

## Final Report: 2016 Snowy Plover Breeding in Coastal Northern California, Recovery Unit 2

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**Abstract.**—*The Snowy Plover (Charadrius nivosus) is a federally threatened shorebird that breeds and winters along the Pacific coast from Baja, Mexico to Washington. For the sixteenth year, we monitored a color-marked population of breeding plovers in coastal northern California, designated Recovery Unit 2 (RU2). In this report we summarize our findings, including composition and size of the breeding population, distribution of plovers across occupied sites, productivity, results of an experiment testing raven response to nest mini-exlosures, and preliminary estimates of overwinter survival. In 2016, the population grew by 18% over the previous year (from 61 to 72 adults) continuing a trend of positive growth for the seventh consecutive year. The arrival of 25 first-time breeders from outside RU2 indicates that immigration continues to play a critical role in population growth. The return of 35 resident breeders and 12 philopatric yearlings (6 males and 6 females) also contributed to the steady increase. Nesting occurred on nine beaches, with most plovers breeding at Clam Beach (39%), South Spit (14%), and Stone Lagoon (13%). For the first time since 1989, observers found nests at Tolowa Dunes in Del Norte County. Plovers initiated 76 nests, hatched 65 chicks, and fledged 40 juveniles, the highest total fledged since 2001. South Spit was the most successful site, producing 35% of juveniles. Apparent nesting success (i.e., percentage of nests that hatched at least 1 chick) was 36%, while predation was confirmed (20%) or suspected (28%) in most cases of nest failure. Per capita reproductive success was  $1.21 \pm 1.29$  fledglings per male, surpassing the recovery objective value of 1.0 for the first time since 2004.*

**Key words.**—*Charadrius nivosus, immigration, northern California, predation, productivity, Recovery Unit 2, reproductive success, survival, Snowy Plover.*

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### Introduction

For the sixteenth consecutive year, biologists from Humboldt State University (HSU) worked with county (Humboldt County Public Works), state (Department of Fish and Wildlife, Department of Parks and Recreation), and federal (Bureau of Land Management, National Park Service, and United States Fish and Wildlife Service) staff, as well as Mendocino Coast Audubon Society volunteers, to monitor breeding activity of the Snowy Plover (*Charadrius nivosus*) in coastal northern California (Del Norte, Humboldt, and Mendocino counties; USFWS Recovery Unit 2). In this report, we summarize our findings for 2016 and interpret results in light of the species' recovery plan (USFWS 2007).

### Background

In 1993, the United States government listed the Pacific coast population of the Snowy Plover (hereafter "plover") as threatened under the Endangered Species Act (USFWS 1993). The USFWS designated critical habitat in 1999, an action that was finalized in 2012. In 2001, the USFWS initiated the development of a recovery plan, which was completed in 2007 (USFWS 2007). In 2006, after a 5-year review, a proposal to delist the plover was denied, despite evidence that coastal and interior populations were genetically similar (Funk et al. 2007). The population was listed based on evidence of a significant decline, as well as a reduction in the number of occupied breeding sites across the range. Prior to listing, Page et al. (1991) estimated the California population at 1386 plovers, down 11 percent from the 1565 estimated a decade earlier (Page and Stenzel 1981).

The recovery plan (USFWS 1993, 2007) identified three main factors considered detrimental to the population via decreased productivity (i.e., the number of young produced annually). In general, it did not address the effects of adult and juvenile survival on population growth. Those factors compromising productivity included: 1) increased development and human recreational activity in beach habitats favored by nesting plovers; 2) predation of eggs and chicks by corvids (*Corvus brachyrhynchos*, *C. corax*), gulls (*Larus* spp.), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), and striped skunk (*Mephitis mephitis*); and 3) degradation of nesting habitat by introduced plants such as European beach grass (*Ammophila arenaria*). The recovery plan also split the Pacific coast into six independently managed recovery units (RUs), outlining specific objectives for each. In May 2015, a coordinated, week-long survey of the coastal population estimated 2260 breeding adults, the highest recorded since annual censuses began in 2005. This estimate remained well below the range-

wide objective of 3000 birds, although in some recovery units (e.g., RU1, RU4), local population sizes surpassed region-specific minimums outlined by the recovery plan (USFWS 2007).

Recovery Unit 2 (RU2) is comprised of Mendocino, Humboldt, and Del Norte counties. In RU2, plovers have bred and wintered along ocean beaches and gravel bars of the Eel River (Colwell et al. 2010), although nesting on the gravel bars has not been detected since 2010. While most breeding plovers have occurred in Humboldt, there have been sporadic nesting attempts in both Mendocino and Del Norte Counties. In 1977, Page and Stenzel (1981) observed 64 birds and 18 nests at 7 Humboldt County locations, estimating this constituted 6% of plovers breeding in coastal California. At that time, Humboldt had more plovers than any other location north of Monterey County. During the early 1990s, Fisher (1992-94) surveyed Humboldt County beaches and recorded between 22-32 birds and 17-26 nests each year. In 1999, LeValley (1999) reported 49 birds and 23 nests at 4 locations. In 2000, McAllister et al. (2001) reported 40 adults and 43 nests. Historically, plovers in northern California had only been observed nesting on coastal beaches, yet in 1996, Tuttle et al. (1997) discovered breeding plovers on gravel bars of the lower Eel River. With the onset of intensive monitoring in 2001, we showed that most plovers in Humboldt County nested on these gravel bars (Colwell et al. 2005, 2010) and very successfully so (Herman and Colwell 2015) until gravel bar breeding subsided altogether by 2011. Since then plovers have bred exclusively on sandy ocean-fronting beaches.

Over the past several decades the total number of breeding sites and breeding adults in Humboldt, Mendocino, and Del Norte counties has decreased. However, it is difficult to assess local population trends prior to 2001 since researchers surveyed different habitats with varying effort. Moreover, since plovers tend to disperse widely during the breeding season (Stenzel et al. 1994, Pearson and Colwell 2013), it is likely that some individuals are recorded as breeding at multiple locations. Increased monitoring effort in RU2 over the past 16 years has improved understanding of local demographics, revealing a steady decline in the population in 2001-09 followed by an average annual increase of 23 percent since 2010.

### **Study Area and Methods**

Observers monitored plovers in Mendocino, Humboldt, and Del Norte Counties. Intensive surveying occurred at locations in Humboldt County where observers detected plover breeding activity. In 2016, breeding locations included Stone Lagoon, Big Lagoon, Clam Beach, Mad River Beach, North Spit and South Spit of Humboldt Bay, Eel River Wildlife Area and Centerville Beach, as well as Tolowa Dunes in Del Norte County. We monitored several additional sites with suitable habitat with varying frequency; most suitable sites were visited at minimum during the breeding window survey. We conducted monitoring under federal (USFWS recovery permit #TE-73361A-1; USFWS banding permits #23844 and #10457), state (Department of Fish and Wildlife collecting permit #SC0496; Department of Parks and Recreation scientific research permit #16-635-017), and university (Humboldt State University IACUC #14/15.W.07-A) permits.

*Banding.* We captured and marked adult plovers with a unique four-band combination of colored plastic bands (including aqua, blue, green, orange, red, violet, white, and yellow) and a numbered USFWS metal band wrapped in colored tape. We marked all newly hatched chicks (n=65) on the right leg with a brood-specific color-taped USFWS band in order to track chick survival and philopatry (Colwell et al. 2007). When we could determine order of hatch in a brood (i.e., by relative wetness of down), we banded chicks sequentially by USFWS band number. Details of the 2015 nonbreeding and 2016 breeding banding efforts are provided in Appendices A and B, respectively.

*Surveys.* Observers made 443 visits (i.e., full surveys, nest and brood checks, and banding; Table 1) to sites from mid-March to early September, when the last chick fledged on Centerville Beach. Most surveys occurred at Stone Lagoon (16%), Clam Beach (15%), South Spit (12%), Ten Mile Beach (10%), Big Lagoon (9%) and Centerville Beach (9%). We reduced monitoring of the Eel River gravel bars to one visit (i.e., during the breeding window survey), given that we had not detected breeding plovers there for five consecutive years. Upon finding a nest, observers noted the number of eggs in the clutch. If we found a complete clutch, we floated eggs to determine stage of development and estimate hatch date (Liebezeit et al. 2007). We recorded nest locations using a global positioning system (GPS). We monitored broods on a weekly or biweekly basis and confirmed that chicks had fledged if we observed them at least 28 days after they had hatched (Page et al. 2009). We also confirmed failure of broods by noting behaviors of tending males, such as initiating a new nest or departing a site, that indicated loss of chicks prior to the 28-day fledge date.

Table 1. Summary of the number of surveys<sup>a</sup> conducted each month for breeding Snowy Plovers in RU2 in 2016.

County	Site	March	April	May	June	July	August	September	Total
<i>Del Norte</i>	Tolowa Dunes	2	1	5	2	2	2	0	14
<i>Humboldt</i>	Gold Bluffs Beach	1	1	1	1	1	1	0	6
	Stone Lagoon	12	18	15	15	9	2	0	71
	Dry Lagoon	1	2	2	3	1	2	0	11
	Big Lagoon	1	4	7	13	11	2	0	38
	Clam Beach	7	10	17	19	11	3	0	67
	Mad River Beach	2	5	4	5	7	1	0	24
	North Spit	0	3	3	8	4	0	0	18
	South Spit	4	7	13	10	13	4	0	51
	Eel River Wildlife Area	2	5	4	4	5	0	0	20
	Centerville Beach	2	5	5	8	7	10	2	39
<i>Mendocino</i>	Ten Mile Beach	6	8	11	6	7	5	0	43
	Virgin Creek Beach	1	4	3	2	3	3	0	16
	Manchester State Beach	2	3	3	2	3	2	0	15
	Total	43	76	93	98	84	37	2	433

<sup>a</sup> Ten additional surveys occurred at Crescent Beach, Enderts Beach, Freshwater, Elk River, Eel River gravel bars, and McNutt Gulch.

*Ancillary Data.* During surveys, we recorded the presence of marked adults incubating eggs or tending chicks (e.g., brooding, performing a distraction display), and used this information to determine nest ownership and reproductive success. We regularly monitored the status of nests, noting whether a clutch had failed or not. In the event of clutch failure, we categorized probable cause as one of the following: 1) predation (predator footprints directly approached an empty nest or eggshell fragments/yolk were found in the vicinity); 2) abandoned (eggs showed no sign of approach or tending by plovers over multiple observations); 3) sand-covered (eggs were mostly or completely buried in sand following sustained strong winds); 4) tidal overwash (eggs were displaced or absent concurrent with a recent high tide line overtaking the nest); 5) human-caused (eggs were crushed or absent coincident with vehicle, human, or dog tracks approaching or passing directly over the nest); or 6) unknown (eggs were absent from the nest with no or unclear indication of cause of failure, or there was no sign of the nest whatsoever due to the amount of time elapsed since the last nest check). We consistently attributed failure of buried nests to wind-driven sand, although in some cases abandonment could not be conclusively ruled out as the direct cause.

*Nest Enclosure Experiment.* Common Ravens are significant predators of plover eggs and chicks in RU2 (Burrell and Colwell 2012) and are especially abundant at Clam Beach County Park and Little River State Beach (Lau 2015). Use of nest enclosures is a valuable means of non-lethal predator control, though there are associated risks with adult plover mortality (Hardy and Colwell 2008) and ravens potentially being cued in to plover nests, which may leave chicks vulnerable to predation at hatch. In 2015, we conducted an experiment to evaluate the response of ravens to mini-enclosures placed around fake plover nests. We conducted five 28-day trials from March to July, during which we erected 24 enclosures at random locations within the habitat restoration area (HRA) at Little River State Beach. We quantified raven activity at enclosures by counting the number of sets of raven tracks within 3 m; afterwards we swept the tracks clean with a broom to avoid counting them again on subsequent visits. We also recorded raven activity in 3 m ground plots at random locations within the HRA. Additionally, we used seven years (2009-15) of ground plot data to generate a site-wide hotspot map of raven activity for Clam Beach County Park and Little River State Beach.

*Overwinter Survival.* In an attempt to understand the spatial distribution of plovers during the non-breeding season and quantify episodes of overwinter mortality, we initiated a mark-resight study of marked individuals at three locations in Humboldt County (Clam Beach, South Spit, and Centerville Beach) known to host winter flocks. Surveys took place bimonthly from September to March in 2014-15 and 2015-16. Observers surveyed for plovers along 2.5 km transects at each location, recording flock size, percentage of individuals foraging, identity of individuals (i.e., band combinations), and environmental data (e.g., temperature, wind speed and direction, percent cloud cover). Using resight data of uniquely marked plovers, we calculated survival probabilities between surveys and from year to year.

*Data Summary and Analysis.* Since plover breeding locations differ in habitat and management issues, we collated data separately by site. We defined apparent nest success as the number of nests that successfully hatched at least one

chick divided by the total number of nests. We calculated the number of fledged chicks per male to facilitate comparisons with population viability analyses published in the recovery plan (USFWS 2007).

**Results and Discussion**

*Population Size.* In 2016, the breeding population increased by 18% over the previous year, from 61 to 72 adults (Table 2), similar to the average annual growth rate of 23% since 2010. There were slightly more females (39) than males (33; Appendix C). Seventy breeders (97%) were color-marked; 64 of these were uniquely marked whereas 6 had brood-specific bands from either Oregon (4 females) or RU2 (1 male and 1 female).

Over the past 16 years, composition of the breeding population has varied in the ratio of returning adults to first-time breeders, as well as in the ratio of philopatric birds to immigrants (Table 2). For each year, we categorized each breeder as: a) a marked adult that bred in RU2 in a previous year, b) a marked adult (usually a yearling) that hatched in RU2 and returned to breed for the first time, c) an immigrant marked elsewhere, as evidenced by a band combination not used in RU2, or d) an unmarked adult. We assumed all unmarked birds immigrated to RU2, given that monitoring is sufficiently thorough to ensure nearly all chicks are banded at time of hatch. In 2016, the numbers of returning adults and newly arrived immigrants were similar to the previous year, whereas the number of locally recruited yearlings quadrupled. The adult return rate (63% of 2015 breeders; Table 3) and proportion of immigrants (35% of 2016 breeders) were similar to the last several years, indicating survival and immigration continue to play an important role in maintaining the RU2 population (Mullin et al. 2010).

Table 2. Annual variation in composition of the breeding population of Snowy Plovers in RU2 in 2001-16.

Year	Males				Females				Total
	Returning (marked) Adults	Returning (marked) Yearlings	Marked Immigrants	Unmarked Immigrants	Returning (marked) Adults	Returning (marked) Yearlings	Marked Immigrants	Unmarked Immigrants	
2016	18	6	4	5	17	6	10	6	72
2015	18	1 <sup>a</sup>	5	6	14	2	9	6	61
2014	14	5	4	2	16	2	4	4	51
2013	15	1	6	1	12	4 <sup>a</sup>	3	2	44
2012	14	2	2	2	11	2	3	3	39
2011	11	6 <sup>a</sup>	1	2	7	2 <sup>a</sup>	4	3	36
2010	9	2 <sup>a</sup>	3	2	10	1	4	1	32
2009	9	0	0	1	6	2	1	0	19
2008	9	2	3	3	8	1	5	5	36
2007	9	2	2	3	8	2	2	2	30
2006	18	6 <sup>a</sup>	2	4	11	4	4	10	59
2005	19	6	2	7	15	4 <sup>a</sup>	5	8	66
2004	17	5	4	11	16	3	6	12	74
2003	22	4 <sup>a</sup>	0	2	16	5	1	5	55
2002	19	9	0	5	20	6 <sup>a</sup>	1	3	63
2001	14	7	0	8	11	2	2	14	58

<sup>a</sup> Total includes a philopatric ASY bird breeding in RU2 for the first time.

*Philopatry and Site Fidelity.* The number of philopatric yearlings (n=12) was the highest observed in RU2 since 2005 (Table 3). The return rates of hatched chicks (25% for both males and females, assuming an equal sex ratio at hatch) were appreciably higher than the previous 15-year averages (19±12% for males and 14±6% for females). Adult site fidelity (i.e., return of a marked breeder from 2015) was 69% for males and 57% for females. These values are nearly identical to the previous 15-year averages (67±13% for males and 58±18% for females). The higher return rates of males (both chicks and adults) may be the result of higher rates of female natal dispersal (Stenzel et al. 2007, Pearson and Colwell 2013) or greater female mortality (Stenzel et al. 2011).

Table 3. Annual variation in chick and breeding adult return rates of Snowy Plovers in RU2 in 2001-16.

	Year	Males		Females		All Breeders
		Number Banded in the Previous Year	Percentage Returned (n)	Number Banded in the Previous Year	Percentage Returned (n)	Percentage Returned (n)
<b>Chick Return Rates<sup>a</sup></b>	2016	24	25 (6)	24	25 (6)	25 (12)
	2015	9	0 (0)	9	22 (2)	11 (2)
	2014	15	40 (6)	15	13 (2)	27 (8)
	2013	17	6 (1)	17	17 (3)	12 (4)
	2012	17	12 (2)	17	18 (3)	15 (5)
	2011	12	42 (5)	12	8 (1)	25 (6)
	2010	7.5	27 (2)	7.5	13 (1)	20 (3)
	2009	7.5	13 (1)	7.5	27 (2)	20 (3)
	2008	10	20 (2)	10	10 (1)	15 (3)
	2007	27.5	7 (2)	27.5	7 (2)	7 (4)
	2006	35.5	17 (6)	35.5	11 (4)	14 (10)
	2005	35	23 (8)	35	11 (4)	17 (12)
	2004	32	16 (5)	32	13 (4)	14 (9)
	2003	34.5	9 (3)	34.5	14 (5)	12 (8)
	2002	46.5	22 (10)	46.5	11 (5)	16 (15)
	2001	29	24 (7)	29	10 (3)	17 (10)
	<b>Total</b>	<b>359</b>	<b>18.4 (66)</b>	<b>359</b>	<b>13.3 (48)</b>	<b>15.9 (114)</b>
<b>Adult Return Rates<sup>b</sup></b>	2016	26	69 (18)	30	57 (17)	63 (35)
	2015	23	78 (18)	22	64 (14)	71 (32)
	2014	22	64 (14)	21	76 (16)	70 (30)
	2013	19	79 (15)	17	71 (12)	75 (27)
	2012	19	74 (14)	16	69 (11)	71 (25)
	2011	15	73 (11)	16	44 (7)	58 (18)
	2010	10	90 (9)	9	100 (9)	95 (18)
	2009	15	60 (9)	18	33 (6)	45 (15)
	2008	15	60 (9)	14	57 (8)	59 (17)
	2007	29	31 (9)	27	30 (8)	30 (17)
	2006	32	56 (18)	30	37 (11)	47 (29)
	2005	34	56 (19)	35	43 (15)	49 (34)
	2004	27	63 (17)	27	59 (16)	61 (33)
	2003	32	69 (22)	29	55 (16)	62 (38)
	2002	29	66 (19)	29	69 (20)	67 (39)
	2001	18	78 (14)	18	61 (11)	69 (25)

<sup>a</sup> Return of a locally hatched chick to breed in RU2 for the first time; we assume an equal sex ratio among hatched chicks (i.e., an odd number of chicks hatched in a given year produces a non-integer value for the number of males and females in that year).

<sup>b</sup> Return of an RU2-breeding adult to breed again in the next year; individuals are counted for every year they return to breed in RU2.

*Plover Distribution.* Since 2001, plovers have bred at 19 sites (9 beaches and 10 gravel bars along the Eel River) in Humboldt County. Plovers have occasionally bred at 3 sites in Mendocino County and this year, for the first time since monitoring began, observers found nests in Del Norte County (Table 4). In 2016, nesting occurred on 9 ocean-fronting beaches in RU2, including 3 sites plovers have rarely used in recent decades. These included: 1) Tolowa Dunes, where 3 nests comprised the first known breeding attempts since 1989, 2) North Spit of Humboldt Bay, which had its second nest since 1977 (S.W. Harris, unpubl. data), and 3) South Spit of Humboldt Bay, where nesting occurred for the first time since 2010, and with twice as many nests initiated in 2016 than the previous record year. We did not detect plovers on the Eel River gravel bars during the annual breeding window survey.

Table 4. An annual summary of the distribution of breeding Snowy Plovers (as a percentage of adults) in RU2 in 2001-16.

	Year															
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
<i>Del Norte County</i>																
Tolowa Dunes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
<i>Humboldt County</i>																
Gold Bluffs Beach	0	0	0	2	3	0	0	0	0	0	0	0	5	6	2	0
Stone Lagoon	0	0	0	0	0	0	0	0	0 <sup>a</sup>	3	0 <sup>a</sup>	0	0	4	5	13
Big Lagoon	0	0	0	0	6	0	0	0	0	0	12	6	0	0 <sup>a</sup>	7	3
Clam Beach	16	29	38	40	49	53	56	68	63	52	56	62	63	48	41	39
Mad River Beach	0	0	0	0	0	0 <sup>a</sup>	9	0 <sup>a</sup>	0 <sup>a</sup>	7	9	6	2	13	3	4
North Spit	0	0	0	0	0	0	0	0	0	0	0	0	0	0 <sup>a</sup>	0	3
Elk River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Spit	0	0	7	2	6	12	0 <sup>a</sup>	8	0	0	0	0	0	0	0	14
Eel River W. Area	18	18	2	2	0	0	9	11	16	16	15	11	15	17	20	10
Centerville Beach	0	0	0	2	0	3	0	0	0	7	12	17	12	12	16	11
Eel River gravel	66	54	51	39	27	29	25	14	21	16	0	0	0	0	0	0 <sup>b</sup>
<i>Mendocino County</i>																
Ten Mile Beach	0	0	3	7	3	0	0	0	0	0	0	0	5	0	7	0
Virgin Creek Beach	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Brush Creek Beach	0	0	0	5	3	3	0	0	0	0	0	0	0	0	0	0
<b>Total Breeding Plovers</b>	<b>58</b>	<b>63</b>	<b>55</b>	<b>74</b>	<b>66</b>	<b>59</b>	<b>30</b>	<b>36</b>	<b>19</b>	<b>32</b>	<b>36</b>	<b>39</b>	<b>44</b>	<b>51</b>	<b>61</b>	<b>72</b>

<sup>a</sup> Percentages reflect that individuals were only counted once per year (i.e., at their first breeding site).

<sup>b</sup> We surveyed Eel River gravel bars once in 2016, during the annual breeding window survey.

*Productivity.* In 2016, breeding plovers in RU2 at minimum initiated 76 nests, laid 192 eggs, hatched 65 chicks, and fledged 40 juveniles. Compared to all years of monitoring, 2016 had the second greatest number of fledged chicks, exceeded only by 46 chicks fledged in 2001. Apparent nesting success was 36%; this was consistent with the 15-year average of 33±15%. Twenty-seven nests hatched on a record high of 8 beaches, including Stone Lagoon (n=3), Big Lagoon (n=1), Clam Beach (n=7), Mad River Beach (n=1), North Spit (n=1), South Spit (n=6), ERWA (n=1), and Centerville Beach (n=7). Fledging success across RU2 was relatively high at 62% (compared to 47±11% in 2001-15), with 100% of chicks from single broods fledging on 3 sites (Big Lagoon, Mad River, and North Spit). South Spit was an especially productive site, with 14 of 17 chicks (82%) surviving to fledge. The number of broods fledged on South Spit in this year alone (n=6) equals the number that have fledged in all other years combined.

Appendix D details the fates of all detected plover nests. For 28% of nests, we were unable to determine cause of failure. For conclusive causes, predation by Common Ravens, skunks, and potentially other species (as indicated by eggshell fragments nearby or predator tracks leading to the nest cup) accounted for 20%, followed by abandonment and sand-covering (both 6%). Per capita reproductive success averaged 1.21±1.29 fledglings per male. This is the highest productivity since 2001 and the first time since 2004 that the RU2 population has exceeded the 1.0 fledglings per male required to delist the population (USFWS 2007).

*Nest Exclosure Experiment.* Raven activity at exclosures (43.2% of ground plots) was similar to that within random plots (42.1%) within the HRA ( $t_{2,31}=0.55$ ;  $p=0.60$ ), suggesting no attraction by ravens to exclosures. There was an increase in raven activity both at exclosures and random locations during the fourth trial (i.e., late June to early July), corresponding with the seasonal arrival of raven fledglings ( $p<0.001$ ). The day-to-day pattern of raven activity within trials was highly variable; this inconsistency was similar between exclosures and random locations ( $t_{2,06}=0.33$ ;  $p=0.74$ ; Figure 1). All five trials yielded this pattern of variability ( $\chi^2=1.10$ ;  $p=0.89$ ), suggesting indifference to exclosures. Comparative analysis of ground plot data collected in 2009-15 showed that raven activity on Clam Beach County Park and Little River State Beach was highest in the HRA (Figure 2).

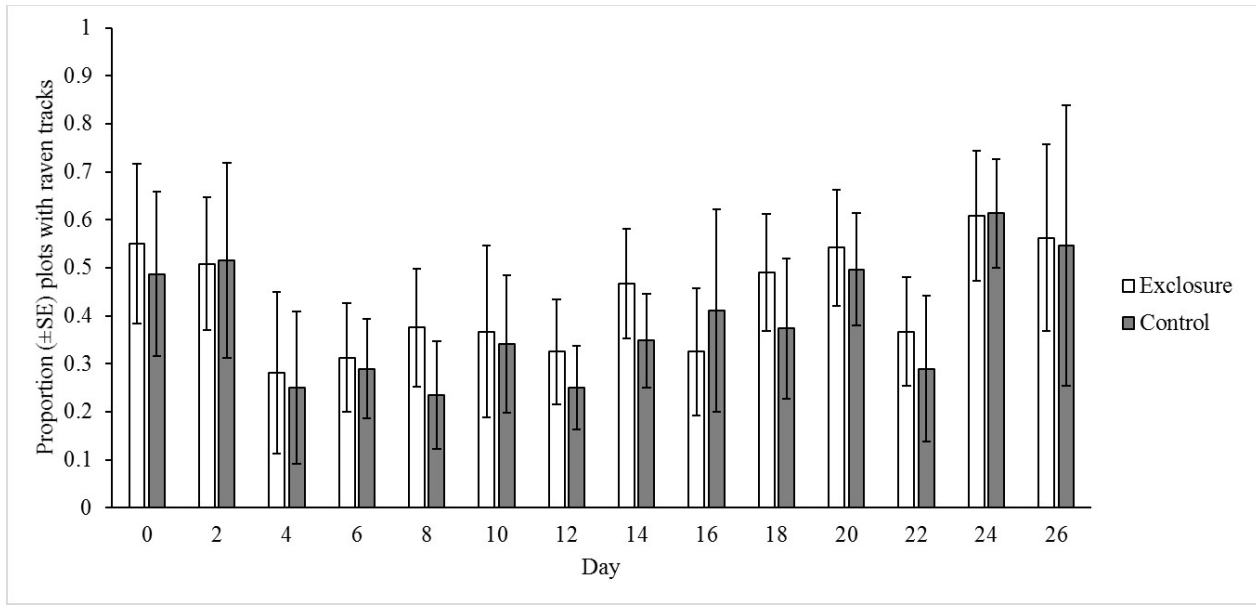


Figure 1. Average ( $\pm$ SE) proportion of treated (exclosure) and control 3 m ground plots ( $n=2,082$ ) with at least one set of raven tracks calculated for each observation day within each 28-day trial.

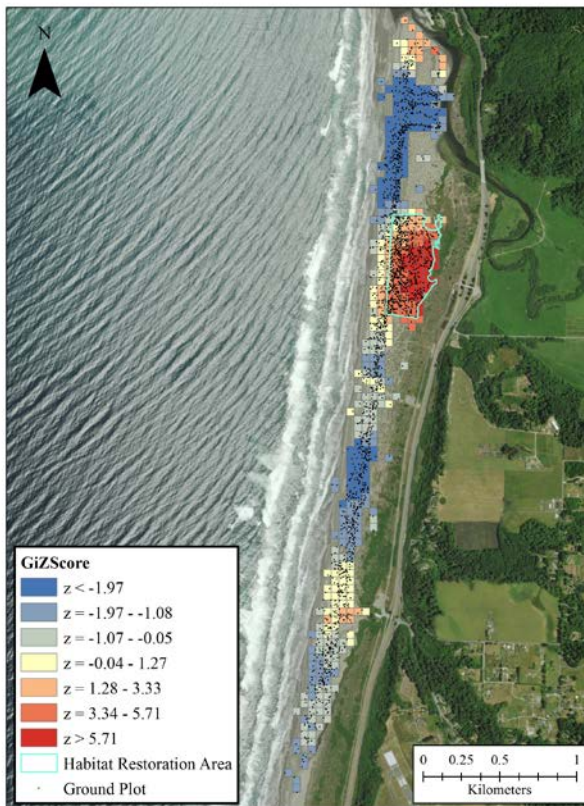


Figure 2. Hotspot map of Common Raven activity on Little River State Beach and Clam Beach County Park resulting from the Optimized Hotspot Analysis (Getis-Ord  $G_i^*$ ) tool in ArcGIS v.10.4.1 using ground plot data ( $n=2,557$ ) from 2009-15. Red areas indicate statistically significant high counts of raven tracks relative to other grids, whereas blue areas indicate statistically significant low counts of raven tracks.

*Overwinter Survival.* Observers recorded 71 uniquely banded plovers in 2014-15, 65 of which were aged, and another 65 of which were sexed. In 2015-16, we detected 91 uniquely marked plovers, 76 of which were aged and sexed (Figure 3). The number of juveniles included for analysis in the sampled population was biased low because most juveniles retain their brood-specific bands into their first year unless they are caught and rebanded subsequent to fledging. The return rate (i.e., percentage of color-marked adults seen at least once during the first winter that we observed at least once during the second winter) from 2014-15 to 2015-16 was 71% (n=52). All plovers returned to the same site they occupied during the first winter. Plovers returned to Clam Beach at a higher rate (79%) than those who returned to Centerville Beach (60%). The return rates of both sexes and both age classes were all similar: 74% of males (n=28), 74% of females (n=21), 75% of juveniles (n=9), and 76% of adults (n=42) returned in 2015-16 (Table 5). Observers did not detect plovers on South Spit in 2014-15, but a small flock formed there irregularly in 2015-16. Bimonthly survival (i.e., between surveys) was 0.971 (SE 0.008) in 2014-15 and 0.936 (SE 0.01) in 2015-16, therefore the probability of surviving the non-breeding season was 0.662 (SE 0.0014) in 2014-15 and 0.396 (SE 0.0907) in 2015-16. This decline in survival probability may represent a true increase in mortality, or may be an artifact of lower site fidelity.

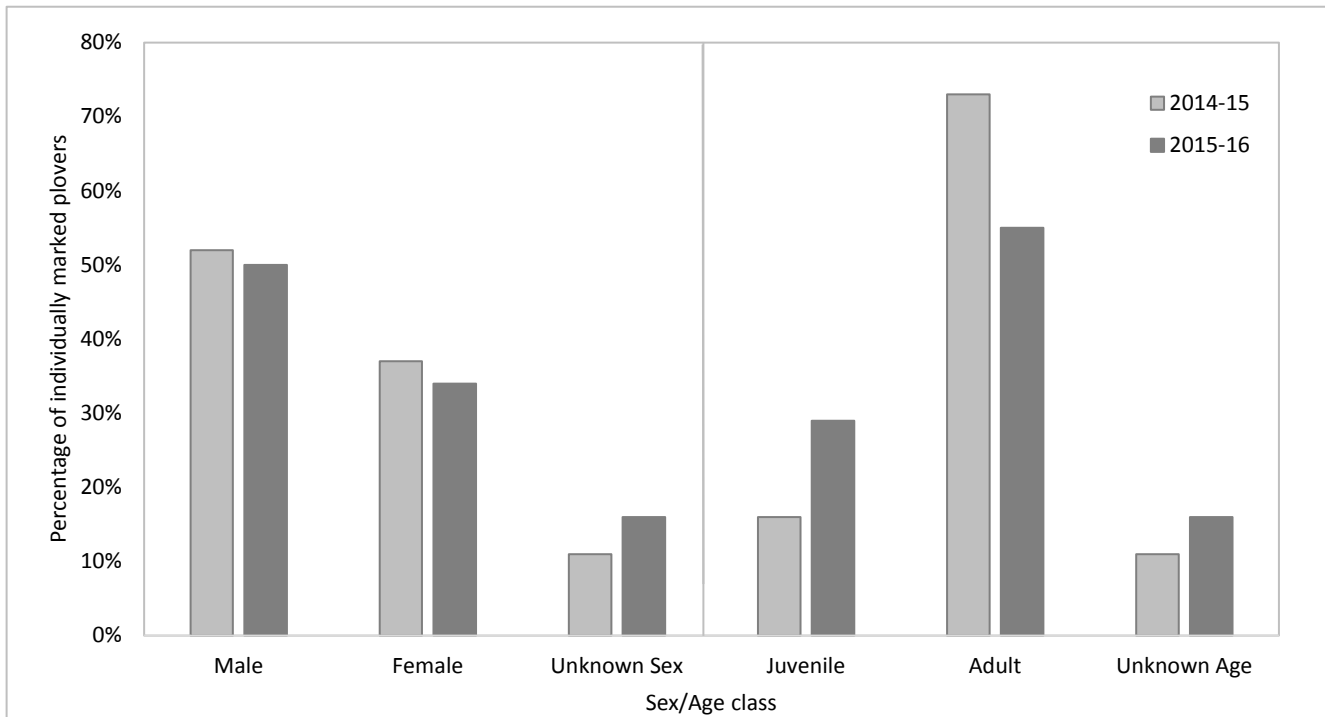


Figure 3. Sex/age composition of Humboldt County winter flocks in 2014-15 and 2015-16 (as percentages of all uniquely banded individuals).

Table 5. Return rates<sup>a</sup> of Snowy Plovers wintering in Humboldt County from 2014-15 to 2015-16.

Age	Sex	Present in 2014-15 (n)	Returned in 2015-16 (n)	Percentage Returned
Juvenile	Male	5	3	60
Juvenile	Female	4	4	100
Juvenile	Unknown	3	2	67
Adult	Male	28	24	86
Adult	Female	24	17	71
Adult	Unknown	3	1	33
Unknown	Male	5	1	20
Unknown	Female	0	-	-
Unknown	Unknown	2	1	50

<sup>a</sup> A plover observed at least once during 2014-15 was considered to have returned if it was observed at least once during 2015-16.



## Conclusions

In 2016, the breeding population of Snowy Plovers in RU2 (72 adults) increased 18% from the previous year, continuing a trend of appreciable positive growth for the seventh consecutive year. This is the largest RU2 breeding population observed since 2004 and roughly half the recovery objective of 150 breeding adults (USFWS 2007). The population increase can be attributed to a typical adult return rate (63% of 2015 breeders) combined with high rates of local recruitment (25% of 2015 chicks) and immigration (35% of 2016 breeders). Plovers bred at nine sites, hatching and fledging chicks from all but one (Tolowa Dunes). South Spit was the most productive breeding location, producing 35% of the 2016 cohort at a fledge rate of 82%. Per capita reproductive success ( $1.21 \pm 1.29$  fledglings per male) was the highest recorded since 2001, exceeding the recovery benchmark of 1.0 fledglings per male for the first time since 2004. The 2016 breeding population was characterized by high rates of overwinter survival and immigration, as well as exceptional productivity. We recommend continued efforts to implement management actions outlined by the recovery plan (i.e., predator control, restriction of human activity, and restoration of nesting habitat) that will further encourage these positive trends.

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**Appendix A.** Details of the Oct-Dec 2015 non-breeding banding effort in RU2.

Band Number (USFWS)	Location	Color Band	Sex	Age	Date Banded	Nest Code	Notes
2381-05428	CV	WV:GW	Unk	Unk	31 Oct	winter flock	Previously unmarked (X:X)
2381-05429	CV	WG:YO	M	AHY	31 Oct	winter flock	Lower right replaced with federal band
2381-05430	CV	WV:GY	Unk	Unk	31 Oct	winter flock	Previously unmarked (X:X)
2381-05431	CV	WV:OW	Unk	Unk	31 Oct	winter flock	Previously unmarked (X:X)
2381-08882	CV	VW:OG	Unk	HY	31 Oct	winter flock	Previously unmarked (X:X)
2381-05391	CV	VW:RR	Unk	HY	13 Nov	winter flock	Banded as a chick at 15ES08 (X:R)
2381-05432	CV	WV:OG	Unk	Unk	13 Nov	winter flock	Previously unmarked (X:X)
2381-05433	CV	WV:OR	Unk	Unk	13 Nov	winter flock	Previously unmarked (X:X)
2381-05434	CV	WV:OY	Unk	Unk	13 Nov	winter flock	Previously unmarked (X:X)
2381-05435	CN	WV:RB	M	Unk	28 Nov	winter flock	Previously unmarked (X:X)
2381-05625	CN	VW:RY	M	AHY	28 Nov	winter flock	Banded as a chick in Oregon (R/A:V)
2381-08720	CN	VW:RG	Unk	HY	28 Nov	winter flock	Banded as a chick in Oregon (S:X)
2381-05436	CV	WV:WY	Unk	Unk	2 Dec	winter flock	Previously unmarked (X:X)

**Appendix B.** Details of the Mar-Aug 2016 breeding banding effort in RU2.

Band Number (USFWS)	Location	Color Band	Sex	Age	Date Banded	Nest Code	Notes
2381-08897	SL	VW:WG	M	1 yr	5 Apr	none	Banded as a chick in Oregon (O/A:G)
2381-07395	SL	WW:WG	F	4 yrs	6 Apr	16SL02	Banded as a chick in Oregon (S:B)
2381-05443	SL	VW:WB	F	AHY	17 Apr	none	Previously unmarked (X:X)
2381-05444	SL	VW:RY	M	AHY	17 Apr	16SL03	Previously unmarked (X:X)
2381-05445	SL	RY:OG	F	1 yr	17 Apr	none	Banded as a chick in Oregon (R/O:N)
2381-05311	SL	X:Y	Unk	HY	25 Apr	16SL01	Chick
2381-05437	SL	X:G	Unk	HY	30 Apr	16SL02	Chick
2381-08846	SS	RY:GW	F	1 yr	1 May	16SS01	Banded as a chick in Oregon (R/W:G)
2381-10057	SS	GY:RG	F	1 yr	1 May	16SS03	Banded as a chick in Oregon (L/W:N)
2381-05418	CN	X:R	Unk	HY	5 May	16CN02	Chick
2381-05419	CN	X:R	Unk	HY	5 May	16CN02	Chick
2381-05415	SS	X:Y	Unk	HY	15 May	16SS01	Chick
2381-05416	SS; CN	X:Y; OV:GY	Unk	HY	15 May; 7 Aug	16SS01	Chick; rebanded in winter flock as a juvenile
2381-05417	SS	X:Y	Unk	HY	15 May	16SS01	Chick
2381-05379	SS	WW:AW	M	1 yr	15 May	16SS01	Banded as a chick at 15ES06 (X:G)
2381-05446	CN	X:R	Unk	HY	16 May	16CN07	Chick
2381-05447	CN	X:R	Unk	HY	16 May	16CN07	Chick
2381-05448	CN	X:R	Unk	HY	16 May	16CN07	Chick
2381-05409	SS	X:W	Unk	HY	17 May	16SS02	Chick
2381-05410	SS	X:W	Unk	HY	17 May	16SS02	Chick
2381-05411	SS	X:W	Unk	HY	17 May	16SS02	Chick
2381-05344	CN	WW:AR	M	3 yrs	22 May	16CN07	Banded as a chick at 13CN21 (X:R)
2381-05403	CN	WW:AY	F	1 yr	22 May	16CN09	Banded as a chick at 15CV08 (X:Y)
2381-05420	SS	GY:AR	F	AHY	25 May	16SS04	Previously unmarked (X:X)
2381-05354	CV	OV:OY	F	1 yr	27 May	16CV06	Banded as a chick at 15CV05 (X:Y)
2381-05452	SS	X:B	Unk	HY	28 May	16SS03	Chick
2381-05453	SS	X:B	Unk	HY	29 May	16SS03	Chick
2381-05386	BL	WW:AB	F	1 yr	29 May	16BL01	Banded as a chick at 15ES01 (X:B)
2381-05468	CN	WW:AG	F	AHY	30 May	16CN12	Previously unmarked (X:X)
2381-05455	CN	X:Y	Unk	HY	31 May	16CN09	Chick
2381-05456	CN	X:Y	Unk	HY	1 Jun	16CN09	Chick
2381-05359	CN	OV:OG	M	1 yr	1 Jun	16CN09	Banded as a chick at 15SL01 (X:G)
2381-05457	CN	X:Y	Unk	HY	2 Jun	16CN09	Chick
2381-05406	CV	VW:AY	F	1 yr	3 Jun	16CV09	Banded as a chick at 15CV08 (X:B)
2381-05358	CS	OV:OB	F	1 yr	3 Jun	16CS05	Banded as a chick at 15SL01 (X:G)
2381-05454	NS	OV:RB	F	AHY	4 Jun	16NS01	Previously unmarked (X:X)
2381-05458	CV	X:W	Unk	HY	10 Jun	16CV06	Chick
2381-05459	CV	X:W	Unk	HY	10 Jun	16CV06	Chick
2381-05449	CV	X:G	Unk	HY	11 Jun	16CV05	Chick
2381-05450	CV	X:G	Unk	HY	11 Jun	16CV05	Chick
2381-05451	CV	X:G	Unk	HY	11 Jun	16CV05	Chick
2381-05360	SS	GY:AG	M	1 yr	12 Jun	16SS07	Banded as a chick at 15ES02 (X:W)

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**Appendix B. (continued) Details of the Mar-Aug 2016 breeding banding effort in RU2.**

2381-05465	CV	GY:AY	M	3 yrs	13 Jun	16CV05	Banded as a chick at 13ES03 (X:Y)
2381-05345	SL	OV:GG	M	3 yrs	14 Jun	16SL07	Banded as a chick at 13CN24 (X:O)
2381-10003	SS	OV:OW	F	1 yr	16 Jun	16SS07	Banded as a chick in Oregon (W/G/W:N)
2381-05472	ES	X:G	Unk	HY	17 Jun	16ES04	Chick
2381-05473	ES	X:G	Unk	HY	17 Jun	16ES04	Chick
2381-05474	ES	X:G	Unk	HY	17 Jun	16ES04	Chick
2381-05462	CV	X:R	Unk	HY	17 Jun	16CV08	Chick
2381-05463	CV	X:R	Unk	HY	17 Jun	16CV08	Chick
2381-05460	NS	X:W	Unk	HY	17 Jun	16NS01	Chick
2381-05461	NS	X:Y	Unk	HY	17 Jun	16NS01	Chick
2381-05466	NS	OV:OR	M	AHY	17 Jun	16NS01	Previously unmarked (X:X)
2381-05464	CV	X:R	Unk	HY	18 Jun	16CV08	Chick
2381-05476	SS	X:R	Unk	HY	19 Jun	16SS04	Chick
2381-05477	SS	X:R	Unk	HY	19 Jun	16SS04	Chick
2381-05478	SS	X:R	Unk	HY	19 Jun	16SS04	Chick
2381-05828	CN	VW:AW	M	2 yrs	20 Jun	16CN16	Banded as a chick in Oregon (R/O:V)
2381-05469	CN	X:B	Unk	HY	21 Jun	16CN11	Chick
2381-05470	CN	X:B	Unk	HY	21 Jun	16CN11	Chick
2381-05392	CN	VW:AR	M	1 yr	21 Jun	16CN11	Banded as a chick at 15ES08 (X:R)
2381-05475	CN	GY:AW	F	AHY	21 Jun	16CN16	Previously unmarked (X:X)
2381-05488	CN	GY:AB	F	AHY	21 Jun	16CN15	Previously unmarked (X:X)
2381-05471	CN	X:B	Unk	HY	22 Jun	16CN11	Chick
2381-05438	BL	X:G	Unk	HY	22 Jun	16BL01	Chick
2381-05439	BL	X:G	Unk	HY	22 Jun	16BL01	Chick
2381-05440	BL	X:G	Unk	HY	22 Jun	16BL01	Chick
2381-05320	BL	OV:BY	M	1 yr	22 Jun	16BL01	Banded as a chick at 15ES04 (X:Y)
2381-05479	CV	X:Y	Unk	HY	24 Jun	16CV09	Chick
2381-05485	MR	X:W	Unk	HY	24 Jun	16MR03	Chick
2381-05486	MR	X:W	Unk	HY	24 Jun	16MR03	Chick
2381-05487	MR	X:W	Unk	HY	24 Jun	16MR03	Chick
2381-05495	SL	X:B	Unk	HY	24 Jun	16SL07	Chick
2381-05441	SL	X:B	Unk	HY	24 Jun	16SL07	Chick
2381-05442	SL	X:B	Unk	HY	24 Jun	16SL07	Chick
2381-05489	CV	X:B	Unk	HY	26 Jun	16CV07	Chick
2381-05490	CV	X:B	Unk	HY	26 Jun	16CV07	Chick
2381-05482	CN	X:G	Unk	HY	29 Jun	16CN13	Chick
2381-05483	CN	X:G	Unk	HY	29 Jun	16CN13	Chick
2381-05484	CN	X:G	Unk	HY	29 Jun	16CN13	Chick
2381-05492	CN	RY:AG	F	AHY	29 Jun	none	Previously unmarked (X:X)
2381-12021	SS	X:G	Unk	HY	5 Jul	16SS06	Chick
2381-12022	SS	X:G	Unk	HY	5 Jul	16SS06	Chick
2381-12023	SS	X:G	Unk	HY	5 Jul	16SS06	Chick
2381-05362	SS	OV:RR	M	1 yr	7 Jul	16SS06	Banded as a chick at 15ES02 (X:W)
2381-05491	SS	X:B	Unk	HY	8 Jul	16SS07	Chick
2381-05493	SS	X:B	Unk	HY	9 Jul	16SS07	Chick
2381-05494	SS	X:B	Unk	HY	9 Jul	16SS07	Chick
2381-05480	CN	X:Y	Unk	HY	12 Jul	16CN15	Chick
2381-08732	CN	VW:AG	F	1 yr	12 Jul	16CN20	Banded as a chick in Oregon (W/A:G)
2381-12030	CN	X:G	Unk	HY	21 Jul	16CN20	Chick
2381-12031	CN	X:G	Unk	HY	21 Jul	16CN20	Chick
2381-12024	CV	X:W	Unk	HY	4 Aug	16CV11	Chick
2381-12025	CV	X:W	Unk	HY	5 Aug	16CV11	Chick
2381-12027	CV	X:R	Unk	HY	9 Aug	16CV10	Chick
2381-12028	CV	X:R	Unk	HY	9 Aug	16CV10	Chick
2381-10257	CN	OV:GW	Unk	HY	29 Aug	winter flock	Banded as a chick in Oregon (G/Y:W)

Appendix C. Summary of Snowy Plover breeding in RU2 in 2016 with comparison to 2000-15.

Location	Females <sup>a</sup>	Males <sup>a</sup>	Nests	# Nests Exclosed	% Nests Hatched <sup>b</sup>	# Chicks Hatched	# Chicks Fledged
Del Norte County							
Tolowa Dunes	2	1	3	0	0	0	0
Humboldt County							
Gold Bluffs Beach	0	0	0	-	-	0	0
Stone Lagoon	5	4	8	0	38	5	2
Big Lagoon	1	1	1	0	100	3	3
North Clam Beach	15	12	25	0	28	17	8
South Clam Beach	4	4	6	0	0	0	0
Mad River Beach	4	2	4	0	25	3	3
North Spit Beach	1	1	1	0	100	2	2
South Spit Beach	6	6	9	0	67	17	14
Eel River Wildlife Area	4	4	7	0	14	3	2
Centerville Beach	6	7	12	0	58	15	6
Eel River Gravel Bars							
Cock Robin Island	0	0	0	-	-	0	0
Fulmor	0	0	0	-	-	0	0
Roper's	0	0	0	-	-	0	0
Singley	0	0	0	-	-	0	0
Loleta	0	0	0	-	-	0	0
Fernbridge	0	0	0	-	-	0	0
Worswick	0	0	0	-	-	0	0
Drake	0	0	0	-	-	0	0
Canaveri Island	0	0	0	-	-	0	0
Mercer-Fraser	0	0	0	-	-	0	0
Sandy Prairie	0	0	0	-	-	0	0
Mendocino County							
Tenmile Beach	0	0	0	-	-	0	0
Virgin Creek Beach	0	0	0	-	-	0	0
Brush Creek Beach	0	0	0	-	-	0	0
<b>RU2 Totals</b>							
2016	39	33	76	0	35	65	40
2015	31	30	69	0	29	48	28 <sup>c</sup>
2014	26	25	81	0	15	27	17
2013	21	23	59	0	24	35	17
2012	19	20	41	0	37	39	15
2011	16	20	32	0	44	35	9 <sup>c</sup>
2010	16	16	42	2	21	24	13
2009	9	10	35	0	14	15	9
2008	19	17	50	0	14	15	8
2007	14	16	41	0	22	21	11
2006	29	30	58	19	34	55	20
2005	32	34	57	27	47	71	28
2004	37	37	70	28	43	76	39
2003	27	28	74	23	38	64	32
2002	30	33	75	25	40	76	23
2001	29	29	57	13	68	97	46
2000	--	--	42	18	64	58	--

<sup>a</sup> Based on histories of marked birds with known nests or exhibiting breeding behavior (e.g., courtship) over a prolonged period. Some individuals are assigned to multiple sites (e.g., ERWA and Centerville Beach).

<sup>b</sup> Apparent nesting success = 100(number of nests hatching at least 1 chick / total number of nests).

<sup>c</sup> Data updated from original final reports to include 1 additional fledged chick each in 2015 (ERWA) and 2011 (Centerville Beach).

**Appendix D.** Annual variation in nesting success<sup>a</sup> and causes of clutch failure (as a percentage of total nests) in RU2 in 2001-16.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Hatched	68	39	38	43	47	34	22	14	14	21	44	37	24	15	29	36
Failed and cause																
Predation	7	16	23	26	12	19	27	28	31	19	13	17	16	9	29	20 <sup>c</sup>
Abandoned	4	5	7	13	7	14	2	4	0	2	3	2	4	7	3	6
Sand covered	2	9	8	6	7	0	5	4	6	0	3	5	2	1	1	6
Tidal overwash	0	3	5	1	4	0	0	0	6	5	3	0	2	5	6	3
Human	0	9	7	4	0	5	5	6	11	0	0	5	0	0	1	1
River flood	0	0	7	0	7	0	0	0	0	0	0	0	0	0	0	0
Unknown <sup>b</sup>	19	19	5	7	16	28	39	44	31	52	34	34	52	63	30	28
Total Nests	57	75	74	70	57	58	41	50	35	42	32	41	59	81	69	76

<sup>a</sup> Apparent nesting success = 100(number of nests hatching at least one chick / total number of nests).

<sup>b</sup> Eggs in these nests disappeared prior to the predicted hatch date and there was no conclusive sign of cause of failure.

<sup>c</sup> Eggshell fragments/yolk were found at the nest site (n=6) or CORA/skunk tracks directly approached the nest (n=9).

**Appendix E.** List of papers, oral and poster presentations, and training sessions produced or conducted in 2015-16.

**Peer-reviewed Scientific Papers**

- Colwell, M.A., E.J. Feucht, S.E. McAllister, and A.N. Transou. Lessons learned from the oldest Snowy Plover. In prep. for submission to Wader Study.
- Colwell, M.A., E.J. Feucht, M.J. Lau, D.J. Orluck, S.E. McAllister, and A.N. Transou. Population biology of Snowy Plovers in coastal northern California. In prep. for submission to Wader Study.
- Lau, M.J., and M.A. Colwell. Geospatial modeling of Common Raven activity in Snowy Plover habitats. In prep. for submission to Condor.
- Leja, S.D., and M.A. Colwell. Response of Snowy Plovers to human and natural restoration. In prep. for submission to Restoration Ecology.
- Patrick, A.M., and M.A. Colwell. Annual variation in distance to nearest conspecific nest in Snowy Plovers. Journal of Field Ornithology. In revision.

**Professional Presentations and Posters**

- Colwell, M.A. Population dynamics of Snowy Plovers in coastal northern California. Oregon State University presentation. Corvallis, OR. Nov 2015.
- Colwell, M.A., and E.J. Feucht. Status of Snowy Plovers in Recovery Unit 2. Snowy Plover Recovery annual meeting. Portland, OR. Jan 2016.
- Colwell, M.A. Applied research on Snowy Plovers in coastal northern California. Snowy Plover Recovery annual meeting. Portland, OR. Jan 2016.
- Colwell, M.A. Ecology of Snowy Plovers. Friends of the Dunes presentation. Manila, CA. Feb 2016.
- Colwell, M.A. Shorebirds. Trinidad Elementary School class field trip. Trinidad, CA. Apr 2016.
- Colwell, M.A. Diversity and distribution of *Charadrius* plovers. Western Field Ornithologists annual meeting. Fortuna, CA. Oct 2016.
- King, T. R. How to train your raven: testing the response to Snowy Plover nest exclosures. Western Section of The Wildlife Society annual meeting. Pomona, CA. Feb 2016.
- Orluck, D.J. Amphipod distribution in relation to Snowy Plover (*Charadrius nivosus nivosus*) habitat in coastal northern California. Western Section of The Wildlife Society annual meeting. Pomona, CA. Feb 2016.
- Orluck, D.J. Amphipod distribution in relation to Western Snowy Plover (*Charadrius nivosus nivosus*) habitat in coastal northern California. Bureau of Land Management presentation. Arcata, CA. Apr 2016.
- Orluck, D.J. Amphipod distribution in relation to Western Snowy Plover (*Charadrius nivosus nivosus*) habitat in coastal northern California. California North Coast Chapter of The Wildlife Society annual meeting. Humboldt State University, Arcata, CA. May 2016.
- Orluck, D.J. Amphipod distribution in relation to Western Snowy Plover (*Charadrius nivosus nivosus*) habitat in coastal northern California. Marine Science Student Association annual meeting. Eureka, CA. May 2016.
- Papian, N.C. Apparent survival of Western Snowy Plover (*Charadrius nivosus nivosus*) during the nonbreeding season in northern California. California North Coast Chapter of the Wildlife Society annual meeting. Eureka, CA. May 2016.
- Papian, N.C. Apparent survival of Western Snowy Plover (*Charadrius nivosus nivosus*) during the nonbreeding season in northern California. Western Field Ornithologists annual meeting. Fortuna, CA. Oct 2016.

**Books**

- Colwell, M.A. and S.M. Haig. (editors) Ecology and conservation of *Charadrius* plovers. Studies in Avian Biology. Including 3 chapters: Introduction; Predation; Conservation. In prep.

**Theses**

- DeJoannis, A.D. Molt in individuals: A description of prealternate molt phenology in a population of Western Snowy Plovers in Humboldt County, California. Masters thesis. Humboldt State University, Arcata, CA. Sep 2016.
- Feucht, E.J. Immigration influences population growth of Snowy Plovers in northern California. Honors thesis. Humboldt State University, Arcata, CA. Jul 2016.

**Appendix E.** (continued) List of papers, oral and poster presentations, and training sessions produced or conducted in 2015-16.

**Theses (continued)**

King, T.R. An experimental test of response by Common Ravens to nest exclosures. Masters thesis. Humboldt State University, Arcata, CA. In prep.

Leja, S.D. Habitat selection and response to restoration by breeding Western Snowy Plovers in coastal northern California. Masters thesis. Humboldt State University, Arcata, CA. Dec 2015.

Orluck, D.J. Amphipod distribution in relation to Western Snowy Plover (*Charadrius nivosus nivosus*) habitat in coastal northern California. Masters thesis. Humboldt State University, Arcata, CA. In prep.