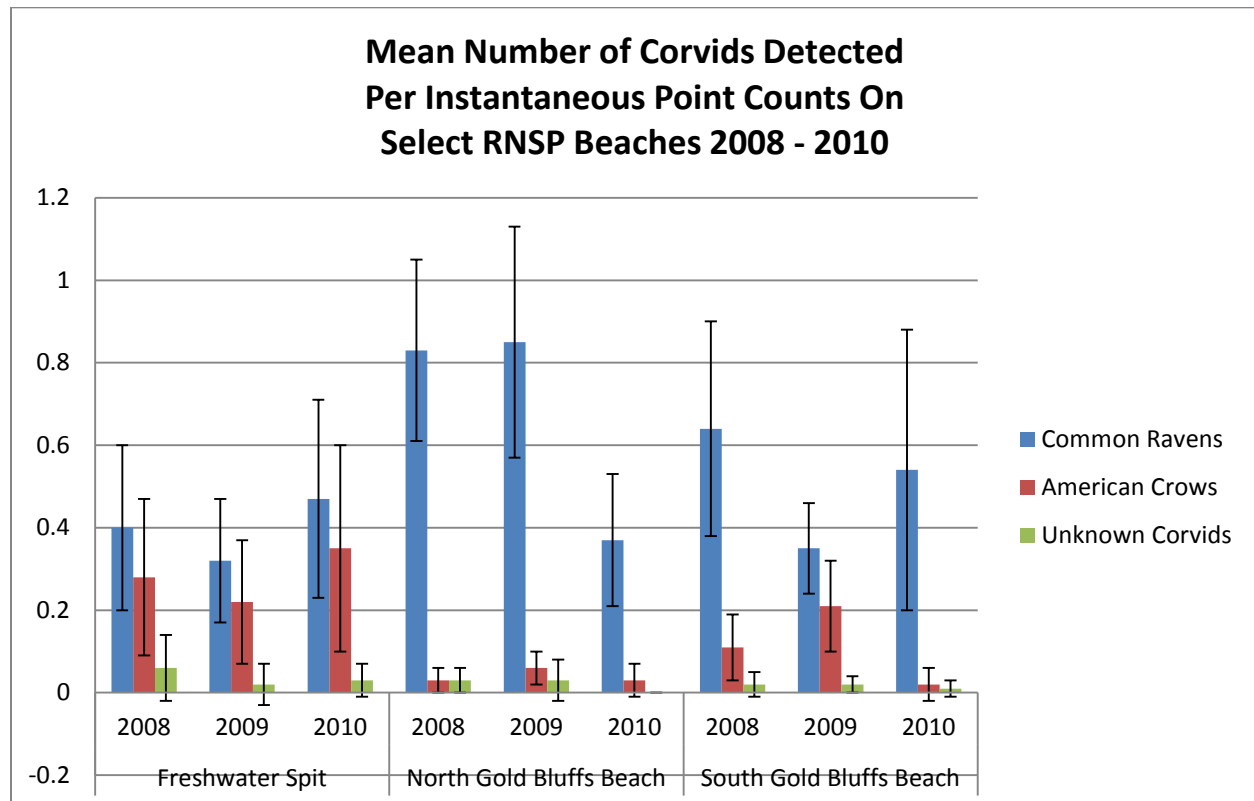


Figure 6. Mean number of common ravens, American crows and unknown corvids recorded within 500m per instantaneous point count on select reaches of beach in Redwood National and State Parks 2008-2010. Surveys were conducted between October of the previous year and September of the year listed. Error bars represent 95% confidence interval. Results represent relative abundance only.

D. Discussion/Recommendations

1) Forest Corvid Surveys

The primary purpose of this past year’s forest corvid survey effort was to continue to compare the effect of more intensive corvid management actions made during the past year to the previous baseline and to compare corvid densities between visitor use areas with differing levels of visitation within RNSP. These objectives continued to prove logistically feasible and should be sustainable in future years if current biological technician staffing levels are maintained.

Similar to 2007 - 2009, a within year comparison of means between the 2010 forest survey station categories showed, as expected, that the campground areas contained a significantly higher number of Steller’s jays as compared to the two control category types. This year campgrounds averaged five to six times the number of jays in the control areas and were similar to results recorded in 2007 and 2008 but not 2009 when control detections were particularly low. The results were significant if the analysis treated each point count station visit as a discrete sampling unit but were not significant if the point count stations themselves were treated as the discrete sampling unit (i.e. the 95% confidence intervals

overlapped). The broad confidence intervals that resulted from the mean of means analysis method were expected because of the much smaller number of sampling units compared to the discrete individual station visit analysis method. In addition, the smaller standard deviations were also expected because the mean of means analysis “smoothed” the dataset even though it resulted in approximately the same means. A statistician will be consulted in 2011 about the best method of analysis and whether the intense sampling schedule recommended by Peery (pers. comm.) is still warranted in order to detect a 50% Steller’s jay population change. Another power analysis needs to be conducted now that four full years of field data are available, as opposed to the one year’s worth of data with which the original power analysis was conducted. If a less intense sampling schedule is warranted from 2011 onwards, then RNSP and the USFWS will also have to determine how to reanalyze the 2007 – 2010 data so that it can be comparable to future survey years.

The dispersed camping area along Redwood Creek continued to have roughly the same jay detection rates as the two control category types in 2010. Interestingly, in 2010 the reach of Redwood Creek where the survey stations are located was completely closed to dispersed campers for the first time but the number of jays detected increased slightly (but not significantly) compared to the two previous years when dispersed camping was allowed. The lack of human presence does not appear to have driven down the detection rate, as would have been expected if human food availability were the primary factor for jay population density. If this trend continues in future forest corridor survey years, it may show that human effects on jays is only measurable at high visitation sites like front country campgrounds and front-country picnic sites and is not detectable at low visitation backcountry dispersed camping areas or low use picnic sites. Finally, the two control category types were again nearly identical. Stations along trails had the same detection rates as the forest control stations. The forest control area survey stations are time consuming to access and have not resulted in any difference when compared with the trail control areas. A statistician will be consulted in 2011 about whether the forest control areas may be dropped in order to make the monitoring program more efficient.

Two previous Steller’s jay point count surveys (Wallen et al. 1998 and George et al. 2001) have been conducted within the Jedediah Smith and Elk Prairie campgrounds and undeveloped marbled murrelet habitat areas of RNSP. Unfortunately, neither of those surveys used the same methodology used for this survey effort and so the results are not directly comparable. George et al. included birds up to 100m from point count stations, twice as far as the limit for this survey, and also included birds detected while walking in between survey stations. George et al. detected much higher numbers of jays at both campgrounds and at control sites; over 14 jays/station detected at the campgrounds and between two and five jays/station at control sites. Wallen et al. used a “no plot boundary” sampling method (J. Gordon, pers. comm.), again, unlike the 50m radius plot size used for this survey effort. Wallen et al. had somewhat similar results to those from this survey but unfortunately did not provide any confidence intervals.

The forest corridor survey results for common ravens, also as expected (L. George and J. Black pers. comm.), were again not conclusive. Raven territories and daily movement patterns are simply too large to be accurately sampled using standard point count methods within a heavily forested environment. There were almost no detections within any of the 50m plot areas and so the results were not included in this year’s report. Instead, only the “no plot boundary” results were reported. The “no plot boundary” results are also difficult to analyze because no detection reliability index can be established for birds located greater than 50m from point count stations, thus violating the assumption that all individuals are being observed. The variation in detectability is especially apparent when stations located deep in forests are compared to more open country survey stations like those along Redwood Creek. The longer sight lines

of the Redwood Creek stations allow for greater visual detections and may skew results considerably (L. George pers. comm. and pers. obs.). L. George (pers. comm.) is currently researching statistical methods which may allow adjustments for such variables. Unfortunately, at this point in time, the raven results are not easily interpreted.

2) Beach Corvid Surveys

Only a gross geographic analysis of the beach corvid monitoring data was made in 2010. Only between survey reach - between years were compared. The gross analysis shows that there is no discernable pattern in raven detections among the three survey reaches. In 2008 and 2009 it appeared that north Gold Bluffs Beach was used most by ravens (Bensen 2009), but this pattern no longer held in 2010. Raven use of north Gold Bluffs Beach fell significantly in 2010. No beach reach appeared to be used any more than any other reach over the past three years (Table 4, Figure 6). The gross geographic level of this analysis does not seem to be able to detect any significant differences. A more intensive GIS driven analysis would most likely result in a more detailed picture of where corvids are using beach habitats more often and thus indicate possible food resource concentrations and whether those concentrations are in proximity of human food sources such as park visitor developments (i.e. day use areas and campgrounds).

Opposite of the ravens, but more expected is the pattern shown by the American crow data. In 2008, crows were most abundant along Freshwater Spit and least abundant along the north Gold Bluffs Beach reach. In 2009, crows were again relatively most abundant along Freshwater Spit and along south Gold Bluffs Beach but least abundant along north Gold Bluffs Beach. In 2010, crows were again by far most abundant along Freshwater Spit (Table 4, Figure 6). Crows are open country birds that thrive in human altered agricultural/rural landscapes (Liebezeit and George 2002). Freshwater Spit parallels not just US Highway 101 but also the Orick valley pastoral area that contains large areas of beef and dairy livestock grazing pastures – prime crow habitat.

The 2008 corvid report (Bensen 2008) stated that no other comparable beach corvid survey data from the region has been published and so it is not possible to put this or last year's RNSP data into a context outside of the park; this is still technically correct. The variation in corvid survey intensity and method (some surveyors use ATV's and some walk) results in greatly varying survey intensities across the entire western snowy plover recovery unit two area. Recovery unit two is the USFWS species recovery region that encompasses Del Norte, Humboldt and Mendocino counties, including RNSP – similar beach corvid surveys to the parks's surveys are conducted throughout this area. Despite that caveat, however, the range of frequency of corvid detections per point count in RNSP, approximately 20% to 35%, are roughly equivalent to the "average" frequencies seen on other regional beaches but are considerably less than the 61% detection frequency seen at Mad River Beach (Colwell et al.2008).

SECTION II. CORVID MANAGEMENT

A. Introduction

A comprehensive description of the purpose, policy, scientific background, management history, objectives and methods of corvid management in Redwood National and State Parks (RNSP or park) is described in the parks' Corvid Management Strategy (RNSP 2008a). The following summary of actions

implemented in 2010 is intended to match the organization of Section V - Management Strategy, Section VI – Effectiveness Monitoring, and Section VIII – Planned Actions If Additional Funding Becomes Available, of the RNSP Corvid Management Strategy (RNSP 2008a), for ease of tracking.

B. Corvid Management Actions Implemented

Section V. A. - Visitor Education; was implemented with the following tasks accomplished:

- Three California State Park Senior aides and one partial State Park Interpreter I dedicated-to-the-murrelet/corvid program salary equivalents were hired for the May – September high park visitor season. These positions were in addition to other seasonal and permanent National and California State Park interpretive staff that informed visitors about murrelets, corvids and food. These positions patrolled/roved (contacted visitors while moving around high use areas like campgrounds and trailheads) the park complex’s three largest front country campgrounds and various high visitation day use areas providing information on marbled murrelets, clean camping, proper trash disposal and the negative effects of intentionally or unintentionally feeding corvids and other wildlife. The roves were timed to occur from 0800 – 1000 and 1700 – 1900 to coincide with the maximum number of visitors in the campgrounds. In addition, the senior aides gave formal interpretive programs, campfire talks, and Junior ranger programs. Funding for these extra positions came from the Kure/Stuyvesant Oil Spill Restoration Trust Fund that is administered by a trustee council made up of officials from the California Department of Fish and Game – Oil Spill Prevention and Response division and the USFWS. Non-oil spill funded seasonal and permanent interpretive staff from both the NPS and CSP roved and made presentations and their numbers are included in the totals above. Interpretive staff conducted 212 murrelet-corvid roves where approximately 10,400 individuals were contacted and 5,500 publications on murrelets-corvids were distributed.
- A corvid-marbled murrelet education article was included in the 2010 issue of the RNSP visitor guide newsletter. Other murrelet corvid specific publications were also produced and distributed. 40,000 of these educational publications were handed out across the parks.
- A short corvid-murrelet educational video produced by Santa Cruz county California State Parks was included in most campfire programs from June through September using newly renovated amphitheater projection booths.
- The same educational video was shown at two RNSP visitor centers on a daily basis.
- New picnic table top bear/corvids informational signs were mounted to all tables at the Elk Prairie and Jedediah Smith campground and picnic areas.
- RNSP staffed a murrelet-corvid educational booth for the entire length of the 2010 Humboldt county fair. 1,780 fair visitors were contacted and 820 publications were distributed.
- In 2010, a total of 263,200 visitors were contacted during their time at RNSP and it can be assumed that the vast majority of them were exposed, at least in passing, to some sort of murrelet-corvid educational media (e.g. sign, pamphlet, video, staff contact).
- A corvid-murrelet dedicated web page was maintained at the publicly accessible Redwood National Park website - <http://www.nps.gov/redw/naturescience/marbled-murrelet.htm>. Approximately 3,300 unique hits were made to this webpage in 2010.

Section V. B. - Temporary Partial Dispersed Camping Prohibition and Removal of Select Picnic Tables; was implemented this year. No dispersed camping was allowed along the lower section of Redwood

Creek from the Bond Creek junction to the downstream park boundary, or approximately 7 miles of previously available dispersed camping area was made unavailable. All backcountry campers must obtain backcountry camping permits at park visitor centers where they received the notice of areas available for camping. Information signs were also installed at Redwood Creek access trails informing backcountry campers of the areas available for dispersed camping. The partial dispersed camping closure on Redwood Creek was feasible and will continue next year. Picnic tables were removed this year previous the beginning of the high use visitor season from five sites per the Corvid Management Strategy: Tall Trees Trail trailhead, Redwood Creek Overlook, Lady Bird Johnson Trail trailhead, Orick Horse Three Hour Loop Trail picnic area and Mill Creek Loop Horse Trail picnic area.

Section V. C. - Law Enforcement; was implemented as part of standard law enforcement practices within RNSP. No specific actions were reported to the Corvid Program Manager.

Section V. D. - Facility Management; was implemented as part of the standard maintenance procedures of RNSP. No specific actions were reported to the Corvid Program Manager.

Section V. E. – Inventory of Potential Human Created Corvid Food Sources Outside of Park. A preliminary inventory was completed in 2008 and the results are included in Bensen (2008a).

Section V. F. – Program Coordination and Reporting; an RNSP staff member continued as the Corvid Program Manager to coordinate corvid management activities in RNSP. This report partially satisfies the data analysis and reporting component of this task.

Section VI. A. - Visitor Education Evaluation; field data was gathered in 2010. The study, conducted by Dr. Carolyn Ward and Dr. Steven Martin, had completed field work in October. Data analysis is underway and a report with a full analysis and management recommendations will be completed by the end of 2011. Approximately \$98,500 in funding was provided by the Kure/Stuyvesant Oil Spill Restoration Trust Fund in 2009 for the study.

Section VI. B. - Corvid Monitoring and Reporting; was completed. The survey effort and data analysis described in this report documents this task for 2010.

Section VII. A. – Outside-the-park Corvid Management; was not implemented in 2010 due to lack of additional funding and staff.

Section VII. B. – Research; 1) The corvid – marbled murrelet education program effectiveness study headed by Drs. Carolyn Ward and Steven Martin was described above in Section VI. A. 2) A study on common raven home range use along Prairie Creek was initiated in 2009 and field work continued in 2010. The study is being conducted by Humboldt State University Wildlife Management graduate student, Amy Scarpignato, under the direction of Dr. Luke George. Additional data gathering may occur in 2011 as will data analysis and report preparation. 3) A Steller’s jay home range use in and around RNSP front country campgrounds began in 2010 and will continue in 2011. The study is being conducted by Humboldt State University Wildlife Management graduate student Will Goldberg under the direction of Dr. Luke George. Approximately \$1,500 of Kure/Stuyvesant oil spill restoration trust funds administered by Redwood National and State Parks and \$1,500 of Redwood National Park base funds were given in support of this study. 4) Lab experiment for a conditioned taste aversion study targeting Steller’s jays began in 2010. Field trials will begin in 2011. The study is being led by Dr. Richard Golightly and Dr. Pia Gabriel from Humboldt State University. Approximately \$65,300 of Command oil

spill restoration trust funds administered by Redwood National and State Parks were given in support of this study.

Section VII. C. – Additional Visitor Education was implemented in 2010 – primarily through additional visitor contacts by the additional seasonal interpretive ranger staff described above for Section V.A.

Section VIII. A. – Adaptive Management Process, was implemented in 2010 with increased educational program intensity, closure of the lower Redwood Creek gravel bars to dispersed camping and removal of picnic tables from five locations throughout Redwood National Park.

Section VII. B. - Future Corvid Management Options, will be implemented, if necessary, in one to two years.

SECTION IV. TRAIL AND BACKCOUNTRY MANAGEMENT PLAN ACTIONS AND AVOIDANCE AND MINIMIZATION MEASURES

A. Introduction

This section of the report describes all visitor development construction minimization measures implemented by the parks in 2010 as stipulated in the terms and conditions of the RNSP Trail and Backcountry biological opinion (USFWS 2007a).

B. Trail Plan Actions and Avoidance and Minimization Measures Implemented

The Lady Bird Johnson – Berry Glen Connector Trail construction was completed and the trail was opened to the public in October, 2010. All avoidance and minimization measures were implemented, including primarily that all above ambient noise producing work was conducted outside of the marbled murrelet noise restriction period (24 March – 15 September). Spotted owl (*Strix occidentalis caurina*) presence surveys were conducted in preparation of the construction of the new route in 2007 and 2008. No spotted owls were detected during the surveys.

As with last year, human food availability surveys were again not conducted in 2010 after it was determined after repeated preliminary observation and trials that a meaningful, repeatable monitoring method was impossible. Preliminary trials in 2007 and 2008 showed that the vast majority of campsites and trashcan areas are clean. No food waste was detectable to the observers. Virtually no food waste available to corvids was detected. Subsequent day long observations of individual corvids feeding within the campsites showed that food scraps were so small as to be unnoticed by observers. In addition, successful feeding bouts were extremely short lived, on the order of seconds. Therefore, it was determined that to develop a statistically meaningful, repeatable monitoring program would require a near continuous observation effort. Even with such effort, it is highly debatable whether such information would result in actionable management decisions. More intensive research based observations, such as the ongoing Steller's jay and common raven habitat use studies within RNSP campgrounds, may however result in actionable management decisions.

All campsites within the Mill Creek Campground have had wildlife proof food storage lockers and all trashcans are wildlife proof. Funding was provided by outside private donations and private non-profit wildlife conservation groups. This project was completed two years ago.

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