NESTING OF THE SNOWY PLOVER IN THE MONTEREY BAY AREA, CALIFORNIA IN 2015

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Introduction

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 2015 to assess the plover's response to management efforts by the government agencies to enhance the species' breeding success and increase its population size. Management actions undertaken by federal and state agencies included:

- Roping-off upper beach and river spit habitat to minimize disturbance of nesting birds by the public.
- Predator removal by the Wildlife Services Division of the U.S. Department of Agriculture (USDA) and the Ventana Wildlife Society.
- Ongoing habitat restoration at multiple sites.
- Exclosures to protect individual nests from predators when needed (Table 1).
- Water management to provide nesting and feeding habitat in the managed ponds of the Moss Landing Wildlife Area (MLWA).

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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 assess 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 2015.

STUDY AREA

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

Monterey Bay Area

South Beach Subregion

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

by dunes, the Old Salinas River channel, salt marsh, and, east of the river channel, by agricultural fields south of and by development north of Potrero Road.

North Beach Subregion

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 development.

Sunset/Manresa: The entire beach from Beach Road to the north boundary of Manresa State Beach. The south end of this subregion is backed by a beach front 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 covered 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.

MONITORING

We attempt to find all plover nests initiated in the study area. 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 28 days of age by watching males known to have broods, 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. In 2015, we recorded 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 807078-15.

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 limit human disturbance to brood-rearing birds during the nesting season.

Mini exclosures, 24-36 inches in diameter and 24 inches high, were used to protect 3 nests from predators at Pajaro Dunes in 2015. Selective removal of problem mammalian and avian predators by Wildlife Service biologists also was conducted in 2015.

Biologists from the Ventana Wildlife Society captured a Great Horned Owl in mid-July on the Pajaro Spit where we suspected owls were responsible for low plover fledging success.

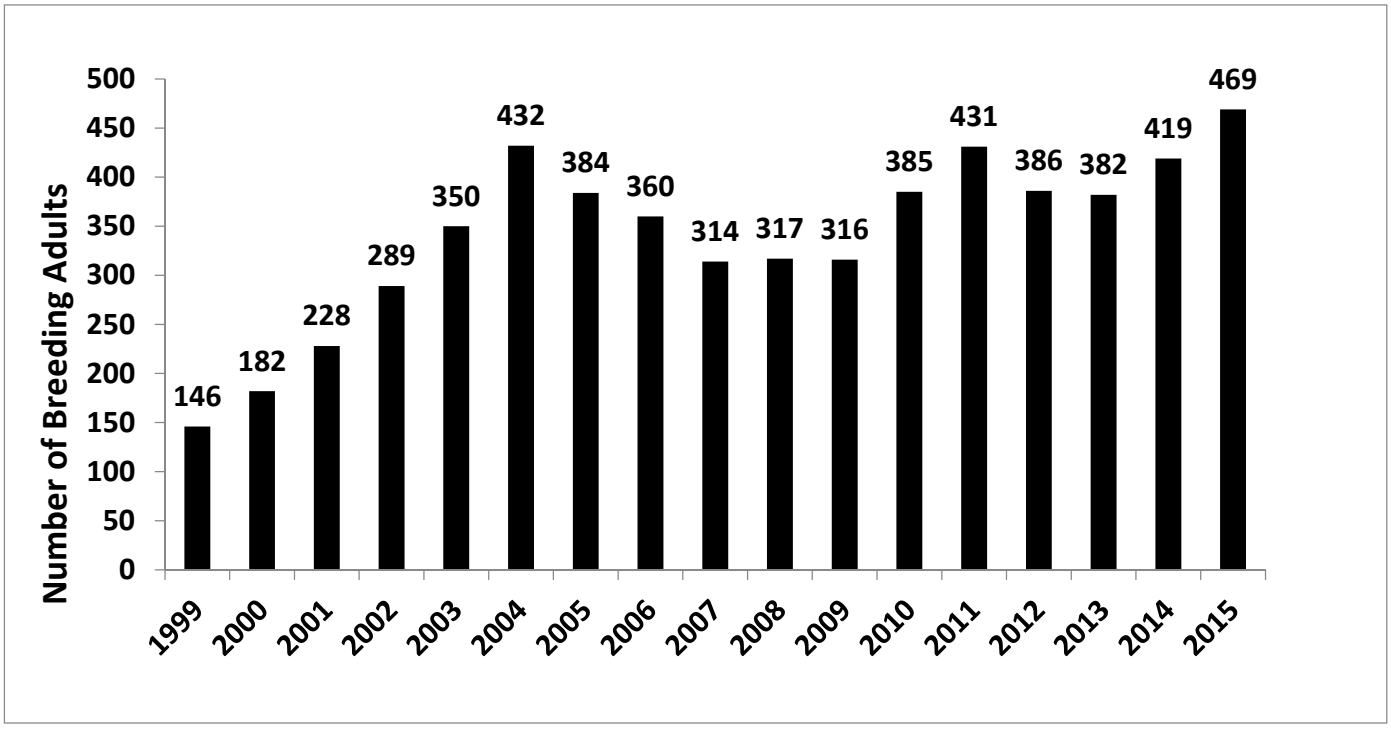
Table 1. Nest protection measures for Snowy Plovers at Monterey Bay in 2015.

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	Unknown (Found as Broods)
Del Monte	5	0	0	5	0	0	0	0	0	1
Sand City	8	0	0	0	0	0	0	0	8	1
Fort Ord	58	0	0	58	0	0	0	0	0	0
Reservation Road	24	0	0	24	0	0	0	0	0	1
Marina										
Marina South	12	0	0	12	0	0	0	0	0	1
Marina Middle	30	0	0	30	0	0	0	0	0	4
Marina North	14	0	0	14	0	0	0	0	0	1
Martin	9	0	0	9	0	0	0	0	0	0
Salinas River NWR	61	0	0	61	0	0	0	0	0	2
Salinas River North										
Salinas River N. Spit	38	0	0	38	0	0	0	0	0	4
Monterey Dunes	32	0	0	32	0	0	0	0	0	3
Molera/Potrero	21	0	0	21	0	0	0	0	0	4
Jetty to Beach Roads					0	0	0	0		
Moss Landing	33	0	0	33	0	0	0	0	0	1
Zmudowski Beach	43	0	0	42	0	0	0	0	1	2
N. Pajaro R.M.	82	0	0	78	3	0	0	0	1	0
Sunset/Manresa	33	0	0	32	0	0	0	0	1	6
Seascape	0	0	0		0	0	0	0	0	0
Salt Ponds	43	0	0	43	0	0	0	0	0	4
Total	546	0	0	532	3	0	0	0	11	35

We continued to manage water levels at the Salt Ponds to create dry nesting substrate and associated wet foraging areas for Snowy Plovers. Water is drawn down rapidly from some ponds at the beginning of the season to provide dry nest sites. Thereafter, flooding of remnant-wet areas is undertaken several times per month throughout the nesting season to maintain foraging habitat for adults and chicks.

THE 2015 NESTING SEASON

Number of Breeders



The 2015 breeding population consisted of at least 245 males and 224 females for a total of 469 Snowy Plovers, the highest total ever during our study.

The males consisted of 206 birds banded before the 2015 breeding season, 11 banded during the 2015 season, and an estimated minimum of 28 unbanded birds. Forty-six juveniles banded as chicks in 2014 remained or returned to the Monterey Bay area and nested in 2015.

The females consisted of 190 banded birds and an estimated (minimum) of 34 unbanded birds. Forty-two juveniles banded as chicks in 2014 remained or returned to the Monterey Bay area and nested in 2015.

Table 2. Snowy Plover nesting success at Monterey Bay in 2015.

Location	Nests and Broods				Unbanded Chicks			Banded Chicks		
	Nest	Brood[1]	Total Nests Hatch	% Nest Hatch	Min. Unb Chicks Hatch	Min. Unb Chicks Fledge	% Min. Unb Chicks Fledge	Banded Chicks Hatch	Banded Chicks Fledge	% Banded Chicks Fledge
Del Monte-Res. R.										
Del Monte	5	1	5	*100%*	4	0	*0%*	10	6	*60%*
Sand City	8	1	0	*0%*	3	0	*0%*	0	0	*0%*
Fort Ord	58	0	25	*43%*	11	1	*9%*	57	28	*49%*
Reservation Road	24	1	9	*38%*	4	0	*0%*	25	10	*40%*
Marina										
Marina South	12	1	5	*42%*	6	0	*0%*	8	5	*63%*
Marina Middle	29	5	14	*48%*	6	1	*17%*	39	9	*23%*
Marina North	15	0	4	*27%*	0	0	*0%*	11	2	*18%*
Martin	9	0	2	*22%*	2	0	*0%*	2	0	*0%*
Salinas NWR	61	2	33	*54%*	14	4	*29%*	75	7	*9%*
Salinas River N										
N. Salinas River	37	5	18	*49%*	24	5	*21%*	31	8	*26%*
Monterey Dunes	32	3	16	*50%*	32	14	*44%*	18	7	*39%*
Molera/Potrero	21	4	5	*24%*	14	11	*79%*	7	5	*71%*
Jetty-Beach Rds.										
Moss Landing	34	1	13	*38%*	20	10	*50%*	17	8	*47%*
Zmudowski Beach	43	2	24	*56%*	21	8	*38%*	50	39	*78%*
Pajaro Spit	82	0	38	*46%*	24	12	*50%*	78	52	*67%*
Sunset/Manresa	33	6	14	*42%*	30	18	*60%*	23	15	*65%*
ALL BEACHES	**503**	**32**	**225**	***45%***	**215**	**84**	***39%***	**451**	**201**	***45%***
SALT PONDS	**43**	**4**	**25**	***58%***	**30**	**9**	***30%***	**46**	**25**	***54%***
GRAND TOTAL	**546**	**36**	**250**	***46%***	**245**	**93**	***38%***	**497**	**226**	***45%***

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

Return Rates

Of color banded adults that nested in 2014, 73% of males and 67% of females returned and bred in 2015. This compares with average return rates of 69% for males and 64% for females from 1999-2014.

Number of Nesting Attempts

We found 546 nests and 36 broods from undetected nests indicating at least 582 nesting attempts in the Monterey Bay area in 2015 (Table 2). Nest locations are plotted in Appendices 1-13.

Clutch Hatching Rates

Our calculations of the clutch hatching rates exclude all nesting attempts documented only from the detection of broods.

The 45% hatching rate of clutches found as eggs on beaches in 2015 was below the 60% average from 1999-2014; also, the 58% Salt Pond percentage in 2015 was below the 65% Salt Pond average from 1999-2014.

Causes of Clutch Loss

There were 10 nests for which clutch fate was unknown.

Of the remaining nests, at least 54% of the 286 losses in 2015 were caused by predators (Table 3) and of the 191 losses attributed to predators 54% were attributed to avian predators, 23% to mammalian predators and 23% to unknown predators.

Common Raven was the main nest predators at Monterey Bay in 2015. Twenty-six nest losses at a total of 7 sites were attributed to ravens and another 17 losses at 4 sites to unidentified corvids that may also have been ravens. Additionally, 56 clutch 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 (Appendix 14).

Gulls were responsible for 7 nest losses.

Skunks, the primary mammalian nest predator, were responsible for a total of 35 nest losses at 9 sites. Coyotes and raccoons took 3-4 nests and 2 nest losses were categorized as unknown mammalian predator (Table 3).

Humans caused 8 losses, 3 of which were in the Sand City area.

Natural elements such as wind, tide and rain were the suspected cause of 19 nest losses (Table 3).

Twelve nests were deserted but none were categorized as having non-viable eggs.

One nest categorized as lost at hatch was undoubtedly also destroyed by avian or mammalian predators but we could not be sure if the losses occurred in the egg or chick phase.

Table 3. Causes of Snowy Plover nest loss at Monterey Bay in 2015[1]. Unk. is Unknown, Pred. is Predator and Des. is deserted.

	Avian Predator				Mammalian Predator				Other Causes										
Locations	**CORA**	**Gull**	**Corvid**	**Unk.**	**Coyote**	**Skunk**	**Racoon**	**Unk.**	**Unk Pred.**	**Human**	**Tide**	**Wind**	**Rain**	**Non-Viable**	**Des.**	**Cause Unk.**	**Lost at Hatch**	**Fate Unk**	**Total**
Del Monte																			0
Sand City									1	3	1					3			8
Fort Ord				2		22			4		2					3			33
Reservation Road				8		1			1		1				2	2			15
Marina South	2			2					2							1			7
Marina Middle	3	1		5					3						1	2			15
Marina North	3			6							1				1				11
Martin				1		1			3							2			7
Salinas NWR	6			1	2	3		2	6	1	1	3			1	2			28
N. Salinas River	9	4		3		1										2			19
Monterey Dunes				10							1				1	3		1	16
Molera/Potrero				14						1						1			16
Moss Landing	2		1	1	2	2					1					12			21
Zmudowski Beach	1		3			1			8		1	2				3			19
Pajaro River Spit		2	12	1		3	1		3	1		3			2	13		3	44
Sunset/Manresa			1			1	2			2	1				3	6		3	19
Salt Ponds									12				1		1		1	3	18
Total	**26**	**7**	**17**	**54**	**4**	**35**	**3**	**2**	**43**	**8**	**10**	**8**	**1**	**0**	**12**	**55**	**1**	**10**	**296**

[1] Some nests in this table attributed to the categories Unknown Avian, Unknown Predator and Cause Unknown will be subsequently coded to "Event Raven" based on proximity to and the timing of nests confirmed lost to raven.

Chicks Hatched

The minimum number of chicks hatching in the Monterey Bay area was 742 of which 497 were banded and 245 were not banded.

Chicks Fledged

Overall, 93 unbanded and 226 banded chicks fledged for a total of 319 fledged juveniles in 2015. This is 1.4 times the average of 229 fledglings from 1999 to 2014.

The fledging rate of banded and unbanded chicks for all sites combined was 43.0% which is above the 1999-2014 average fledging rate 40.4%. At both the beaches and the ponds we obtained a higher fledge rate for banded than unbanded chicks as expected because banded fledglings can be verified over a much longer period than unbanded ones which can only be verified while they are still with the male. The overall fledge rate was 38% for unbanded chicks and 45% for banded chicks (Table 2).

Young Fledged Per Male

The overall fledging rate of banded and unbanded males combined was 1.30 (319 fledglings/245 males) fledglings per male and identical to the 1.30 average from 1999-2014.

There were so many unbanded chicks in 2015 that we tried to sample fledge rate per male for 102 males in which all chicks in every brood were banded and for 104 males for which ≥ 1 chick in one or more broods was unbanded. The rate for the first sample was 1.13 fledglings per male and for the sample with unbanded chicks was 1.50 chicks per male.

DISCUSSION

Our estimate of 469 breeding Snowy Plovers in the Monterey Bay region in 2015 exceeded the USFWS recovery plan target of 338 adults for the region for the 10th time in the 13 years since the target was first attained in 2003. Moreover, the number of breeders in the Monterey Bay area also exceeded 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. Our data continue to suggest that the window survey underestimates the number of breeders in the Monterey Bay region. In 2015, 305 adults were detected in the study area on the window survey. This represents only 65.0% of the estimated 469 adults (mainly color banded birds) known to have nested there

over the season. Over the 10-years from 2005-2014 the average number of plovers detected nesting on the Monterey Bay was 1.35 the average observed on the window survey.

The 319 chicks fledged in 2015 greatly exceeded the previous 16 year average of 229 fledglings for Monterey Bay and the USFWS target of 1 fledgling per male for population stability was also achieved. Despite the above average fledgling production, plovers experienced below average hatching rates in 2015 relative to the prior 16 years in the area. The overall clutch hatching rate was 46% compared with the 61% average. The overall chick fledging rate of 43% compared favorably to the 40% average of the prior 16 years. Fledge rates (combined banded and unbanded) varied widely across the bay, with exceptionally high rates at several sites in the North Bay (e.g., 66% at Zmudowski and 63% at Pajaro River Spit) as compared to lower than average fledge rates at several sites in the South Bay (e.g., 12% at Salinas River NWR and 22% at Marina Middle).

Corvids and skunks continued to be the most significant identified nest predators throughout the bay, with substantial nest loss to skunks at Fort Ord. The poor fledge rates at Marina Middle to North Salinas River may have been attributable to the presence of one or more Peregrine Falcons, including the same banded Peregrine Falcon that negatively impacted productivity in 2014. In contrast, there was anomalously high fledgling production at both the north and south margins of the bay, including 6 juveniles at Del Monte and 33 juveniles at Sunset/Manresa.

RECOMMENDATIONS

The following summarizes additional management actions for Monterey Bay nesting sites:

Corvids, especially ravens, continue to be the dominant avian predator of plover nests and we expect this to continue. In addition, large-scale raven predation events are occurring earlier in the nesting season.

- Initiate raven management efforts early in the nesting season as part of bay-wide management program

In the past 3 years, skunks have become a dominant predator of plover nests at multiple sites, particularly in the southern bay where historically they have been absent from beaches. Skunks particularly impacted nesting at Fort Ord, but were also problematic at Salinas River NWR and the Pajaro Spit.

- Initiate skunk management early in the season at sites impacted by skunks in 2015
- 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 Peregrine Falcons negatively impacted fledging success over a large area in central Monterey Bay. Peregrine Falcons depredate several life stages of Snowy Plovers (adults, chicks and recently fledged young) and pose a wide-spread threat to plovers. Certain individuals are probably responsible for most predation that occurs and some individuals may cause no impacts. This underscores the need to observe all potential avian predator species closely to determine which ones are impacting plovers.

- Monitor diurnal avian predators and determine management actions.

Human trespass into closed areas continues to compromise productivity at multiple sites.

- Maintain regulatory signs and fencing.
- Increase enforcement of beach rules and regulations.

Human disturbance, including trampling of unprotected nests, continues to suppress productivity in the northern Sand City area.

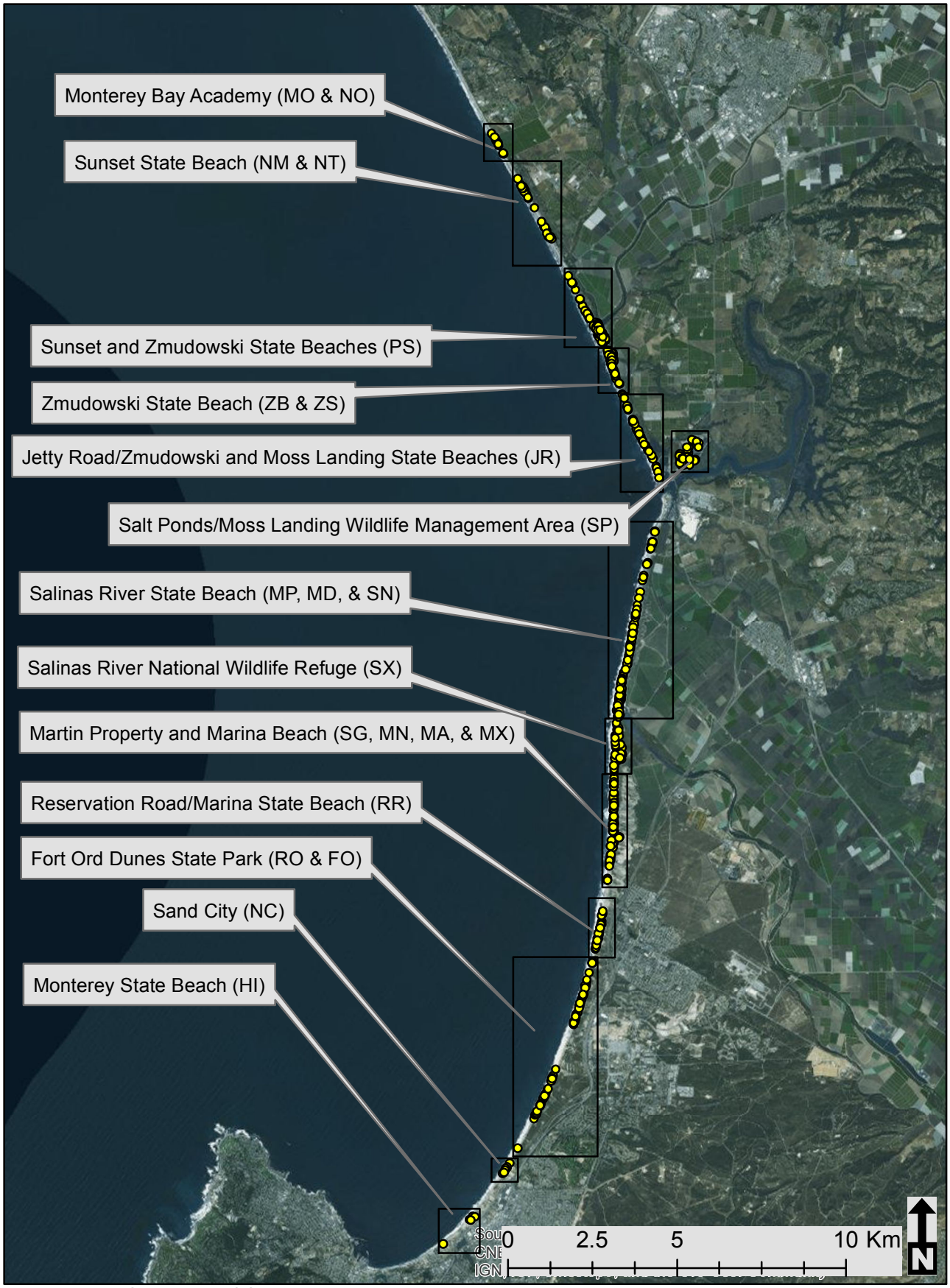
- Symbolically fence plover nest and brood rearing areas located beyond habitat protection areas.

Nesting activity has increased in recent years at the northern and southern ends of the bay. Additional survey work by land owners and managers would provide the information needed to develop better management strategies at these sites.

- 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.

ACKNOWLEDGEMENTS

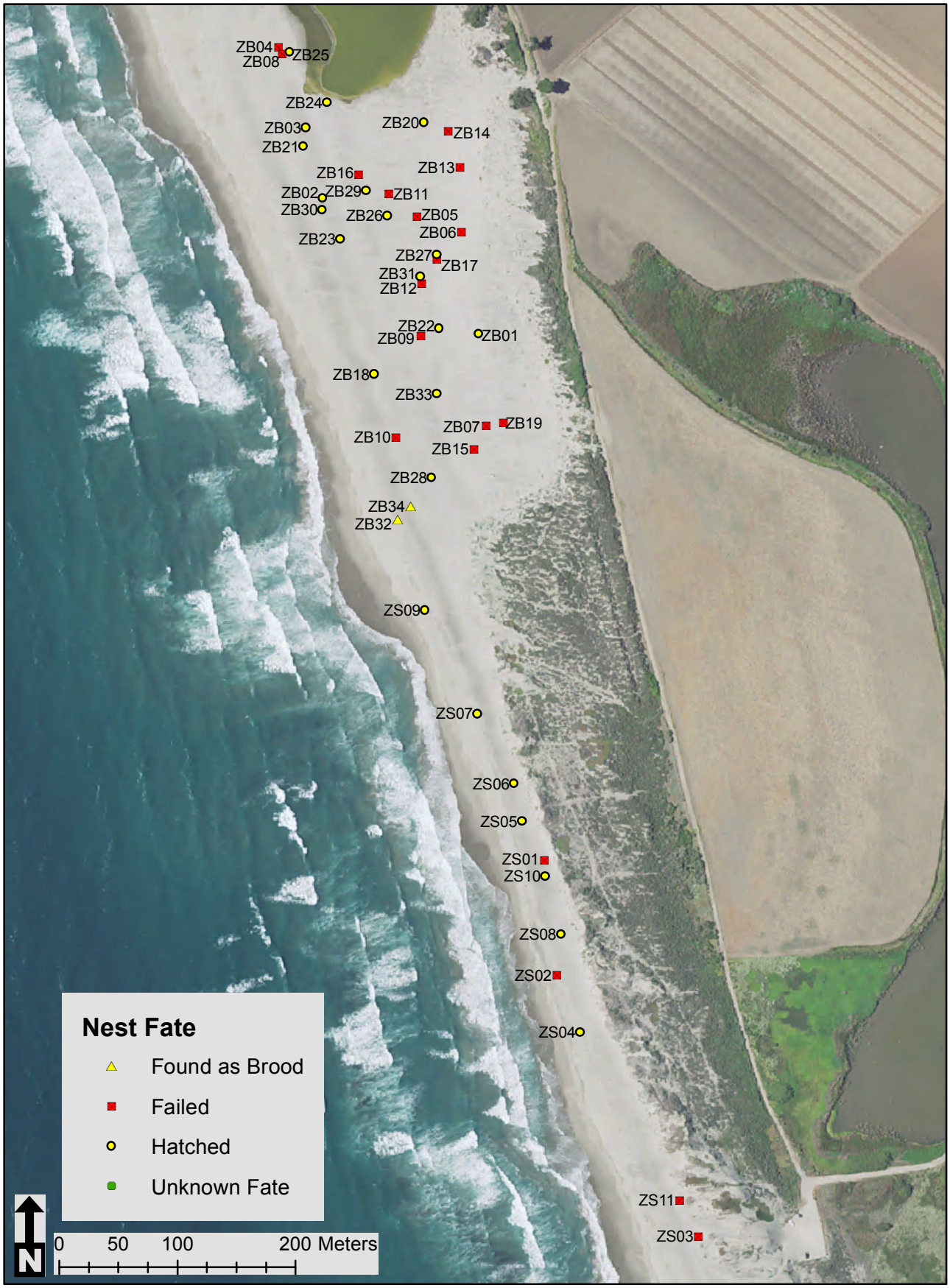
Jacob Martin greatly assisted with the fieldwork at Sunset Beach and Amy Palkovic at Reservation Road and Fort Ord. Kelly Surgalski, Esther Haile, and Chris Caris also contributed significantly to the field work in the south bay. Amy Palkovic deserves special thanks for preparing the nest maps. Nick Todd and the Ventana Wildlife Society conducted raptor management work. Personal 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.



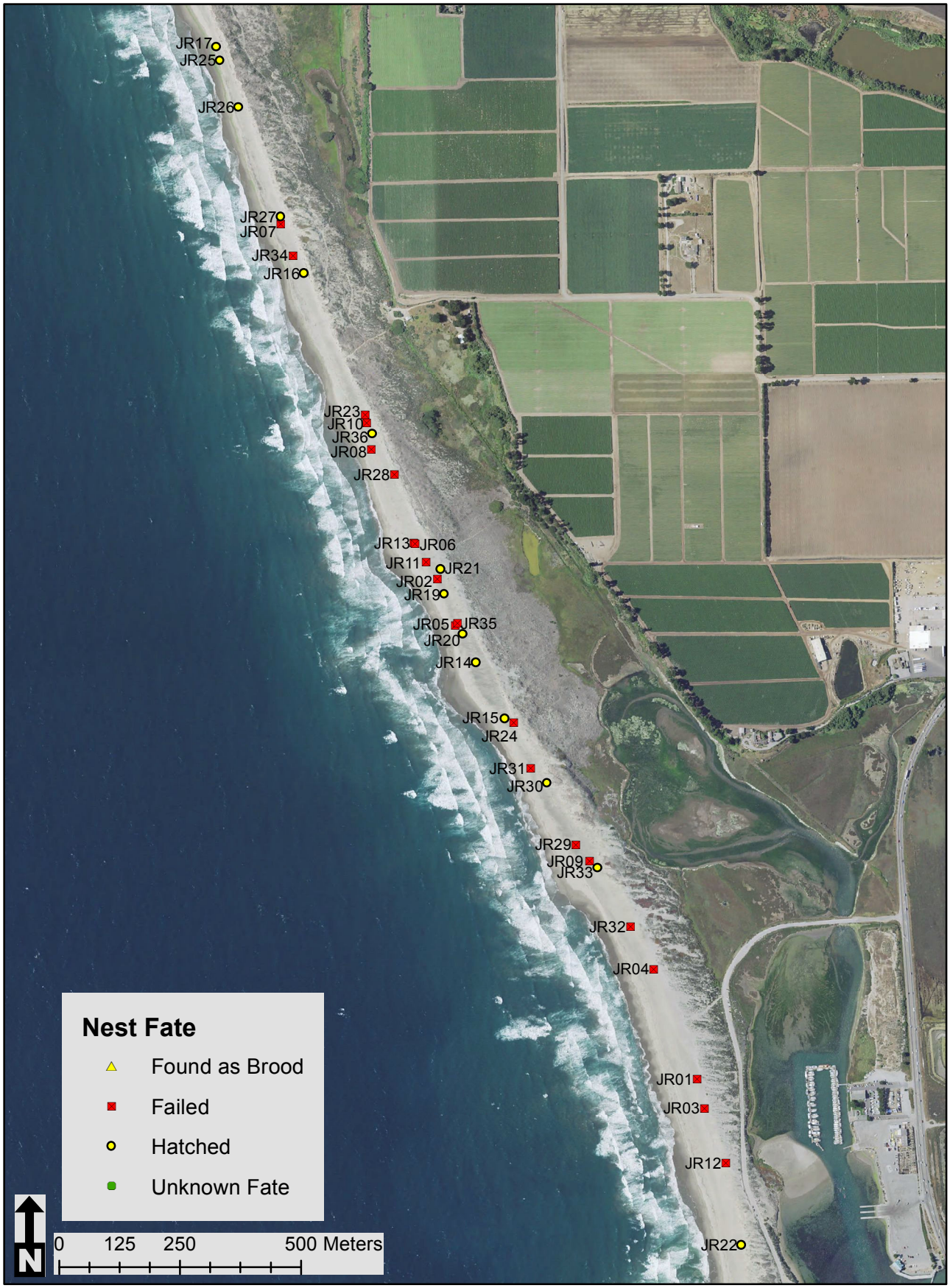
Appendix 1. Overview of Snowy Plover nest locations in the Monterey Bay area in 2015.

Appendix 2. Snowy Plover nest locations at Monterey Bay Academy and at the northern section of Sunset State Beach in 2015.

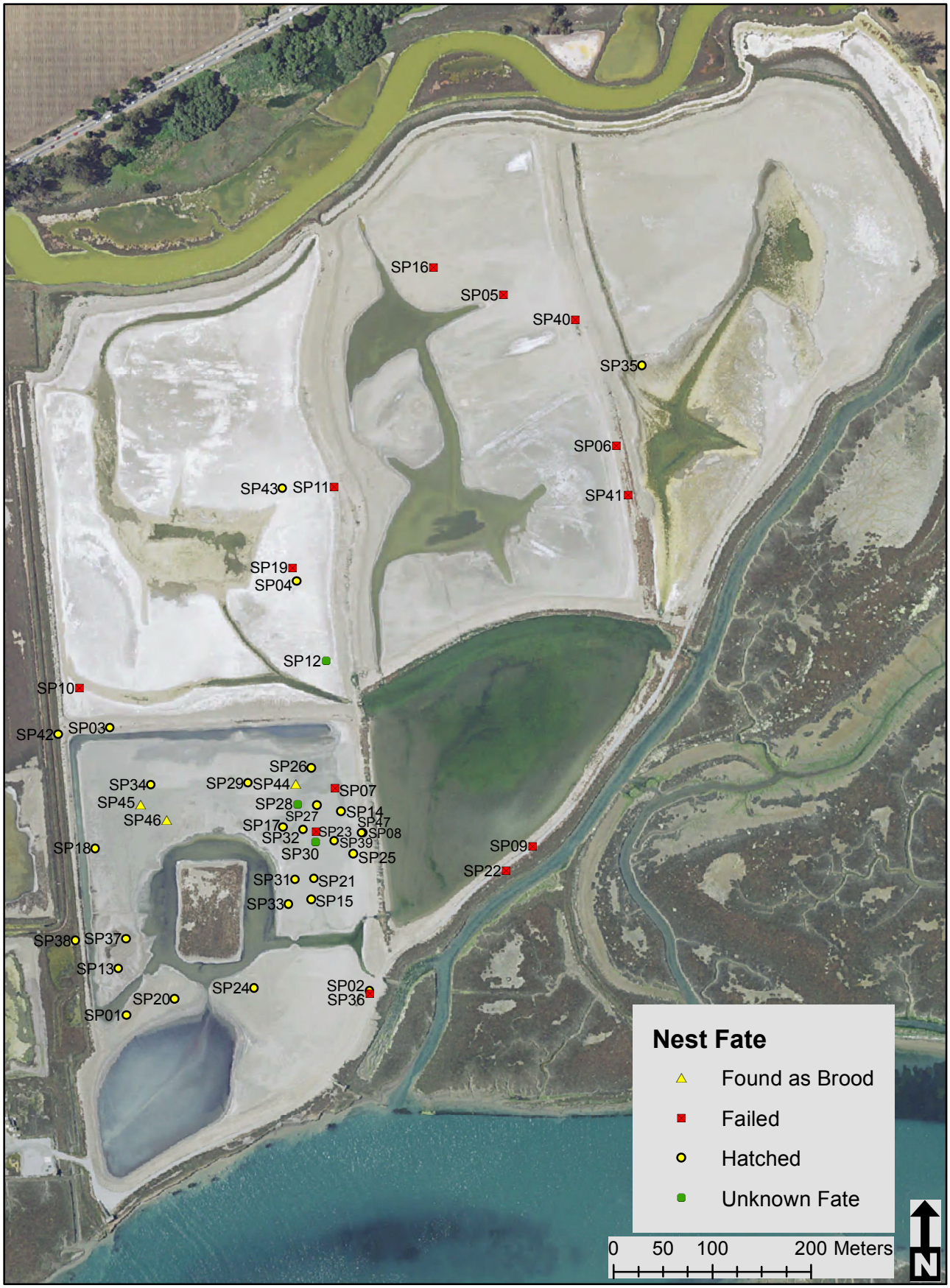
Appendix 3. Snowy Plover nest locations at the Pajaro spit at Sunset and Zmudowski State Beaches in 2015.



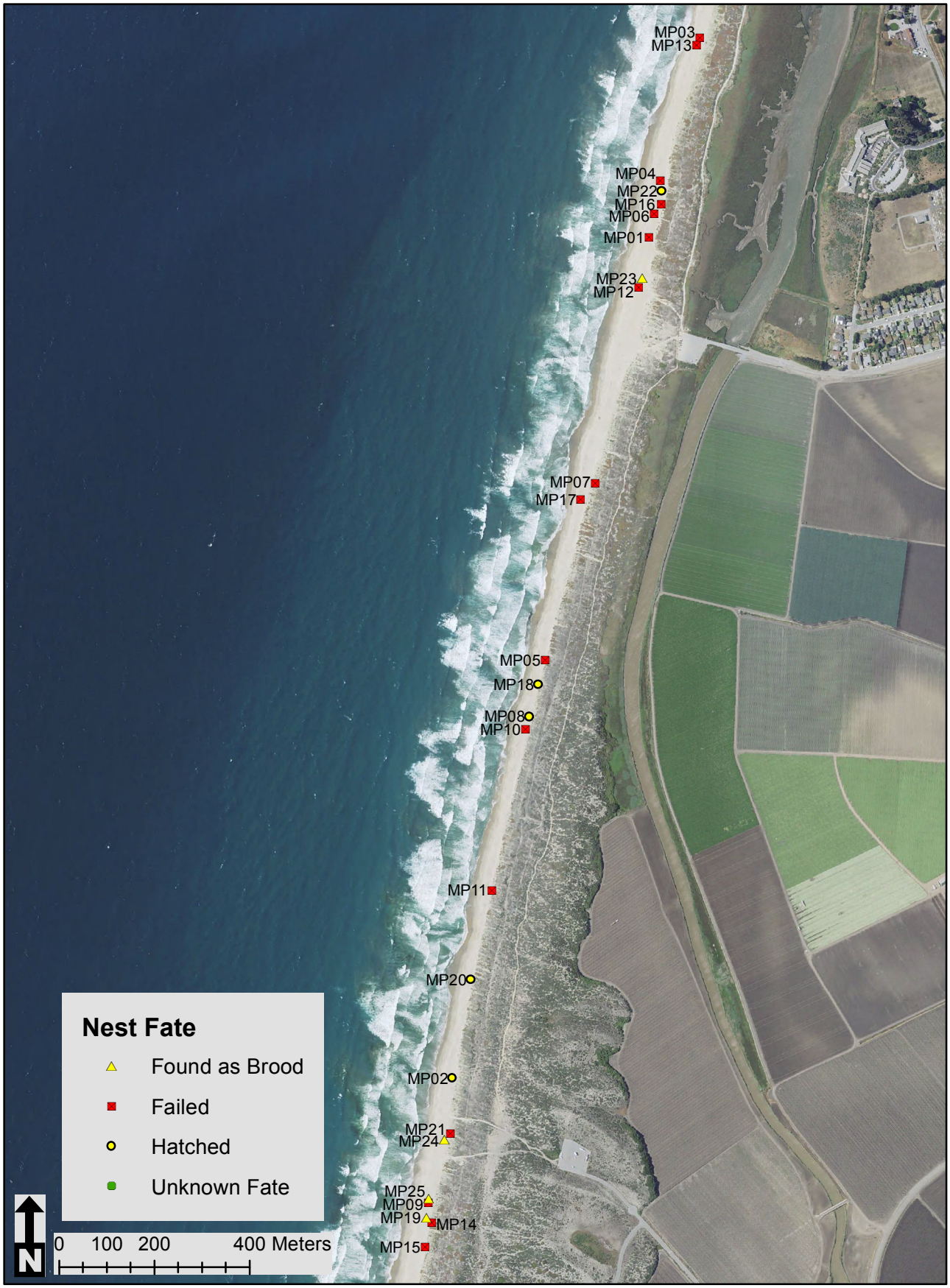
Appendix 4. Snowy Plover nest locations at the central portion of Zmudowski State Beach in 2015.



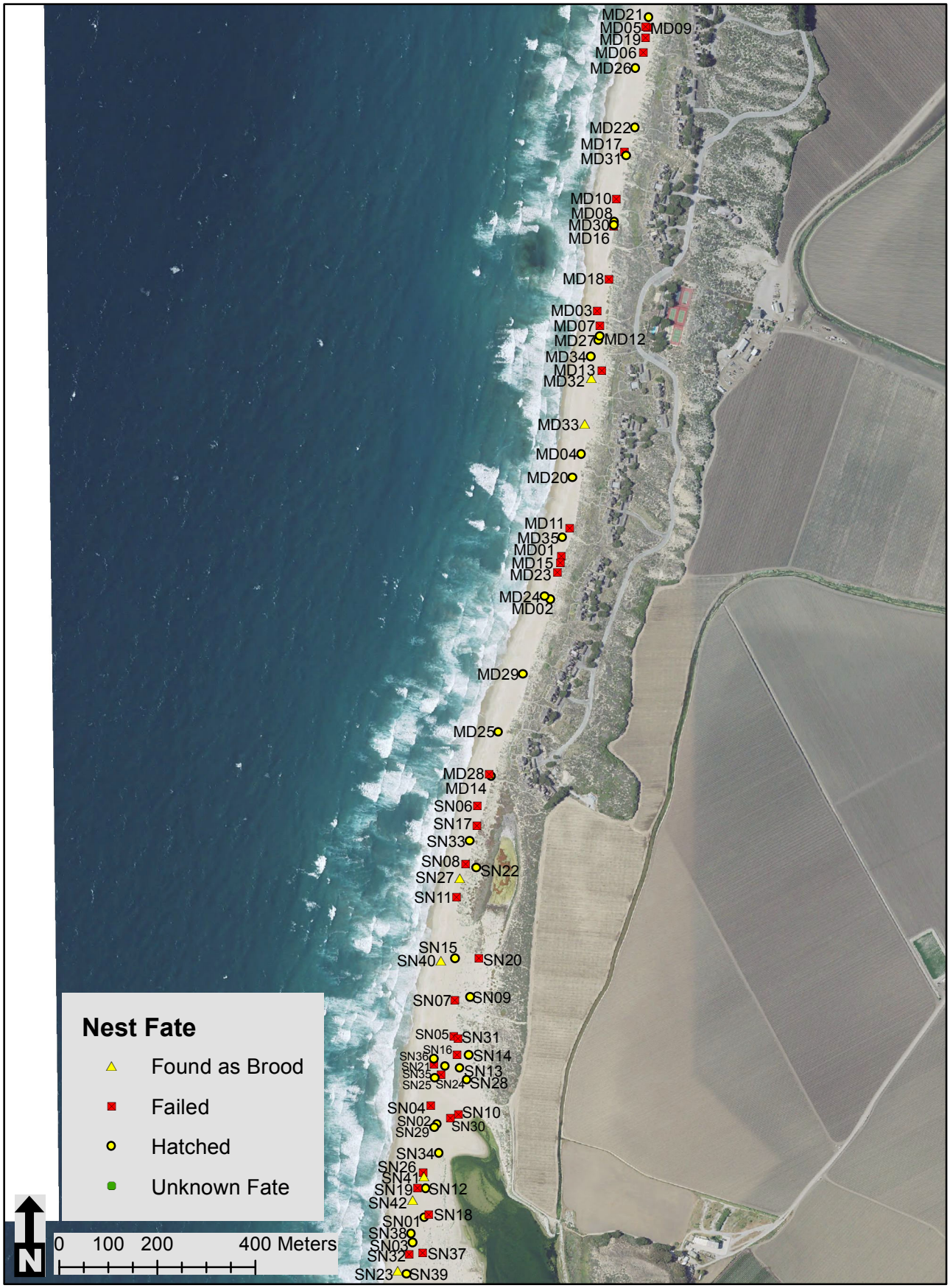
Appendix 5. Snowy Plover nest locations at Jetty Road at Zmudowski and Moss Landing State Beaches in 2015.



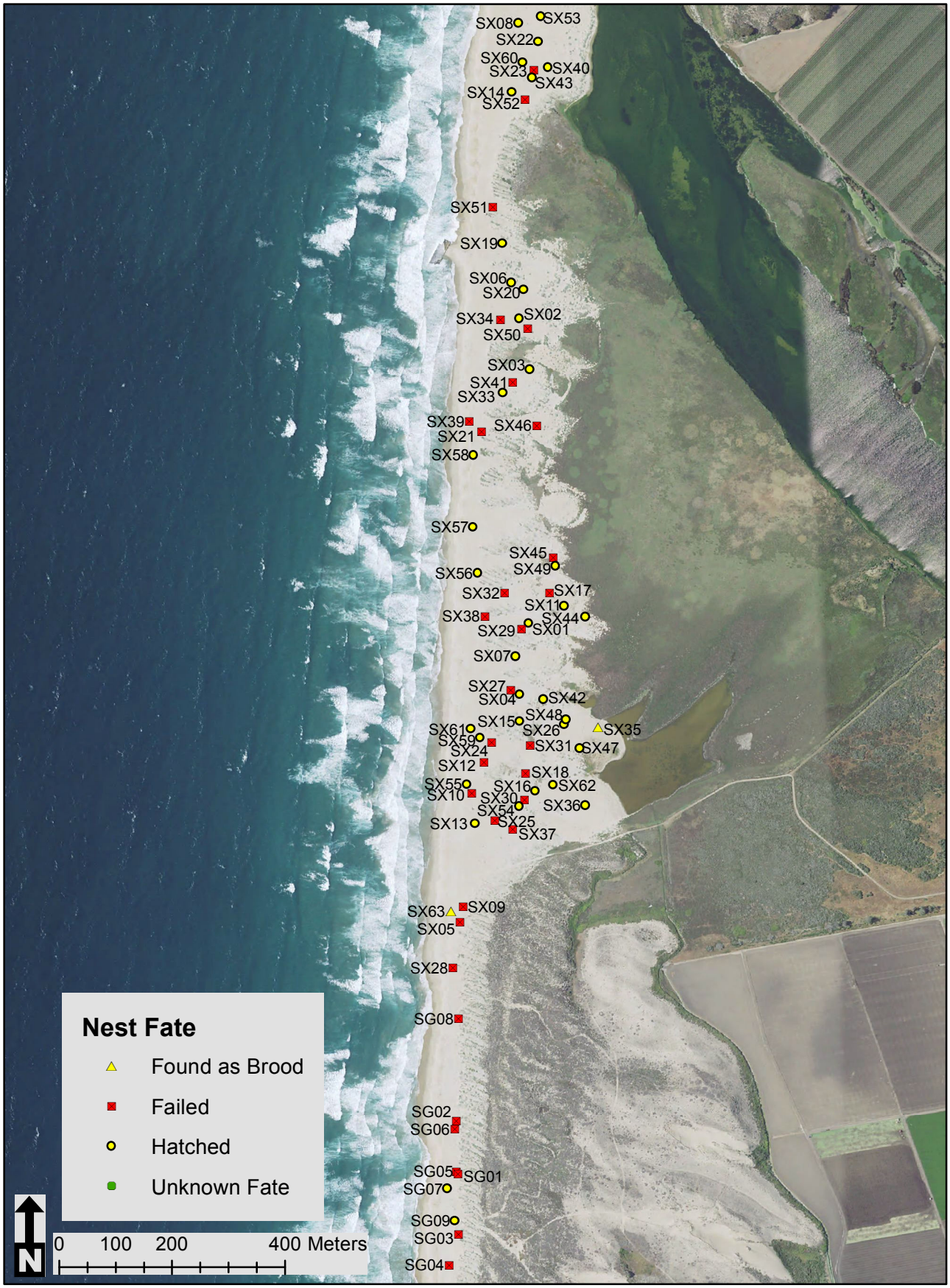
Appendix 6. Snowy Plover nest locations at Moss Landing Wildlife Area in 2015.



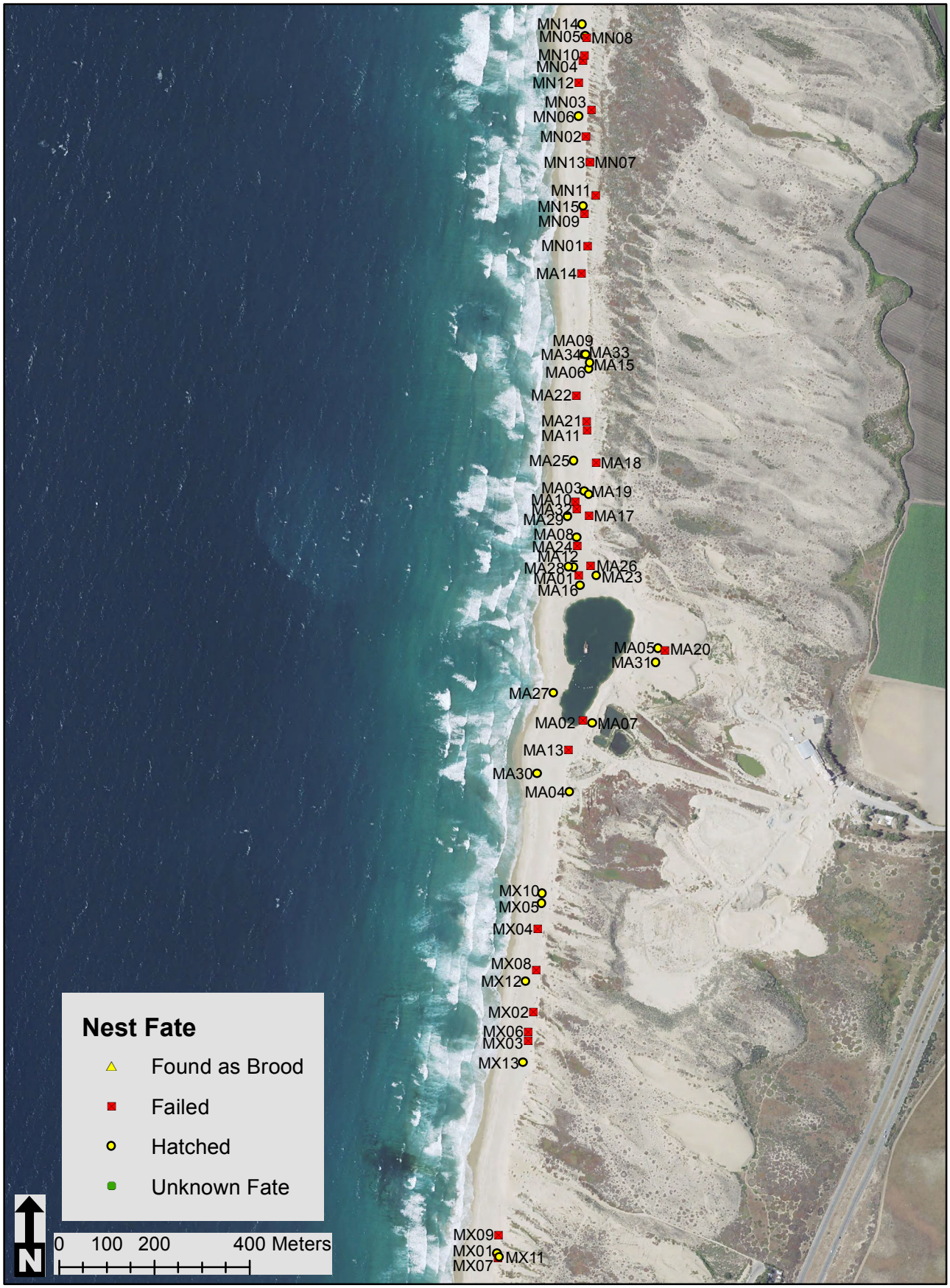
Appendix 7. Snowy Plover nest locations at the northern portion of Salinas River State Beach in 2015.



Appendix 8. Snowy Plover nest locations at the southern portion of Salinas River State Beach in 2015.



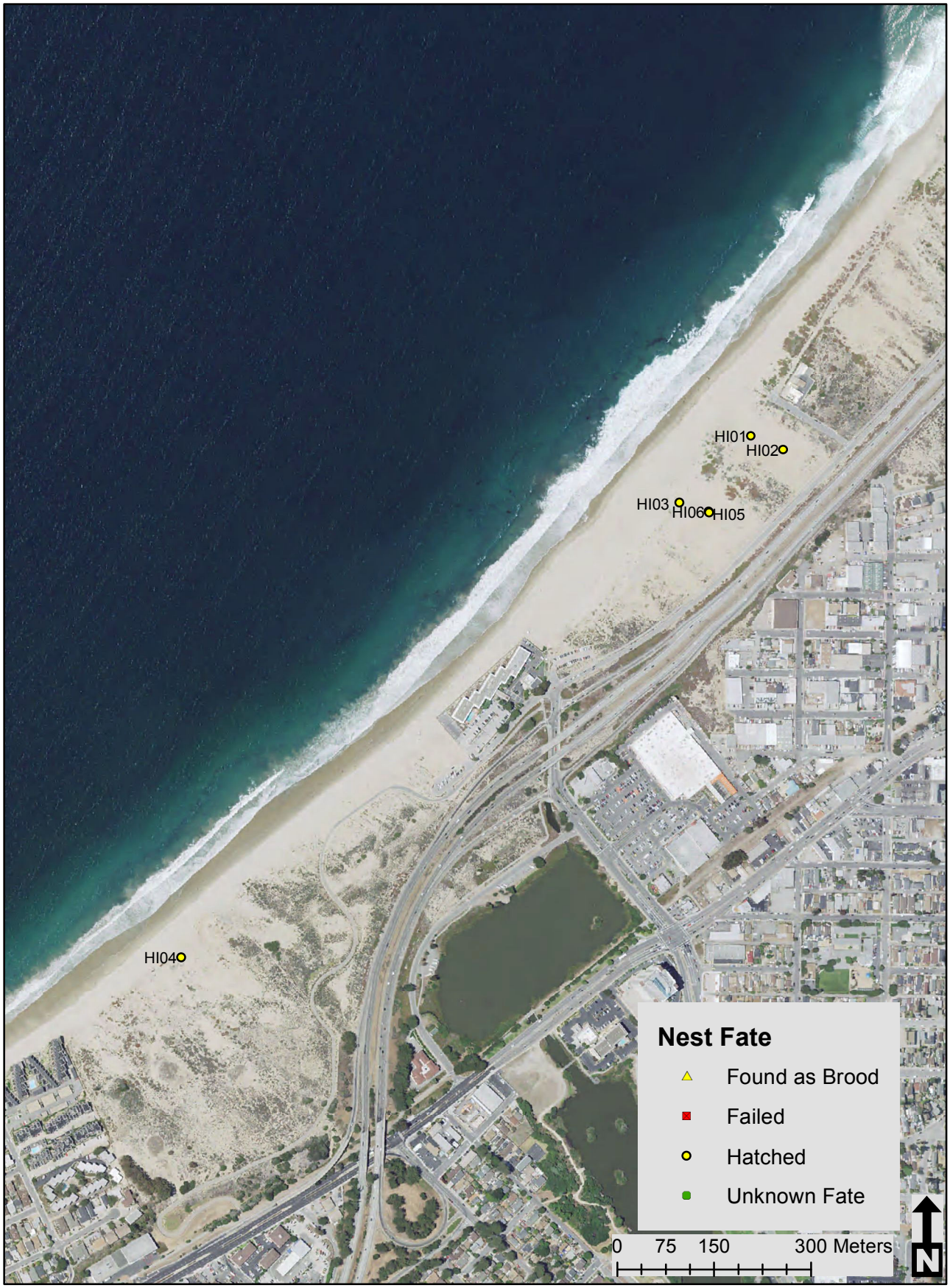
Appendix 9. Snowy Plover nest locations at the Salinas River National Wildlife Refuge and the Martin dunes in 2015.



Appendix 10. Snowy Plover nest locations at Marina beach in 2015.

Appendix 11. Snowy Plover nest locations at Marina State Beach and the northern portion of Fort Ord Dunes State Park in 2015.

Appendix 12. Snowy Plover nest locations at the southern portion of Fort Ord Dunes State Park and Sand City in 2015.



Appendix 13. Snowy Plover nest locations at Monterey State Beach in 2015.

Appendix 14: Number of lost nests coded as Unknown Avian, Unknown Predator and Cause Unknown that can be moved into the "Event Raven" loss category (See Table 3)

Locations	Original Cause moved to CORA event			CORA event total
	Unk. Avian	Unk. Pred.	Cause Unk.	
Del Monte				
Sand City				
Fort Ord				
Reservation Road	6			6
Marina South	2			2
Marina Middle	3	3		6
Marina North	4			4
Martin	1			1
Salinas NWR	1	2		3
N. Salinas River	3			3
Monterey Dunes	9			9
Molera/Potrero	13			13
Moss Landing			2	2
Zmudowski Beach		5	1	6
Pajaro River Spit	1			1
Sunset/Manresa				
Salt Ponds				
Total	**43**	**10**	**3**	**56**