Redwood
National and State Parks

National Park Service
U.S. Department of the Interior

California Department of
Parks & Recreation

Forest and Beach Corvid Monitoring and Management
Trail and Backcountry Management Plan Implementation
2012 Annual Progress Report

January 2013

US Fish and Wildlife Service Biological Opinion Reference #: 8-14-2003-1517

Title page photos clockwise from upper right (all photos taken in Redwood National and State Parks in 2012): Steller's jay perched on campsite sign, Elk Prairie Campground, Prairie Creek Redwoods State Park; corvid proof campground standpipe drain grate prototype, Jedediah Smith Redwoods State Park; common raven at Crescent Beach picnic area, Redwood National Park; corvid education program sign with new logo and motto, Elk Prairie Campground entrance station, Prairie Creek Redwoods State Park.

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 2007-2012. Section II describes corvid management activities that took place in RNSP in 2012. Section III describes the progress of any projects from 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 – USFWS ref. # 8-14-2003-1517). 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 nivosus nivosus*) 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) and other recent research (Peery and Henry, 2010) revealed that nest predation by corvids is currently, and expected to continue to be, the primary cause of murrelet population decline, particularly in California. High rates of murrelet nest predation by corvids in RNSP have been conclusively recorded (Golightly and Schneider 2011, Hebert and Golightly 2006, RNSP unpub. data). 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 (Falxa et al. 2011, McShane et al. 2004). Murrelets have been found to forage at sea primarily off the coast immediately adjacent to their inland nesting grounds (Raphael et al. 2004, Hebert and Golightly 2006). The California population represents roughly a third of the federally listed population. Current murrelet fledging success (percentage of chicks leaving the nest alive) within RNSP is estimated to be 0.3% - 2.0% (Hebert and Golightly 2006). To maintain just 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 federally-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 indicate that Steller's jay densities in parks' 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, a Corvid Management Strategy (RNSP 2008a) was developed. The goal of the strategy is to decrease the density of corvids surrounding visitor use areas and facilities in the parks.

SECTION I. FOREST AND BEACH CORVID MONITORING

A. Introduction

The RNSP Corvid Management Strategy (RNSP 2008a) is intended to be adaptive. Effectiveness monitoring is central to the success of the strategy. Monitoring whether and how jay, crow and raven populations are responding to management actions is central to determining if the goal of reducing corvid densities near high use visitor areas is being met. The information collected through monitoring will hopefully assist the parks develop effective management techniques that will be directed to the areas most affected by corvids. For more detail on the

monitoring design, rationale and corvid population targets (for forest corvids only), 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) and modified after a power analysis was performed on the 2007 – 2011 survey results (George and Peery 2012). Forest corvid surveys were conducted from June 2012 through August 2012. The 30 monitoring station locations are shown in Figure 1. The stations are grouped according to one of two types they sample, control areas or type of visitor use area. Ten 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). During the 2007 – 2011 survey years, four off trail survey points and six trail survey points were used as controls. The power analysis (George and Peery 2012) showed that there was no difference between the two control types and so the four off-trail points were converted to trail points for ease of survey in 2012. Five stations are located within frontcountry 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 backcounty 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). A March 2009 USFWS review of the 2008 report (Bensen 2008a) suggested that the results of the analysis may have been erroneous because sampling location independence is not equivalent to temporal sampling independence. Therefore, in order to maintain consistency between survey years and address this critique, data from 2009 through 2010 were analyzed in two ways 1) using the original 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 the second analysis. A normal distribution was assumed for both analyses. In 2011, an outside study design assessment and statistical analysis was made of all the RNSP Steller's jay monitoring data (2007 – 2011). The assessment resulted in the data being analyzed using a mixed model analysis of variance. George and Peery (2012) again treated each visit to each point count station as a discrete data point. Their results were presented in the 2011 RNSP corvid monitoring and management report (RNSP 2012). This reasoning and analytical methodology were used again for the 2012 survey data analysis presented here.

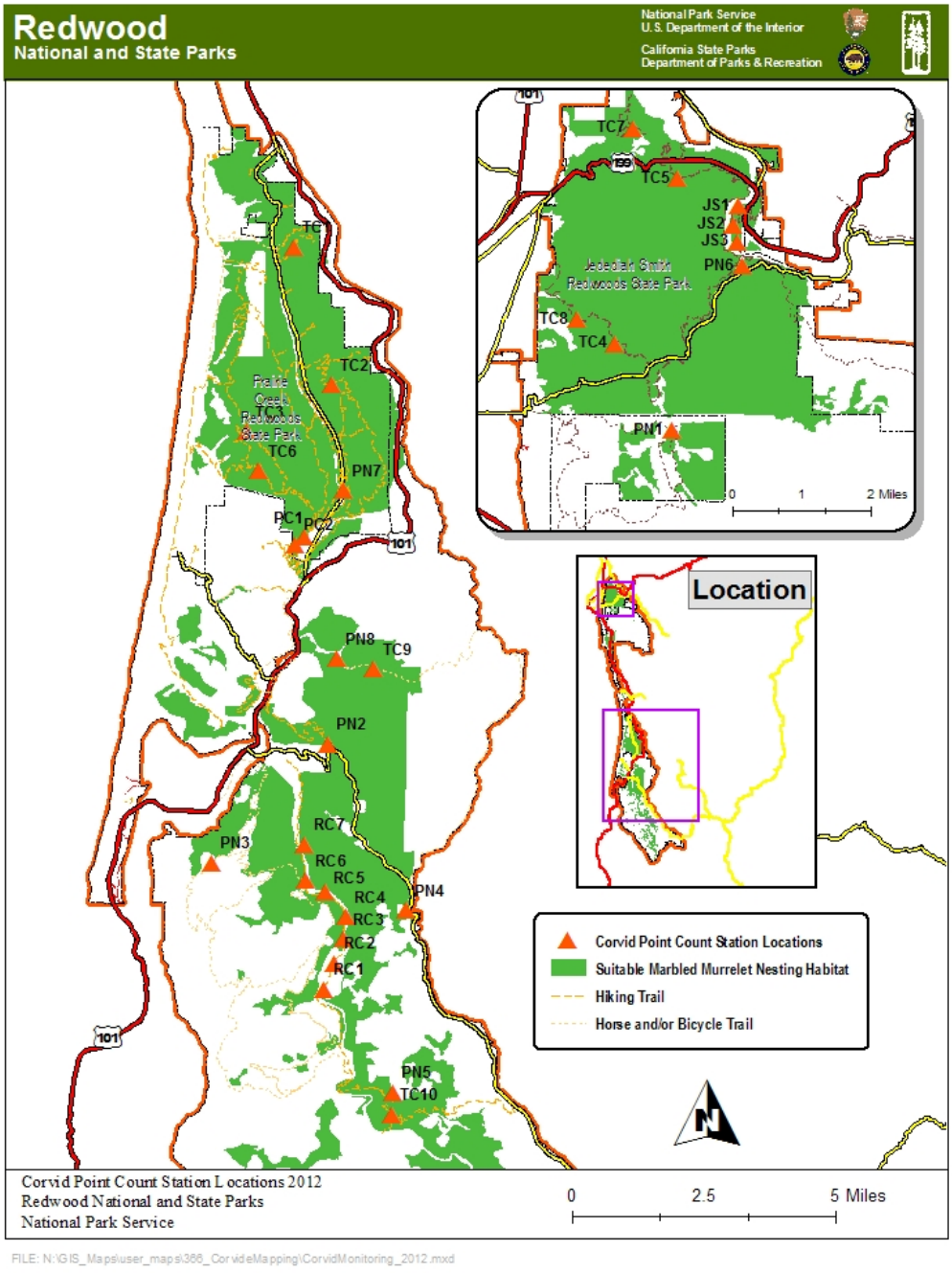

Figure 1. Location of point count survey stations within Redwood National and State Parks. TC = trail control station (n = 10), JS = Jedediah Smith campground station (n = 3), PC = Elk Prairie campground station (n = 2), PN = picnic area station (n = 8), RC = Redwood Creek dispersed camping area station (n = 7).

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 2011 to September 2012 and so the beach corvid surveys spanned the same period of time. Instantaneous point counts were made "on the twenty minute mark" for foot based surveys, or "on the ten" for ATV-based surveys 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 June through August of 2012 for a total of 180 surveys or six visits to each station. Approximately 600 person hours were spent in the field completing the surveys.

The results for Steller's jays are shown in Figure 2 and Table 1. 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). This was the first year since surveys began in 2007 that a large drop in Steller's jays numbers was recorded in Jedediah Smith and Elk Prairie campgrounds. All other survey area types remained relatively stable.

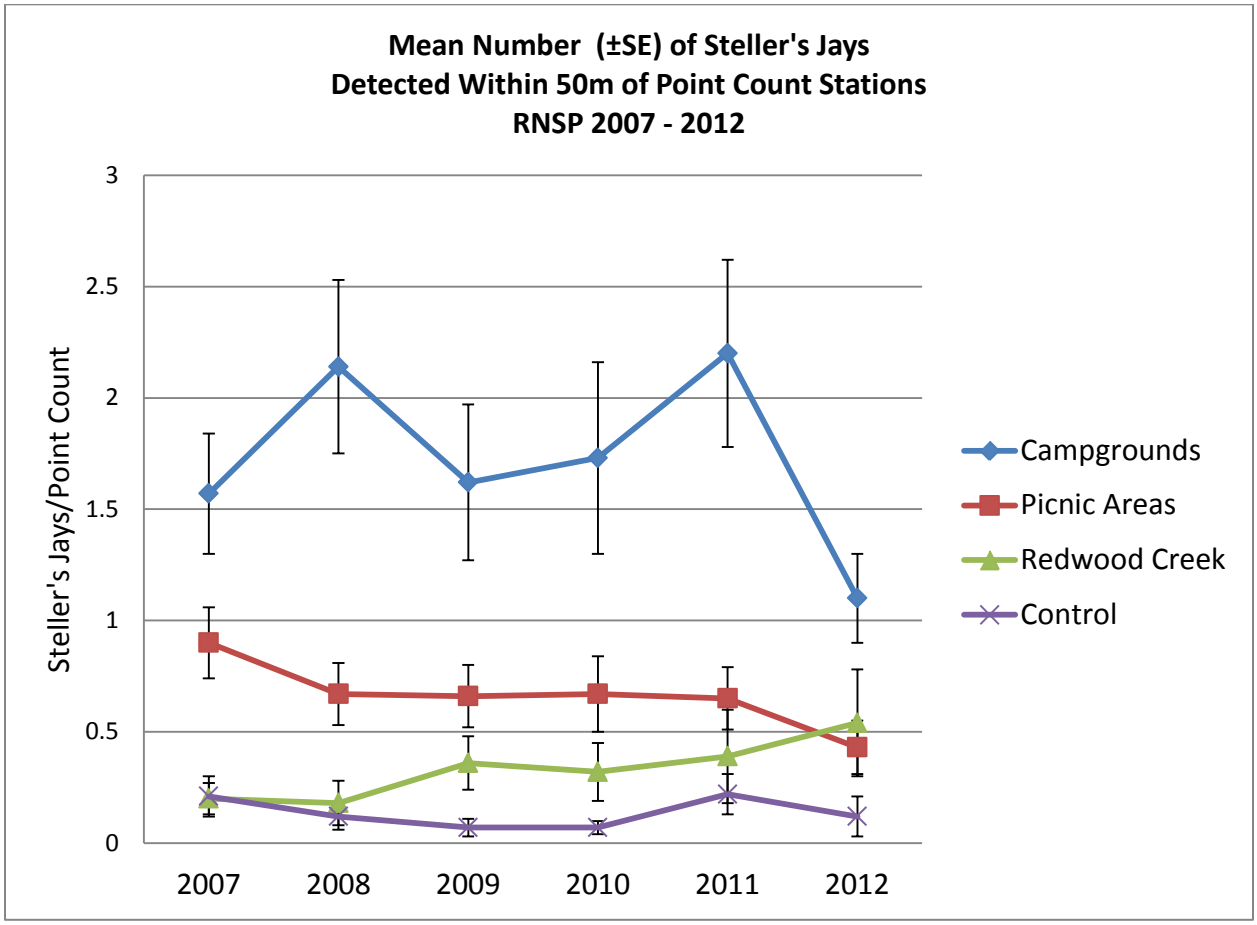

Figure 2. Mean number of Steller's jays detected within 50m of point count stations (±SE) in RNSP 2007-2012.

Table 1. Mean number of Steller's jays detected within 50m of point count stations in RNSP during June through August of 2007 – 2012.

		Campgrounds	Picnic Areas	Redwood Creek	Control Areas
n/year		30	48	42	60
mean	**2012**	1.1	0.43	0.54	0.12
	2011	2.2	0.65	0.39	0.22
	2010	1.73	0.67	0.32	0.07
	2009	1.62	0.66	0.36	0.07
	2008	2.14	0.67	0.18	0.12
	2007	1.57	0.9	0.2	0.21
SD	**2012**	0.41	0.24	0.49	0.17
	2011	0.86	0.29	0.43	0.17
	2010	0.89	0.34	0.26	0.07
	2009	0.71	0.29	0.24	0.08
	2008	0.8	0.28	0.21	0.12
	2007	0.55	0.31	0.15	0.18
Range	**2012**	0 - 4	0 - 4	0 - 8	0 - 5
	2011	0 - 10	0 - 4	0 - 5	0 - 4
	2010	0 - 9	0 - 5	0 - 2	0 - 1
	2009	0 - 7	0 - 5	0 - 2	0 - 3
	2008	0 - 7	0 - 3	0 - 2	0 - 2
	2007	0 - 5	0 - 5	0 - 2	0 - 4

The large home ranges and long distance daily movements of common ravens in RNSP (Scarpignato 2011) 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 previous years'(e.g. Bensen 2010, Bensen 2008a and Bensen 2007). None or virtually no ravens were detected within 50m of monitoring stations. The same lack of detections occurred during the 2012 survey year and so a presentation of raven detections within 50m of point count station results was 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 Figure 3 and Table 2. These results represent all detections at each station, regardless of how far away the individual ravens were from the station. Raven density cannot be estimated with this method nor can a high probability of detection be established, making the results inconclusive.

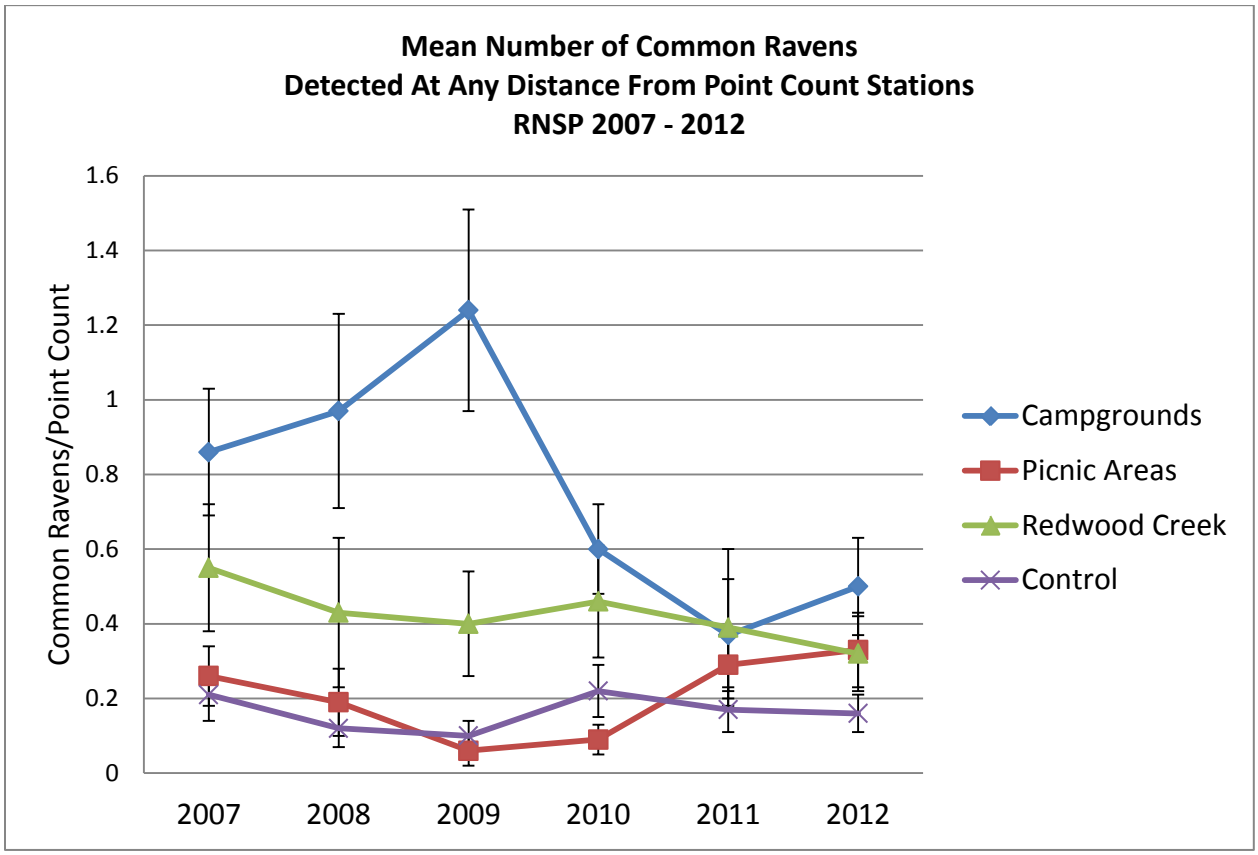

Figure 3. Mean number of common ravens (±SE) detected at any distance of point count stations in RNSP during June through August, 2007 - 2012.

Table 2. Mean number of common ravens detected at any distance of point count stations in RNSP during June through August of 2007 – 2012. Results indicate relative abundance only.

		Campgrounds	Picnic Areas	Redwood Creek	Control Areas
n/year		30	48	42	60
mean	**2012**	0.5	0.33	0.32	0.16
	2011	0.37	0.29	0.39	0.17
	2010	0.6	0.09	0.46	0.22
	2009	1.24	0.06	0.40	0.10
	2008	0.97	0.19	0.43	0.12
	2007	0.86	0.26	0.55	0.21
SD	**2012**	0.73	0.64	0.59	0.41
	2011	0.81	0.65	1.13	0.45
	2010	0.67	0.29	0.79	0.56
	2009	1.48	0.25	0.89	0.30
	2008	1.4	0.61	1.07	0.38
	2007	0.89	0.54	1.08	0.55
Range	**2012**	0 - 2	0 - 2	0 - 2	0 - 2
	2011	0 - 3	0 - 3	0 - 5	0 - 2
	2010	0 - 2	0 - 1	0 - 2	0 - 3
	2009	0 - 4	0 - 1	0 - 4	0 - 1
	2008	0 - 4	0 - 3	0 - 5	0 - 2
	2007	0 -2	0 -2	0 -3	0 - 2

2) Beach Corvid Surveys

The instantaneous corvid point counts conducted during western snowy plover surveys between October 2007 - September 2008, October 2008 – September 2009, October 2009 – September 2010, October 2010 – September 2011 and October 2011 – September 2012 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 five 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 2010/11. 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 3 and Figure 4).

Table 3. 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 - 2012. 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		**'08**	**'09**	**'10**	**'11**	**'12**	**'08**	**'09**	**'10**	**'11**	**'12**	**'08**	**'09**	**'10**	**'11**	**'12**
n		64	82	74	77	71	179	208	176	185	121	133	156	112	158	92
mean	Common Ravens	0.40	0.32	0.47	0.21	0.23	0.83	0.85	0.37	0.19	0.24	0.64	0.35	0.54	0.38	0.36
	American Crows	0.28	0.22	0.35	0.10	0.07	0.03	0.06	0.03	0.03	0	0.11	0.21	0.02	0.03	0
	Unknown Corvids	0.06	0.02	0.03	0	0.04	0.03	0.03	0	0	0	0.02	0.02	0.01	0	0
SD	Common Ravens	0.20	0.66	1.05	0.68	0.56	0.22	2.03	1.09	0.58	0.68	0.26	0.70	1.85	0.93	0.70
	American Crows	0.18	0.67	1.07	0.38	0.35	0.03	0.32	0.24	0.02	0	0.08	0.67	0.19	0.02	0
	Unknown Corvids	0.07	0.22	0.16	0	0.35	0.03	0.35	0	0	0	0.02	0.14	0.09	0	0
% pts. at least one detection	Common Ravens	25%	22%	22%	9%	15%	33%	32%	19%	13%	15%	29%	26%	21%	20%	25%
	American Crows	17%	13%	20%	8%	4%	2%	4%	2%	2%	0	7%	13%	<1%	2%	0
	Unknown Corvids	5%	1%	1%	0%	1%	2%	1%	0%	0%	0	2%	1%	<1%	0%	0

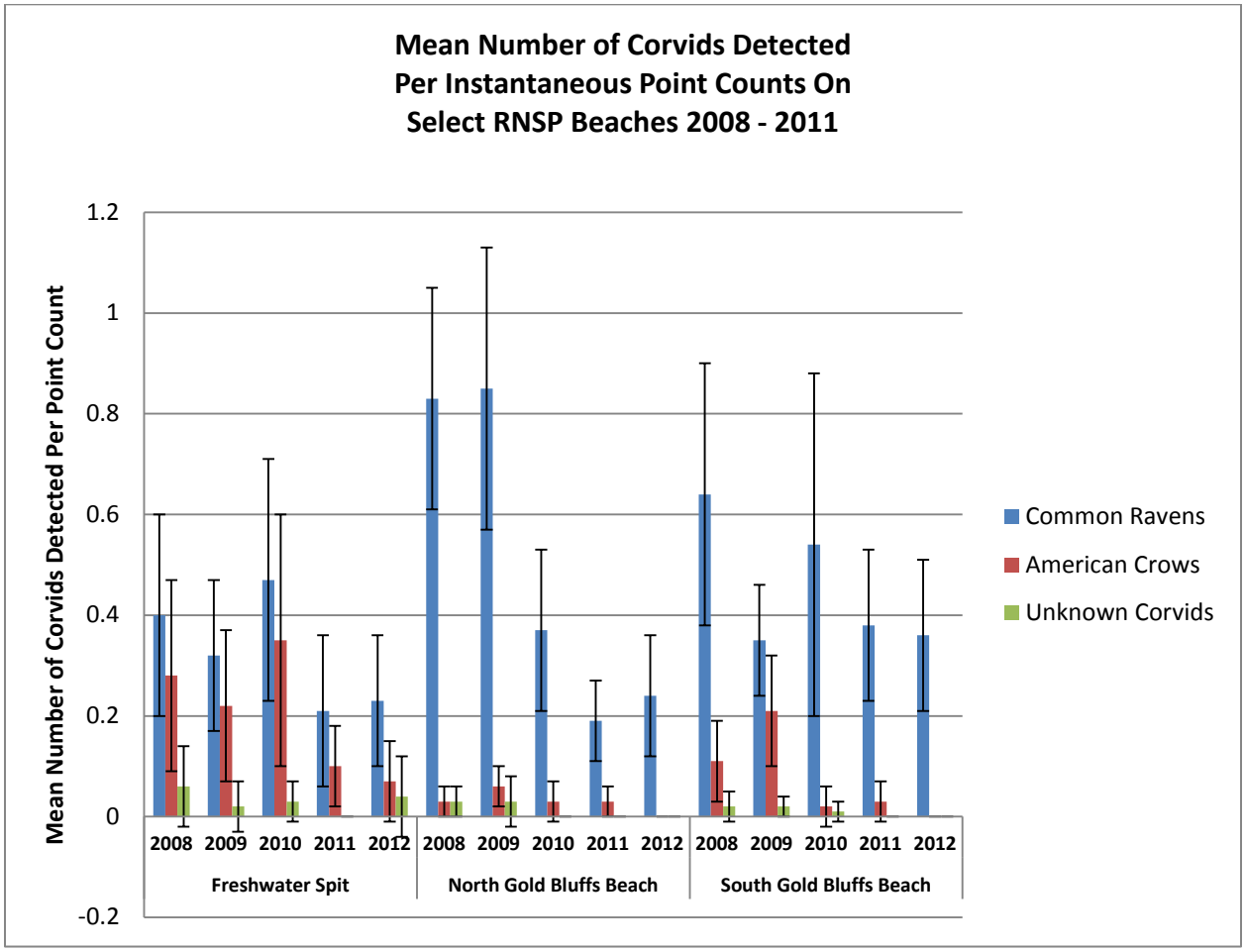

Figure 4. Mean number of common ravens, American crows and unknown corvids recorded within 500m per instantaneous point count on select reaches of beach in Redwood National and State Parks 2008-2012. Surveys were conducted between October of the previous year and September of the year listed. Error bars represent 95% confidence interval. Results represent relative abundance only.

D. Discussion

1) Forest Corvid Surveys

The year 2012 was set in the RNSP Corvid Management Strategy (RNSP 2008a) as an adaptive management evaluation year. The years 2007 – 2009 had less intensive forest corvid management in high use visitor areas of the parks while the years 2010 – 2012 had increasingly intense and focused corvid management. In 2012, management effort intensity was concentrated on the campgrounds almost exclusively and new visitor education slogans, personal visitor contact methods and media were implemented based on Ward et al.'s (2012) recommendations stemming from their assessment of the RNSP corvid education program. This past year's results, when compared with the previous five years' results, will contribute to the analysis of whether

the RNSP forest corvid management program is effectively reducing forest corvid densities in high use visitor areas as compared to control areas away from high use visitor areas. An additional important point to note is that the study design for the RNSP forest corvid monitoring program is structured to be able to detect a 50% change in corvid densities at the campgrounds with 95% accuracy (George and Peery 2012, RNSP 2008a).

Similar to 2007 - 2011, a within year comparison of means between the 2012 forest survey station categories showed that the campground areas contained a significantly higher number of Steller's jays as compared to the control areas (Table 1, Figure 2). This is the first survey year, however, that a large drop in jay numbers was recorded in the campgrounds. The decrease approached the 50% decrease designed to be detectable by the monitoring program, if a rough running average of the previous five years of monitoring is used as a benchmark (Table 1, Figure 2). It is too early to state that the decrease is attributable to the more intense and targeted corvid management actions that occurred in the campgrounds in 2012. There is the possibility that the decrease was simply a localized phenomenon unconnected with any management actions. A compelling counterpoint, however, is the fact that none of the other survey areas (i.e. picnic areas – which did not have intensive corvid management in 2012, Redwood Creek – where there was no dispersed backcountry camping allowed in 2012, and the control areas) experienced a large drop in Steller's jay numbers. The fact that those areas remained stable provides evidence that the decrease in Steller's jays at the campgrounds was not a region wide ecological or demographic phenomenon. The next two to three years of monitoring should be very telling. If the lower numbers of Steller's jays in the campgrounds trend continues and the control areas remain stable, then there will be stronger evidence that the increased corvid management intensity methods are effective.

The dispersed camping area along Redwood Creek continued to have roughly the same Steller's jay detection rates as the control areas in 2012. Interestingly, in 2012, as in 2010 and 2011, the reach of Redwood Creek where the survey stations are located was completely closed to dispersed campers but the number of jays detected increased slightly (but not significantly) compared to 2007 - 2009 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. The evidence is mounting that human effects on Steller's jays is only measurable at high visitation sites like frontcountry campgrounds and frontcountry picnic sites and is not detectable at low visitation backcountry dispersed camping areas.

The forest corvid 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, as shown by Scarpignato's (2011) raven home range study conducted in RNSP, 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 (pers. obs. and L. George pers. comm.). Unfortunately, at this point in time, the raven results are not easily interpreted. The trends seen in Figure 3 most likely are not mirroring reality but are instead sampling error artifacts. It is entirely likely that point count methodologies are inappropriate to monitor common ravens in the RNSP forest environment. At this point, no viable alternative common raven monitoring methods have been developed or suggested.

2) Beach Corvid Surveys

Only a gross geographic analysis of the beach corvid monitoring data was made in 2012. Only between survey reach - between years were compared. The gross analysis shows that there is only a discernable pattern in raven detections on north Gold Bluffs Beach. In 2008 and 2009 it appeared that north Gold Bluffs Beach was used most by ravens compared to the other two reaches, but this pattern no longer held from 2010 - 2012. Raven use of north Gold Bluffs Beach fell significantly in 2010 - 2012 (Table 3, Figure 4), for no obvious reason. Raven use is now roughly even among the three reaches.

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. From 2010 - 2012, crows were again most abundant along Freshwater Spit, but less strongly (Table 3, Figure 4). Crows are open country birds that thrive in human altered agricultural/rural landscapes (Liebezeit and George 2002). Freshwater Spit parallels US Highway 101 with convenient parking for access to both the beach and a popular fishing area at Freshwater Lagoon, and is immediately south of the Orick valley pastoral area that contains large areas of beef and dairy livestock grazing pastures – prime crow habitat. Thus, it makes sense that crows have been most abundant on that beach.

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 10% to 35% (Table 3), are roughly equivalent to slightly below 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 is described in the parks' Corvid Management Strategy (RNSP 2008a). The following summary of actions implemented in 2012 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:

- The corvid management program visitor education recommendations outlined in Ward et al. (2011) were partially implemented in 2012, including:
    - Adoption of the "Keep It Crumb Clean" motto and logo – example 1, Appendix I.
    - Conveying message at key visitor access points to ensure target audience receives orientation. Park staff identified the four campground entrance kiosks as key access points to provide information to the most critical sub-segment of park visitors that the corvid education campaign must reach - campers. Every vehicle entering the park campgrounds from May through September received a card with the "Keep It Crumb Clean" motto and logo on the front and a message on the reverse – example 2, Appendix I, along with a short verbal message from entrance kiosk park staff. Tens of thousands of visitors were contacted this way.
    - Increasing signage with simple messaging. "This is a Crumb Clean Campground" signs were installed at campground entrance kiosks and other prominent locations within campgrounds – see cover page for example.
    - Concentrating all interpretive staff scheduling and deployment to campgrounds during evening meal times when most campers were present and managing food at their sites. See next item for details.
- Three National Park Service seasonal interpretive rangers and one partial State Park Interpreter II 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 Park Service 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 three largest front country campgrounds in RNSP 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 1700 – 1900 to coincide with the maximum number of visitors in the campgrounds. In addition, the seasonal rangers 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 US Fish and Wildlife Service (USFWS). Non-oil spill funded seasonal and permanent interpretive staff from both the National Park Service and California State Parks roved and made presentations and their numbers are included in the totals above. Interpretive staff contacted approximately 10,000 visitors during roves.

- A corvid-marbled murrelet education article was included in the 2012 issue of the RNSP visitor guide newsletter. Other murrelet corvid specific publications were also produced and distributed.
- A short corvid-murrelet educational video produced by California State Parks Santa Cruz District was included in most campfire programs from June through September using newly renovated amphitheater projection booths.
- RNSP staffed a murrelet-corvid educational booth for the 2011 Humboldt County (10 days) and Del Norte County (four days) Fairs. Approximately 1,500 fair visitors were contacted and 1,500 publications were distributed.
- In 2012, approximately 250,000 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.

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 receive information on areas available for camping. Information signs were also installed at Redwood Creek access trails informing backcountry campers of the areas available for dispersed camping. Per the Corvid Management Strategy, picnic tables were made unavailable at five sites: 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. Specific actions include the installation of four prototype corvid proof grates on French drain covers at campground water standpipes – see cover page for example.

The purpose of these grates is to prevent corvids from obtaining food scraps washed off campers' dishes. The prototypes proved effective and all French drains are planned to be covered by these grates in 2013. Unlike previous years, no corvid proof food storage lockers or trashcans required replacement or repair in 2012.

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; a California State Park and a National Park Service staff member continued as the co-Corvid Program Managers 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; completed in 2011, see RNSP (2012) for details.

Section VI. B. - Corvid Monitoring and Reporting; was completed. The survey effort and data analysis described in this report documents this task for 2012.

Section VII. A. – Outside-the-parks Corvid Management; was not implemented in 2012 due to lack of additional funding and staff.

Section VII. B. – Research; see RNSP (2012) for a synopsis of the three large scale corvid management related research studies conducted in RNSP and completed in 2011. Only one corvid related study continued in 2012:

1) A Steller's jay home range use study in and around RNSP front country campgrounds began in 2010 and continued in 2012. Field work/data gathering was completed. A completed master thesis is expected in 2013. The study is being conducted by Humboldt State University Wildlife Management graduate student Will Goldenburg 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. All of those funds have been spent. Preliminary results indicated that Steller's jays utilized campgrounds as a feeding and fledged young rearing ground with nests arrayed in a spoke like pattern extending up to one kilometer around the campgrounds. More detailed analyses and management implications will be forthcoming when the thesis is completed.

Section VII. C. – Additional Visitor Education was implemented in 2012 – see Section V.A. above for details.

Section VIII. A. – Adaptive Management Process; was implemented in 2012 with increased educational program intensity, education motto and logo changes, closure of the lower Redwood Creek gravel bars to dispersed camping and removal of picnic tables from five locations throughout Redwood National Park. The three recently completed corvid management research studies will continue to inform park managers in 2013 and a number of changes are expected

over the next two years given the additional findings. Discussions about the ramifications of the corvid monitoring data and research studies conducted in RNSP and elsewhere in the marbled murrelet range have begun with the US Fish and Wildlife Service and California Department of Fish and Game. Additional information is expected from other marbled murrelet management areas within the next year. Further corvid management changes and improvements will most likely result from those discussions and analysis. See next item for when changes may occur.

Section VII. B. - Future Corvid Management Options; will be implemented, if necessary, in one year with a full review of current actions occurring in early 2013 in consultation with the US Fish and Wildlife Service, California Department of Fish and Game and regional corvid and marbled murrelet experts.

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 2012 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. The 2012 high visitor use period (May through September) was the second high visitation season for this trail. All avoidance and minimization measures were implemented. The primary measure was 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.

No other new trails or facilities described in the RNSP Trail and Backcountry Management Plan biological opinion (USFWS 2007a) were opened nor was construction begun in 2012.

As with last year, human food availability surveys were again not conducted in 2012 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 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 results of the Steller's jay and common raven habitat use studies within RNSP campgrounds, may result in actionable management decisions.

All campsites within the Mill Creek Campground have 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 three years ago. Wildlife proof food storage lockers and trashcans were maintained throughout the RNSP complex using internal funding sources as well as oil spill restoration funds.

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Appendix I

Example of New Corvid – Murrelet Visitor Education Program Motto and Logo

Example 1 – New corvid education program motto "Keep It Crumb Clean" and logo. The motto and logo are now used on all corvid/murrelet related education media including web pages, visitor guides, signs, pamphlets, and ranger presentations.

Never Feed Wildlife

Why?

- It's dangerous to you and the animal.
- Fed ravens and jays threaten wildlife.
- It's against the law!

What should I do?

- Store all food and smelly items in bear-proof food storage lockers.
- Keep food within arm's reach when cooking or preparing.

Keep it Crumb Clean!