NESTING OF THE SNOWY PLOVER (*Charadrius nivosus*) IN THE MONTEREY BAY AREA, CALIFORNIA IN 2016

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SUMMARY

Researchers and associates of Point Blue Conservation Science (Point Blue), the U.S. Fish and Wildlife Service (USFWS), and the California Department of Parks and Recreation (CDPR) monitored nesting Snowy Plovers at Monterey Bay in Monterey and Santa Cruz counties in 2016 to assess the plover's response to management efforts by the government agencies to enhance the species' breeding success and maintain its population size. Management actions undertaken by federal and state agencies included:

- Roping-off upper beach and river spits to minimize human disturbance of nesting plovers.
- Predator removal by the Wildlife Services Division of the U.S. Department of Agriculture.
- Ongoing habitat restoration and management at multiple sites.
- Water management to provide nesting and feeding habitat in the managed ponds of the Moss Landing Wildlife Area.

An estimated 427 Snowy Plovers nested in the greater Monterey Bay area in 2016. Our estimate exceeded the USFWS recovery plan target of 338 adults for the region for the 11th time in the 14 years since the target was first attained in 2003.

They had at least 381 nests (Table 2, Appendices 1-13) of which 357 were found as eggs and 24 as broods of chicks.

The 54% of nests that hatched in 2016 was below the average of 61% from 1999-2014.

At least half the nest losses were caused by predators of which avian species were most responsible. Ravens may have taken close to 50 nests. Humans were suspected of being the cause of 9 nest losses.

The number of chicks hatching was 452-567 of which 257 were banded.

A minimum of 202 chicks fledged of which 109 were banded and 93 unbanded.

The estimate of juveniles fledged per male is 0.9 as calculated by the minimum number of unbanded and banded chicks (n=202) known to have fledged divided by number of banded and unbanded males (n=224) in the population.

The 202 chicks that were confirmed to have fledged in 2016 should be considered a minimum total number because more unbanded chicks likely fledged than we were able to verify. The actual number may have easily exceeded the 1999-2014 year average of 229 fledglings for Monterey Bay. Accordingly, the USFWS target of 1.0 fledgling per male for population stability may have been exceeded.

INTRODUCTION

Staff and research associates of Point Blue Conservation Science, with the assistance of staff and/or interns of the U.S. Fish and Wildlife Service and the California Department of Parks and Recreation, have monitored nesting Snowy Plovers annually on the shores of Monterey Bay since 1984, and on small pocket beaches in northern Santa Cruz County since 1988, to ascertain the number of breeding plovers, number of nests, clutch hatching rate, chick fledging rate, and causes of egg and chick loss. Here we summarize the results of the monitoring effort in 2016.

Throughout this document, 2016 results will be compared to a running average from 1999-2014. Beginning in 2015, we modified our study design by not attempting to band every chick that hatched. Thus, fledge rates and other reported numbers from 2015 on should be viewed with this in mind

STUDY AREA

The study area is in Monterey and Santa Cruz counties and includes the beaches of Monterey Bay, former salt ponds in Elkhorn Slough (hereafter Salt Ponds), and pocket beaches in northern Santa Cruz County (Appendix 1). For reporting purposes we divide up the study area as follows:

Monterey Bay Area

South Beach Subregion *(USGS 7.5 ' Topographic maps for Marina and Moss Landing)*

Del Monte: Beach between the City of Monterey and Tioga Road, Sand City. Most of it is adjacent to Sand City. The beach is managed by CDPR.

Sand City: Beach between Tioga Road, Sand City and the south boundary of Fort Ord.

South Fort Ord: Beach between the south boundary of Fort Ord and the site of former Stilwell Hall. It is managed by CDPR.

North Fort Ord: Beach between the Stilwell Hall site and the Lake Court beach access to Marina State Beach. It is managed by CDPR.

Reservation Road: From the Lake Court beach access for Marina State Beach to Reservation Road. It is managed by CDPR.

Marina: The entire beach from Reservation Road to the southern border of the Salinas River National Wildlife Refuge. It is managed by CDPR and the Monterey Peninsula Regional Park District. It is subdivided into four segments, all of which are completely or partly bordered by private property (Table 1).

Salinas River National Wildlife Refuge: The entire beach on the Salinas River National Wildlife Refuge (NWR), which is owned and managed by USFWS.

Salinas River North: The entire beach from the northern border of the Salinas River NWR to the mouth of Elkhorn Slough. It is owned and managed by CDPR. It is further divided into three segments – the north spit of the Salinas River, Monterey Dunes, and Molera/Potrero road segments (Table 1). The Monterey Dunes segment is backed by a beach-front residential development. The Molera/Potrero segment is backed by dunes, the Old Salinas River channel, salt marsh, and, east of the river channel, by agricultural fields south of and by a harbor, residential, and municipal development north of Potrero Road.

North Beach Subregion *(USGS 7.5 ' Topographic maps for Moss Landing and Watsonville West, and for pocket beaches Santa Cruz, Davenport, and Año Nuevo)*

Jetty Road to Beach Road: All the beach between Jetty Road (mouth of Elkhorn Slough) and Beach Road. It is divided into 3 segments all managed by CDPR (Table 1). The north end of the Pajaro Spit is bounded by a beach front residential development.

Sunset/Manresa: The entire beach from Beach Road to the north boundary of Manresa State Beach. The south end of this sub-region is backed by a beach front residential development. The beach is managed by CDPR.

Salt Pond Region

It includes approximately half of the former salt ponds in Elkhorn Slough that have been converted to managed, diked wetlands and are now encompassed within the California Department of Fish and Wildlife's (DFW) Moss Landing Wildlife Area.

Northern Santa Cruz County Pocket Beach Region

We sporadically surveyed the four beaches known to have formerly supported nesting Snowy Plovers in northern Santa Cruz County. ***Wilder Creek Beach*** and ***Laguna Creek Beach*** are owned and managed by CDPR. ***Scott Creek Beach*** is owned and managed by the County of Santa Cruz and ***Waddell Creek Beach*** is owned by the CDPR and by a private party.

METHODS

We attempt to find all plover nests initiated in the study area and record the longitude and latitude of all nests with Global Positioning Units. These locations are depicted in Appendices 1-13. Monitoring is conducted under U. S. Fish and Wildlife Service Permit TE 807078-16.

Unique color band combinations are used to individually mark a sample of adults and chicks. For color banding, adults are usually trapped on the nest while chicks are captured in or near

the nest at the time of hatching. Clutch hatching dates are estimated from egg laying dates, when known, or from egg flotation. They are further refined by examination of eggs for cracked shells, tapping chicks, or peeping chicks just before the estimated hatching date. Chicks are considered fledged if they survive 28 or more days after hatching. Monitors look for fledglings when they have reached this age by watching males known to have broods, by observing broods directly, and by monitoring flocks of roosting plovers during the latter part of the nesting season. Fledging success for specific sites is always categorized by nest location, even in cases where broods move to adjacent areas before fledging.

Table 1. Snowy Plover Nest Protection Measures in 2016.

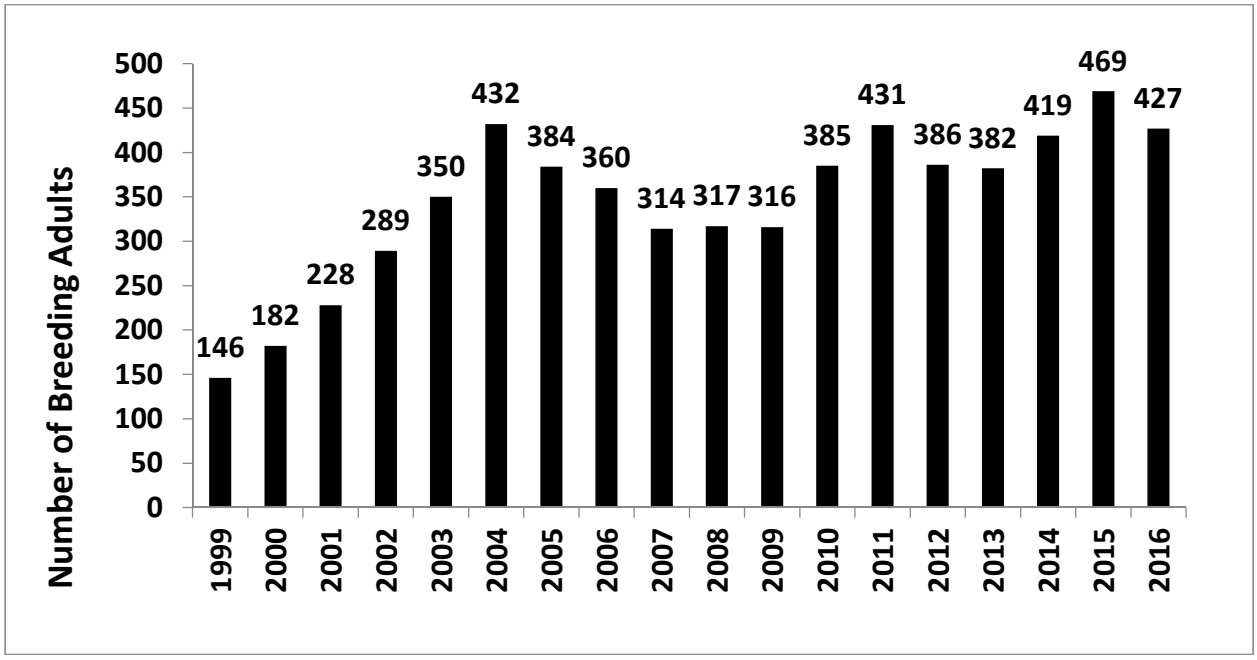
Location	Total Nests	Large Excl. Only	Mini Excl. Only	Symb. Fence Only	Symb. Fence & Mini Excl.	Symb. Fence & Large Excl.	Symb. Fence & Gull Excl.	Signs Only	None
Del Monte	14			14					
Sand City	8			0					8
Fort Ord	35			34					1
Reservation Road	7			7					
Marina									
Marina South	6			6					
Marina Middle	23			23					
Marina North	1			1					
Martin	4			4					
Salinas River NWR	49			49					
Salinas River North									
Salinas River N. Spit	19			19					
Monterey Dunes	12			12					
Molera/Potrero	19			19					
Jetty to Beach Roads									
Moss Landing	20			19					1
Zmudowski Beach	12			12					
N. Pajaro R.M.	64			64					
Sunset/Manresa	34			34					
Seascape									
Salt Ponds	30			30					
Total	**357**	**0**	**0**	**347**	**0**	**0**	**0**	**0**	**10**

MANAGEMENT

Techniques used to improve the breeding success of Snowy Plovers in the study area include closure of the marsh, dunes, and upper beach at Salinas River NWR and closure of the Salt Ponds to the public. On California State Park beaches symbolic fencing, consisting of signed, roped-off upper beach areas, is used to protect most nests (Table 1) and to minimize human disturbance to brood-rearing birds during the nesting season. Selective removal of problem mammalian and avian predators by Wildlife Service biologists also was conducted in 2016. We also manage water levels at the Salt Ponds to create dry nesting substrate and associated wet foraging areas for Snowy Plovers.

2016 NESTING SEASON

Figure 1. Estimated number of breeding Snowy Plovers in the Monterey Bay area.



Estimated Number of Breeders In 2016 the nesting population consisted of an estimated 224 males and 203 females for a total of 427 Snowy Plovers. The 224 males consisted of 172 birds banded before the 2016 breeding season, 13 banded during the 2016 season, and an estimated minimum of 39 unbanded birds. Included in the 172 males banded before the 2016 breeding season were 32 juveniles banded as chicks in 2015. The females in 2016 consisted of 168 banded birds, 15 of which were marked in 2016, and an estimated (minimum) of 35 unbanded birds. Thirty-nine juveniles banded as chicks in 2015 were females that nested in the Monterey Bay in 2016.

Return Rates Of color banded adults that nested in 2015, only 59% of males and 52% of females returned and bred or were suspected of breeding in 2016. This compares with average return rates of 69% for males and 64% for females from 1999-2014.

Table 1. Nesting success of snowy plovers in the Monterey Bay area in 2016.

	Nests and Broods				Unbanded Chicks				Banded Chicks		
Location	Nest	Brood[1]	Total Nests Hatch	% Nest Hatch	Min. Unb Chicks Hatch	Max. Unb Chicks Hatch	Min. Unb Chicks Fledge	Min. % Unb Chicks Fledge	Chicks Banded	Banded Chicks Fledge	% Banded Chicks Fledge
Del Monte-Res. Rd.											
Del Monte	14	0	8	57%	6	8	1	17%	13	1	8%
Sand City	8	0	1	13%	2	3	2	100%	0	0	
Fort Ord	35	0	25	71%	18	29	8	44%	40	25	63%
Reservation Road	7	1	5	71%	4	8	4	100%	8	3	38%
Marina											
Marina South	6	0	5	83%	2	3	0	0%	11	0	0%
Marina Middle	23	2	10	43%	6	24	3	50%	10	4	40%
Marina North	1	1	0	0%	1	3	0	0%	0	0	
Martin	4	0	2	50%	0	2	0	0%	4	0	0%
Salinas NWR	49	2	18	37%	17	34	11	65%	13	7	54%
Salinas River North											
N. Salinas River	19	2	7	37%	11	18	10	91%	4	1	25%
Monterey Dunes	12	3	10	83%	17	29	13	76%	7	3	43%
Molera/Potrero	19	1	14	74%	14	25	3	21%	16	5	31%
Jetty-Beach Rds.											
Moss Landing	20	0	7	35%	4	12	3	75%	4	4	100%
Zmudowski Beach	12	0	7	58%	1	1	1	100%	15	6	40%
Pajaro Spit	64	0	41	64%	30	30	15	50%	75	38	51%
Sunset/Manresa	34	5	6	18%	14	20	6	43%	9	4	44%
TOTAL BEACHES	**327**	**17**	**166**	**51%**	**147**	**249**	**80**	**54%**	**229**	**101**	**44%**
SALT PONDS	**30**	**7**	**24**	**80%**	**48**	**61**	**13**	**27%**	**28**	**8**	**29%**
GRAND TOTAL	**357**	**24**	**190**	**53%**	**195**	**310**	**93**	**48%**	**257**	**109**	**42%**

[1]Nests found as broods are not included in percentage of nests hatching

Nesting Attempts We found 357 nests and broods from 24 undetected nests indicating at least 381 nesting attempts in the Monterey Bay area in 2016 (Table 2, Appendices 1-13).

Clutch Hatching Rates Our calculations of the clutch hatching rates exclude all nesting attempts documented only from the detection of broods as well as 6 nests for which clutch fate was unknown. The 51% hatching rate of clutches found as eggs on beaches in 2016 (Table 2) was below the 60% average from 1999-2014; but the 80% Salt Pond percentage in 2016 was

considerably greater than the 65% Salt Pond average from 1999-2014. The 53% rate for ponds and beaches combined in 2016 was below the average of 61% from 1999-2014.

Clutch Failure Of the 161 nests known to have failed, at least 50% of the losses in 2016 were caused by predators (Table 3). Of the 84 losses attributed to predators 62% were attributed to avian predators, 14% to mammalian predators and 24% to unknown predators.

Common Raven was the main nest predator at Monterey Bay in 2016. Twenty-two nest losses at a total of 9 sites were attributed to ravens and additionally, 27 losses attributed to unknown avian predator, unknown predator, or unknown cause, that occurred at a time and location of an identified raven depredation event, may have also been due to ravens (Table 4).

Gulls were responsible for 7 nest losses.

Skunks, a primary mammalian nest predator some years, were responsible for a total of 3 nest losses, all at one site in 2016. Coyotes were the suspected cause of 3 nest losses, raccoons of 5 losses, and unidentified mammals 1 loss.

Other causes of loss were far less common that those due to predators. Humans were suspected to have caused 9 losses, 5 of which were in the Sand City area. Natural elements such as wind, tide and rain were the suspected cause of 12 nest losses (Table 3). Ten nests were deserted and 1 was categorized as having non-viable eggs.

Table 3. Causes of Snowy Plover nest loss in the Monterey Bay area in 2016[1]

	Avian Predator					Mammalian Predator					Other Causes									
Locations	CORA	WHIM	Gull	Corvid	Unk.	Coyo.	Canine	Skunk	Racc.	Unk.	Unk Pred.	Hum.	Tide	Wind	Rain	Non-Viable	Des.	Cause Unk.	Fate Unk.	Total
Del Monte	1											1					1	3		**6**
Sand City												5					1	1		**7**
Fort Ord	3				1			3				1	1				1			**10**
Reservation Road	1																1			**2**
Marina South	1																			**1**
Marina Middle	3		1		1						3			1				4		**13**
Marina North																		1		**1**
Martin														1					1	**2**
Salinas NWR	9		1		15	1						2						3		**31**
N. Salinas River	1		1		3	2					3		1					1		**12**
Monterey Dunes																	1		1	**2**
Molera/Potrero													1					4		**5**
Moss Landing			2								2		2	1				6		**13**
Zmudowski Beach	1																1	2	1	**5**
Pajaro River Spit	2	1	2		2						4		1			1	2	8		**23**
Sunset/Manresa					1				5	1	2		2	1			1	14	1	**28**
Salt Ponds											3						1		2	**6**
Total	**22**	**1**	**7**	**0**	**23**	**3**	**0**	**3**	**5**	**1**	**17**	**9**	**8**	**4**	**0**	**1**	**10**	**47**	**6**	**167**

[1]Some nests in this table attributed to the categories Unknown Avian, Unknown Predator and Unknown Cause will be subsequently coded to "Event Raven" based on geographic proximity to and the timing of nests confirmed lost to raven. See Table 4 below for nests that meet these criteria. This suggests ravens may have been responsible for up to 27 nests coded as to unknown categories in Table 3.

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Table 4. Number of lost nests coded as Unknown Avian, Unknown Predator or Unknown Cause considered suitable to be moved into the "Event Raven" loss category (See Table 3).

Locations	Original Cause			CORA event total
	Unk. Avian	Unk. Pred.	Cause Unk.	
Del Monte				0
Sand City				0
Fort Ord	1			1
Reservation Road				0
Marina South				0
Marina Middle	1	1	2	4
Marina North			1	1
Martin				0
Salinas NWR	15			15
N. Salinas River	3			3
Monterey Dunes				0
Molera/Potrero				0
Moss Landing				0
Zmudowski Beach				0
Pajaro River Spit	1		2	3
Sunset/Manresa				0
Salt Ponds				0
Total				**27**

Chicks Hatched The precise number of chicks hatching in the Monterey Bay area was not determined but ranged from 195-310 unbanded chicks in addition to the 257 that were banded (Table 2).

Chicks Fledged Overall, in 2016, 109 banded chicks fledged for a banded-chick fledging rate of 42%. This compares to an average of 40% from 1999 to 2014. At minimum 93 unbanded chicks also were known to fledge in 2016 (Table 2) for a minimum of 202 fledglings. Using an estimated 42% of the unbanded ones plus the banded ones (109) would bring the estimate to 191-239 fledglings. The average from 1999-2014 is 229 fledglings.

Young Fledged Per Male The estimate of juveniles fledged per male is 0.9 as calculated by the minimum number of unbanded and banded fledglings (n=202) divided by number of banded and unbanded males (n=224) in the population. The average from 1999-2014 is 1.3 fledglings per male.

DISCUSSION

Our estimate of 427 breeding Snowy Plovers in the Monterey Bay region in 2016 exceeded the USFWS recovery plan target of 338 adults for the region for the 11th time in the 14 years since the target was first attained in 2003. Moreover, the number of breeders in the Monterey Bay area exceeds the 400-bird target for all of USFWS Recovery Unit 4 which encompasses all coastal nesting areas from Sonoma through Monterey counties.

The USFWS window survey in late May is currently the primary method of estimating the relative size of the entire U.S. Pacific coast population annually. In 2016, 313 adults were detected in the study area on the window survey. Over the 10-years from 2005-2014 the average number of plovers estimated nesting on the Monterey Bay was 1.35 the average observed on the window survey. Applying this factor to the 2016 window survey suggests a breeding population of 1.35 X 313 = 423 birds this year. This corrected window survey total is also remarkably consistent with actual number of breeders we counted in 2016 (427).

The 202 chicks fledged in 2016 should be considered a minimum because more unbanded chicks likely fledged than we were able to verify. The 2016 number may have exceeded the 1999-2014 year average of 229 fledglings for Monterey Bay. The USFWS target of 1 fledgling per male for population stability was also likely achieved despite the ratio of only 0.90 as calculated by the confirmed minimum number of unbanded and banded fledglings divided by number of banded and unbanded males.

Overall, plovers experienced a subpar hatching rate in 2016 relative to the 1999-2014 average in the area. The overall clutch hatching rate was 54% compared with the 61% 1999-2014 average. Hatching rates for beach locations with ≥ 10 nests were highest for Monterey Dunes,

Molera/Potrero roads and Fort Ord (Table 2) and lowest at Sunset/Manresa (Table 2). The salt pond hatching rate was greater than for any beach segment.

The overall chick fledging rate of 42% for banded chicks compared favorably to the 40% average of the 1999-2014 years. Highest fledge rates for locations with ≥ 15 banded chicks were Fort Ord and Pajaro Spit (Table 2). In 2016, Monterey Bay beaches were considerably narrower than in 2015 at many locations, particularly linear beaches near Moss Landing. This resulted in less overall habitat for nesting and for chick-rearing at many locations and may have negatively impacted chick fledging rates at some locations (Table 2).

Corvids continued to be a significant identified nest predator throughout the bay, with substantial nest loss to ravens at Salinas National Wildlife Refuge. Humans also negatively impacted plover hatching rates with deliberate vandalism of nests observed at Salinas River NWR and likely trampling of nests at Sand City. At Salinas River NWR, the vandalism occurred inside large symbolically fenced areas, possibly because nests were visible from the edge of the fencing. At Sand City, no protective fencing was installed on the beach in 2016 (see Table 1), resulting in human-caused trampling of several nests (see Table 3).

RECOMMENDATIONS

Ravens, continue to be the dominant avian predator of plover nests and we expect this to continue.

- Initiate bay-wide raven management efforts early in the nesting season.

In the past years, skunks have been a dominant predator of plover nests at multiple sites, particularly in the southern bay where historically they have been absent from beaches.

- Initiate skunk management early in the season at sites historically impacted by skunks.
- Initiate cooperative predator management efforts with coastal property management entities (e.g., Pajaro Dunes, Monterey Dunes Colony).
- Install a predator exclusion fence at north end of Pajaro Spit to prevent skunks from crossing into nesting area from under the condominiums.

We suspect that multiple raptor species are locally significant predators of both adult plovers and chicks in some years.

- Monitor diurnal avian predators to determine location and scale of predation impacts and to inform possible management actions.

Human-caused impacts are likely negatively affecting plover reproductive success at sites where trespass into closed areas occurs and where high levels of high-impact recreation may limit chick use of lower beach areas.

- Maintain regulatory signs and fencing.
- Increase enforcement of beach rules and regulations.
- Consider restricting high impact recreational uses (e.g. equestrians) where chick fledging rates have been negatively impacted.

Nesting activity has increased in recent years at some sites and declined at others, particularly in northern Santa Cruz County. Additional, regularly scheduled survey work by land managers would provide necessary information to develop appropriate management strategies.

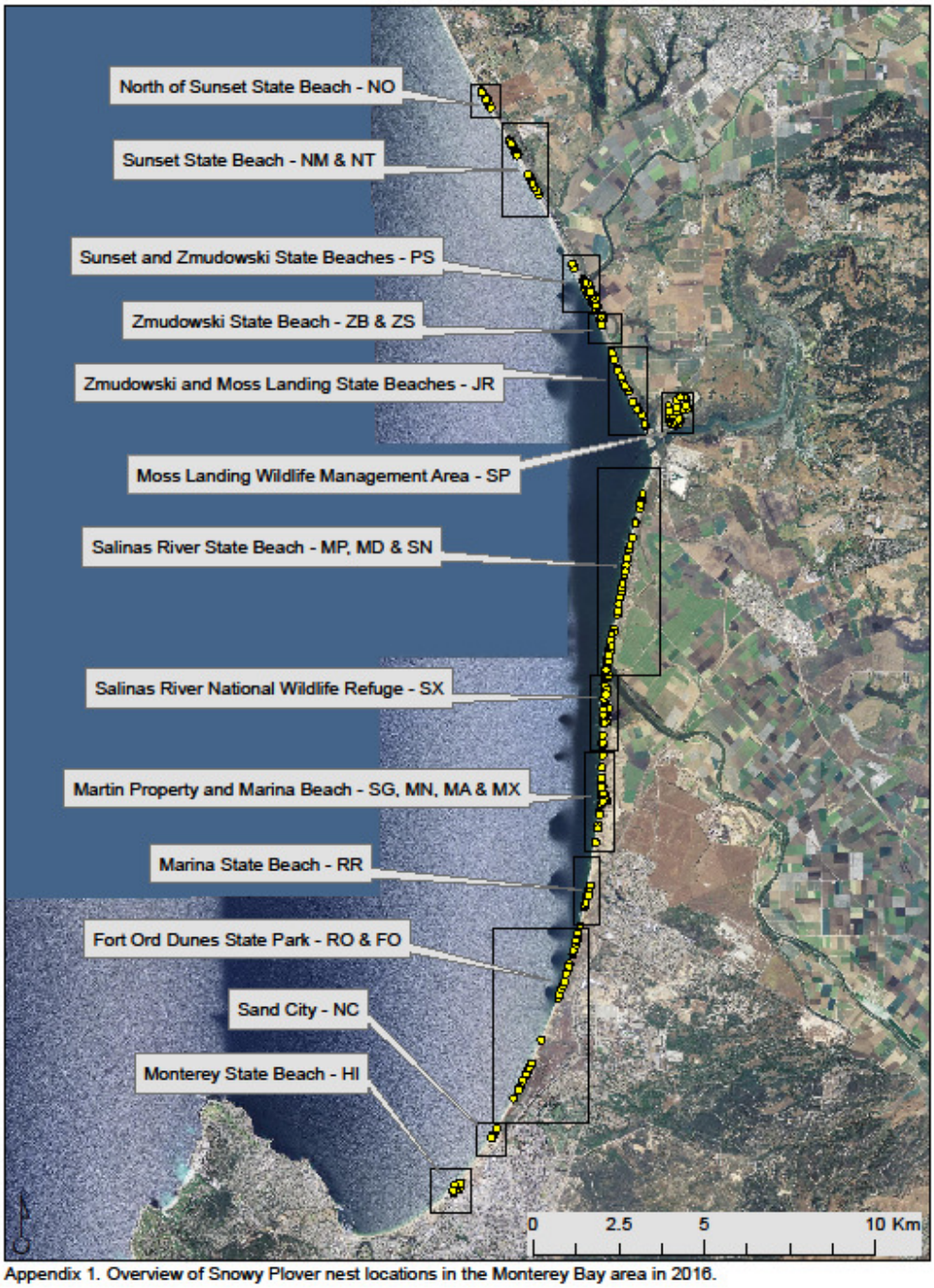
- Increased plover monitoring is needed at the following sites: the North Coast beaches (Wilder, Laguna, Scott Creek, and Waddell beaches), Sunset State Beach and beaches north to Rio Del Mar, and the Sand City/Del Monte beach areas.

FUTURE WORK

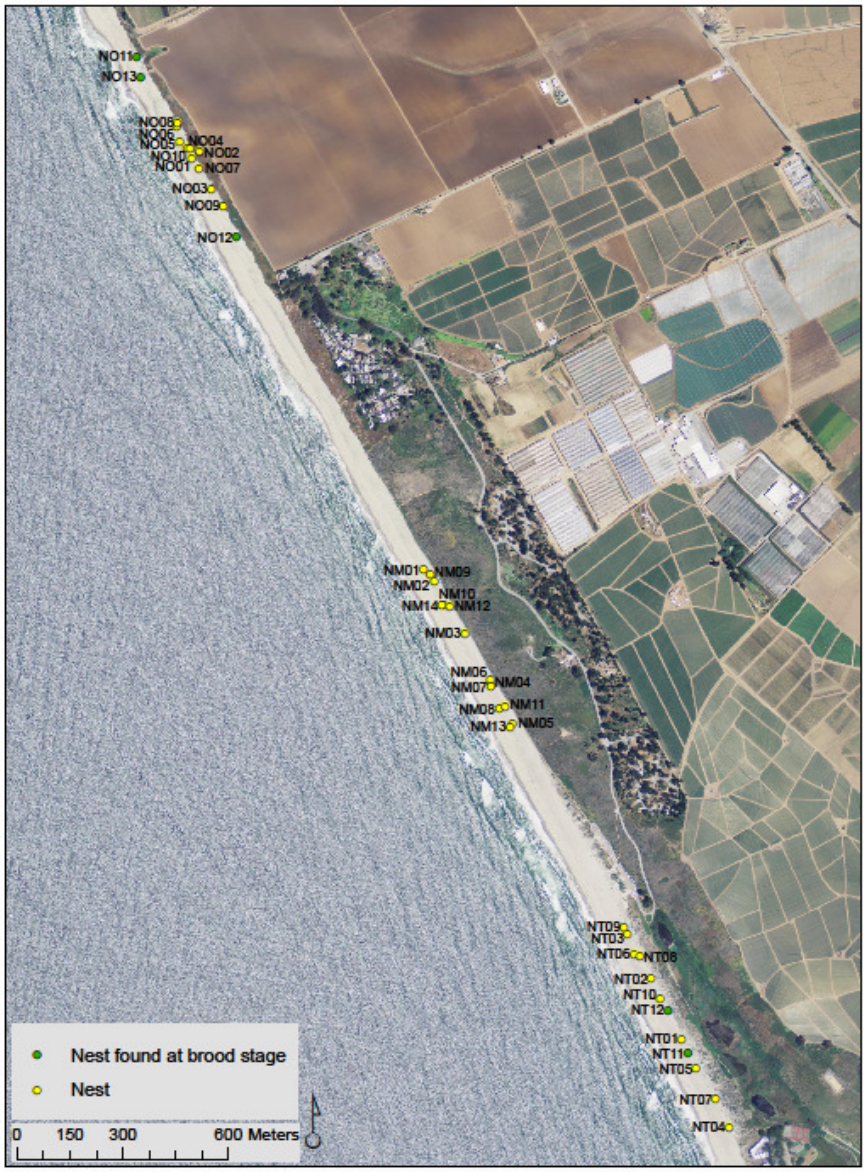
This project, ongoing since 1984, is intended to continue in 2017, with a start date of 1 March.

ACKNOWLEDGEMENTS

Jacob Martin greatly assisted with the fieldwork at Sunset Beach and Amy Palkovic at Reservation Road and Fort Ord. Esther Haile, and Chris Caris also contributed significantly to the field work in the South Bay. Amy Palkovic with California Department of Parks and Recreation (Marina Office) manages the GIS data on which our appendices are based; she deserves special thanks for preparing the nest maps. Personnel of USDA Wildlife Services were responsible for control of skunks and ravens. This project was conducted collaboratively by Point Blue Conservation Science, the Salinas River National Wildlife Refuge Unit of the Don Edwards San Francisco Bay National Wildlife Refuge of the U. S. Fish Wildlife Service, the California Department of Parks and Recreation, the California Department of Fish and Wildlife, the Wildlife Services Unit of the U. S. Department of Agriculture, and the Monterey Bay Aquarium.



Appendix 1. Overview of Snowy Plover nest locations in the Monterey Bay area in 2016.



Appendix 2. Snowy Plover nest locations at Monterey Bay Academy and at the northern section of Sunset State Beach in 2016.

Appendix 3. Snowy Plover nest locations at the Pajaro spit at Sunset and Zmudowski State Beaches in 2016.

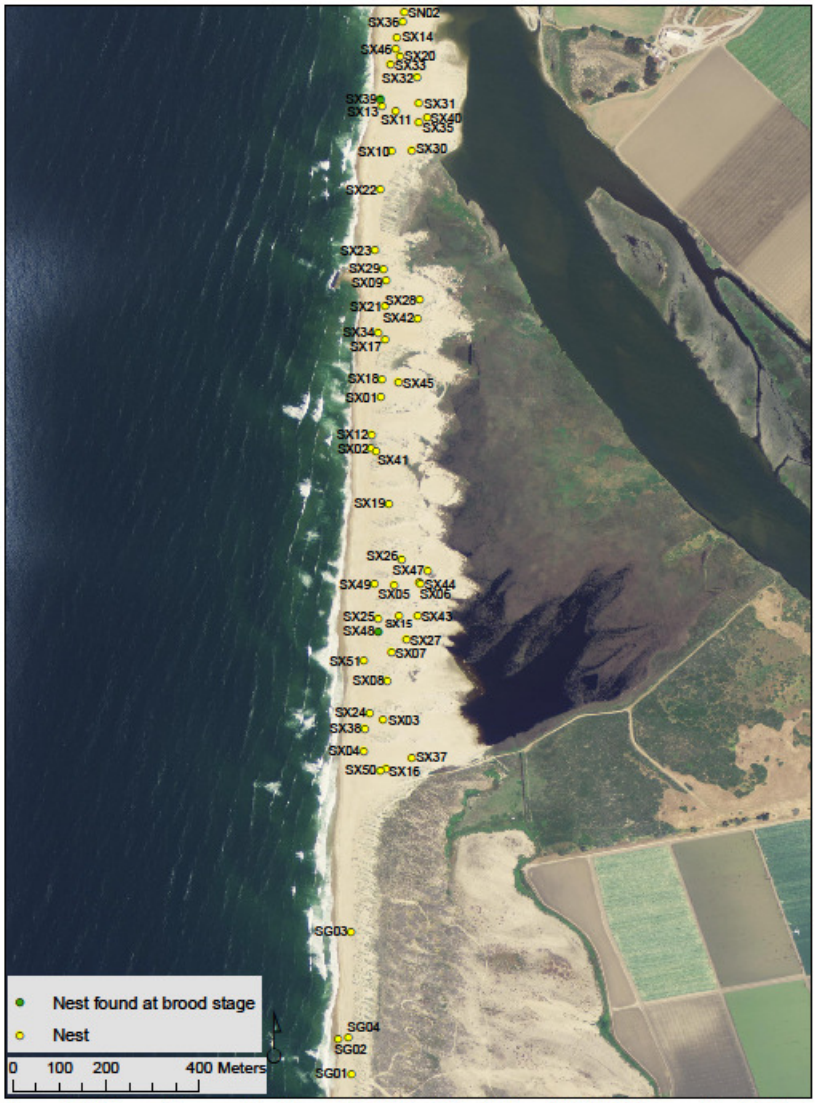
Appendix 4. Snowy Plover nest locations at the central portion of Zmudowskii State Beach in 2016.

Appendix 5. Snowy Plover nest locations at Jetty Road at Zmudowski and Moss Landing State Beaches in 2016.

Appendix 6. Snowy Plover nest locations at Moss Landing Wildlife Area in 2016.

Appendix 7. Snowy Plover nest locations at the northern portion of Salinas River State Beach in 2016.

Appendix 8. Snowy Plover nest locations at the southern portion of Salinas River State Beach in 2016.



Appendix 9. Snowy Plover nest locations at the Salinas River National Wildlife Refuge and the Martin dunes in 2016.

Appendix 10. Snowy Plover nest locations at Marina beach in 2016.

Appendix 11. Snowy Plover nest locations at Marina State Beach and the northern portion of Fort Ord Dunes State Park in 2016.

Appendix 12. Snowy Plover nest locations at the sourthern portion of Fort Ord Dunes State Park and at Sand City in 2016.

Appendix 13. Snowy Plover nest locations at Monterey State Beach in 2016.