



Western Snowy Plover Breeding Season Surveys for 2003

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Executive Summary

We monitored the Pacific Coast Western Snowy Plover (*Charadrius alexandrinus nivosus*) breeding population on the Don Edwards San Francisco Bay National Wildlife Refuge, the Eden Landing Ecological Reserve, Hayward Area Regional Shoreline, and salt ponds managed by Cargill Salt Division, Inc. We counted numbers of adults, chicks, juveniles, and nests, and assessed predators at each of these locations March - September 2003.

Volunteers and staff performed 442 surveys throughout the south Bay. We had a total of 1222 sightings of SNPL; mean numbers were highest in the Baumberg area followed by Warm Springs and Ravenswood; specific ponds within each of those areas were used by plovers for nesting and foraging. The most densely populated ponds appear to be Baumberg B12, B16B, B6B; Ravenswood RSF2, Warm Springs A22/3, and Hayward OBN-12.

The most numerous potential predators appear to be gulls, followed by corvids, herons, and hawks. Mammalian predators were rarely seen, however nocturnal surveys, during which mammals would be most active, were not conducted. Control of predators may need to be implemented in the future, especially for species that are non-native or that are dramatically increasing in urban areas (i.e. California gulls, corvids, red fox).

Water levels must be controlled to maximize plover nesting and foraging habitat. Exclosures may be needed in the future, to protect nests from egg predators. Specific studies examining nest success and causes of failure need to be conducted, however. In addition, more information on chick fledging success is needed to assess the

importance of predation pressure on population viability. Land management that increases salt pond nesting habitat and limits access by humans and predators is required to increase the number of breeding adults within the region, and to increase the number of successful nests.

Introduction

The Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*) (SNPL) was listed as threatened on 5 March 1993 (USFWS 1993). Declines in snowy plover numbers are attributed to poor reproductive success, largely due to habitat loss and degradation, and human disturbance (USFWS 1998). The south San Francisco Bay is one of the largest of the 20 Pacific coast western snowy plover (SNPL) breeding areas remaining in California. In 1981, an estimated 22.4% of 1566 breeding California SNPLs nested in and around the south San Francisco Bay salt ponds (Page et al. 1981).

The Don Edwards San Francisco Bay National Wildlife Refuge (Refuge), California Department of Fish and Game's Eden Landing Ecological Reserve/Baumberg (CDFG), East Bay Regional Parks District (EBRPD), and Hayward Area Parks and Recreation Department (HARD) own properties known to harbor SNPL breeding and/or foraging populations. Cargill Salt Division, Inc., owns and/or operates properties adjacent to and within study area for salt production purposes. Cargill de-waters various ponds at different times during their operations, incidentally exposing salt pond substrate that is then accessible to nesting SNPLs. All of these entities were involved in the 2003 breeding season surveys.

Snowy plovers are site-specific, often nesting in the exact location year after year (Stenzel et al. 1994). We monitored areas where we found nesting plovers in past years, and in addition, we expanded our monitoring efforts to include additional Refuge,

CDFG, EBRPD, HARD, and Cargill areas where we had seen roosting or feeding SNPLs in previous years or where likely habitat existed.

We present data collected during the 2003 breeding season surveys at all south San Francisco Bay locations. Our goals for the 2003 season included: (1) to identify areas used by nesting, feeding and roosting SNPLs, (2) to estimate the number of breeding pairs, (3) to assess predation pressures on SNPLs, and (4) to provide management guidelines to protect and enhance the local SNPL breeding population.

Study area

The south Bay wildlife areas are surrounded by urban development. The Refuge encompasses over 30,000 acres (12,000 ha) of open bay, tidal marsh, salt ponds, mud flats and associated uplands. The CDFG property is located north of the Refuge's northern boundary. This reserve encompasses approximately 5,426 acres (2,200 ha) of salt ponds and uplands and is managed by CDFG and EBRPD. HARD owns the area due north of Highway 92, of which approximately 200 acres (81 ha) was monitored as part of this effort. This area is managed by HARD and EBRPD (Figure 1). The total study area was approximately 35,625 acres (14,417 ha). We also monitored adjacent Cargill properties that had suitable SNPL habitat for foraging and nesting.

Figure 1. Study area of the south San Francisco Bay SNPL breeding season surveys, 2003.

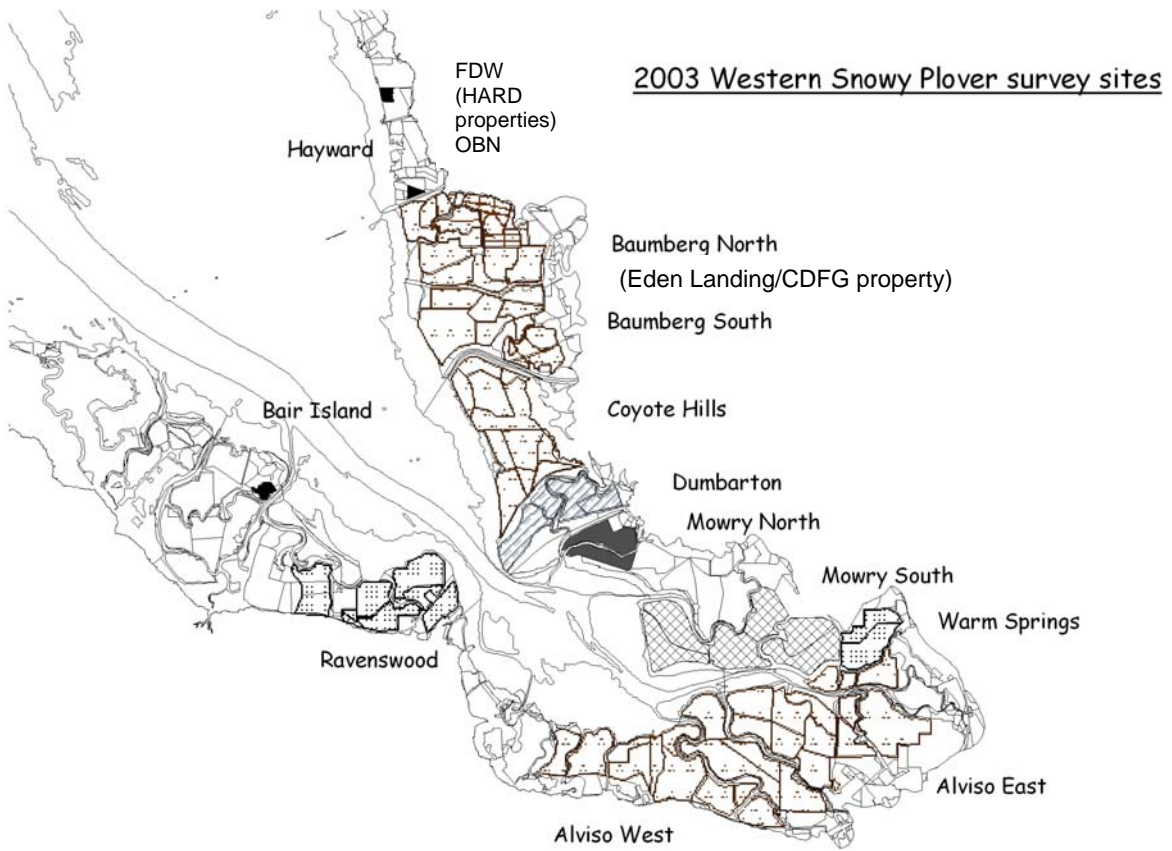


Table 1. Locations of all 2003 breeding season surveys in the south San Francisco Bay.

Area	Land Manager	Locations/ Ponds
Hayward	HARD/EBRPD	Franks Pond West
		Oliver North Pond
Baumberg North	CDFG/EBRPD	B10, B11, B14B, B15B, B16B, CALTRANS POND
		B9, B12-14
		B6A, B6B, B8, B8A
		Chrystallizers
Baumberg South	CDFG/EBRPD	B1, B2, B4-B7
		B1C-B6C
Coyote Hills	REFUGE	Patterson 1&2
		N1A-N4A
		N4-N9, Redrock Road, Bay Trail
		Edge of North Highway 84
Dumbarton	REFUGE	Crescent Pond
		N2/N3
		N1/PP1/ Hickory
Mowry North	REFUGE	N12, N13 pickle ponds
Mowry South	REFUGE	M1-M6
Warm Springs	REFUGE	A22:1-4
		A23
Alviso Ponds (east)	REFUGE	A19-A21
		A16-A18
		A9-A15
		A5-A8
Alviso Ponds (west)	REFUGE	A3N, A3W, A4
		B1, A2E, B2
		A1, A2W
Ravenswood Ponds	REFUGE	R1, R2, SF2
		R3-R5, S5
Bair Island	REFUGE	Inner
		Middle
		Outer

Methods

Population monitoring

We monitored all sites according to the Refuge SNPL protocol (Marriott and Schelin 2001). We drove or walked along the roads and levees of the study site, scanning for plovers with binoculars and a spotting scope. We counted and mapped all males, females, unknown adults, juveniles, and chicks seen. (Chicks are incapable of flight, while juveniles are able to fly. Juveniles have pale feather edges on the back and wing coverts.) Upon spotting an adult SNPL, we stopped the vehicle and observed the plover to determine if it was incubating a nest. We watched the bird until it had returned to its nest or until ten minutes had passed after which we concluded that the plover was not incubating a nest. When we did see a SNPL return to its nest, we mapped the nest location and assigned a number to each new nest that we were able to access in order to track its progress. For nests that were inaccessible, we mapped and recorded a “possible nest” when adults appeared to incubating. We recorded time, pond, number of eggs/chicks in the nest (if known), whether or not the adult was present, and if there were predators in the area. We noted color combinations of banded SNPLs whenever they were observed. We did not return to ponds without SNPL habitat and no sightings of plovers on the first one or two surveys (for example, the many of the western Alviso ponds).

The south bay region was divided into 12 areas (Table 1) that were further subdivided into locations or pond numbers. All areas surveyed were named by the salt pond number where they were located. If SNPLs were located on a levee, then the salt ponds on either side of the levee were used (for example A9/A10) to indicate the levee

on which the bird was observed (Table 1).

Predator surveys

We conducted predator surveys during the same time period in which we surveyed for SNPL in order to estimate potential predator pressure on adults, eggs and chicks. We scanned salt ponds, slough channels, PG&E towers, and surrounding areas along the route. We counted all predators using binoculars and a spotting scope, driving or walking slowly, stopping approximately every ¼ miles. Predator group size, locality, behavior and direction of travel (if in transit), and landscape feature used by predators were noted for every stopping point where predators were observed. Predators seen between ¼ mile survey points were also noted. Ponds with a higher number of SNPLs were surveyed more often than ponds without SNPLs.

Data Analysis

For the purposes of data analysis, a survey was defined as a complete survey of a single pond. Where areas were divided into many small ponds, each pond was still considered a separate survey. Where large ponds took multiple visits over more than one day to complete a survey, the separate survey days were lumped, and considered as a single survey. Snowy Plover sightings were the total number of adults, unknowns, juveniles, and chicks observed at all locations over the total survey period. Because survey effort was not equal at all ponds, we calculated and graphed mean numbers of plovers detected by area in order to control for effort. Maximum number of plovers observed at each pond was estimated using the highest number of individuals counted

during any complete survey over the entire monitoring season. Total numbers of predators were calculated per area, as most predators have a much larger territory than a single pond.

Results

Breeding population

We performed 442 surveys during the 2003 breeding season, and recorded 1222 SNPL sightings. The highest mean numbers of SNPLs were detected in the Baumberg region, followed by Warm Springs and Ravenswood (Figure 2). Within each area, SNPLs were generally located at specific ponds. The most densely populated ponds within Baumberg were B12, B16B, and B6B; within Hayward OBN-1, OBN-12, and OBN-13; within Ravenswood RSF2, Ravenswood Slough channel, and R2; within Warm Springs A22/3 and A22/4 (Figure 2). While Dumbarton N2/N3, Alviso A8, and Ravenswood R1 and R2 had few or no chicks, there were adults present on these ponds (Appendix 1).

The highest numbers of chicks were also detected in Baumberg and Warm Springs, indicating that these sites are the primary areas for nesting SNPLs (Figure 4). Nests were positively identified in five areas. Due to the viewing distances involved, it was often difficult to determine if an adult was sitting on a nest. Most nests in Baumberg pond B6B, and Ravenswood pond RSF2 were not accessible due to water-filled canals that were a feature of those ponds. The numbers below are conservative estimates of nests in each area. A question mark indicates that nesting potentially occurred (Table 2).

Figure 2. Mean numbers of SNPL adults, juveniles, and chicks counted during 2003 breeding season surveys within each area.

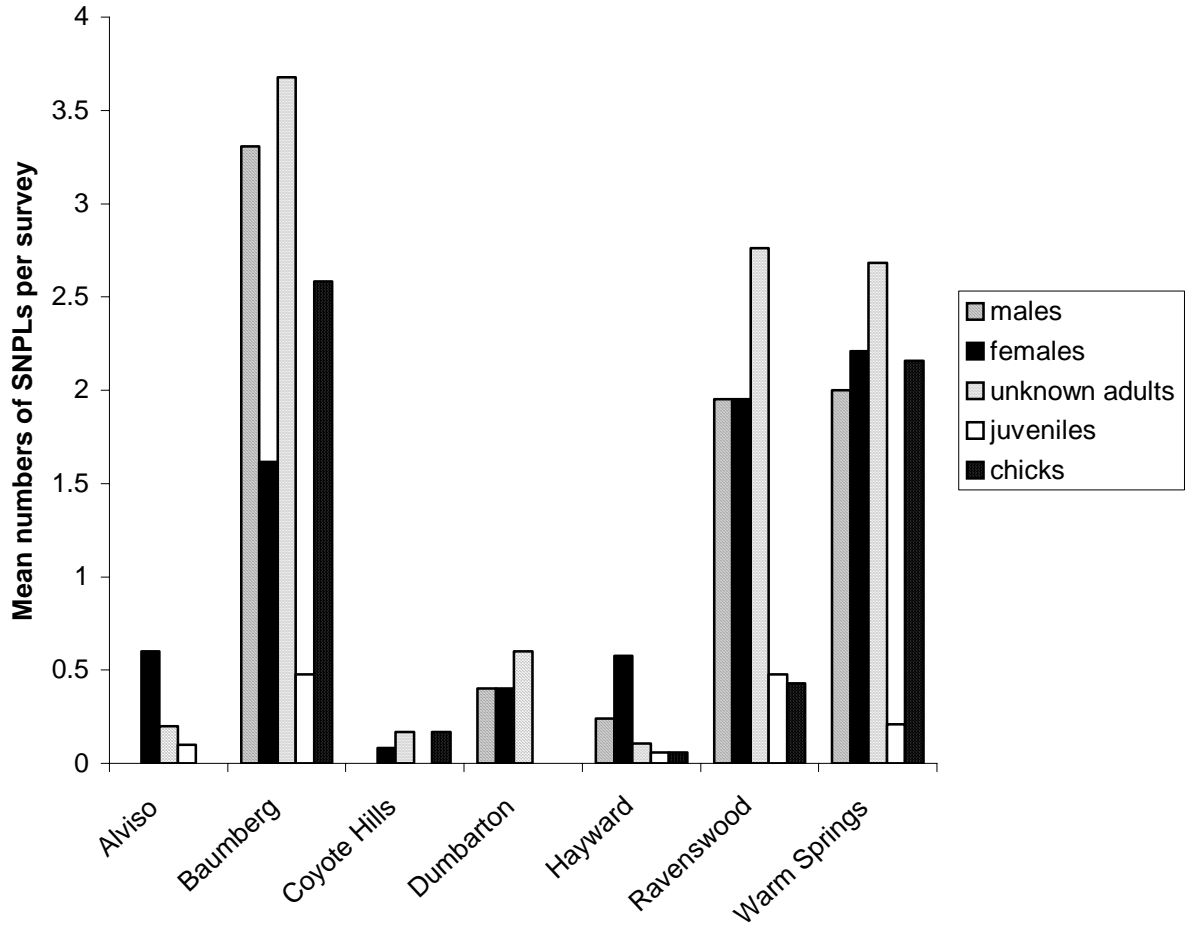


Figure 3. Maximum numbers of SNPL adults counted in any complete survey during the 2003 breeding season. Ponds with a single SNPL observation were deleted from the graph (see Appendix 1).

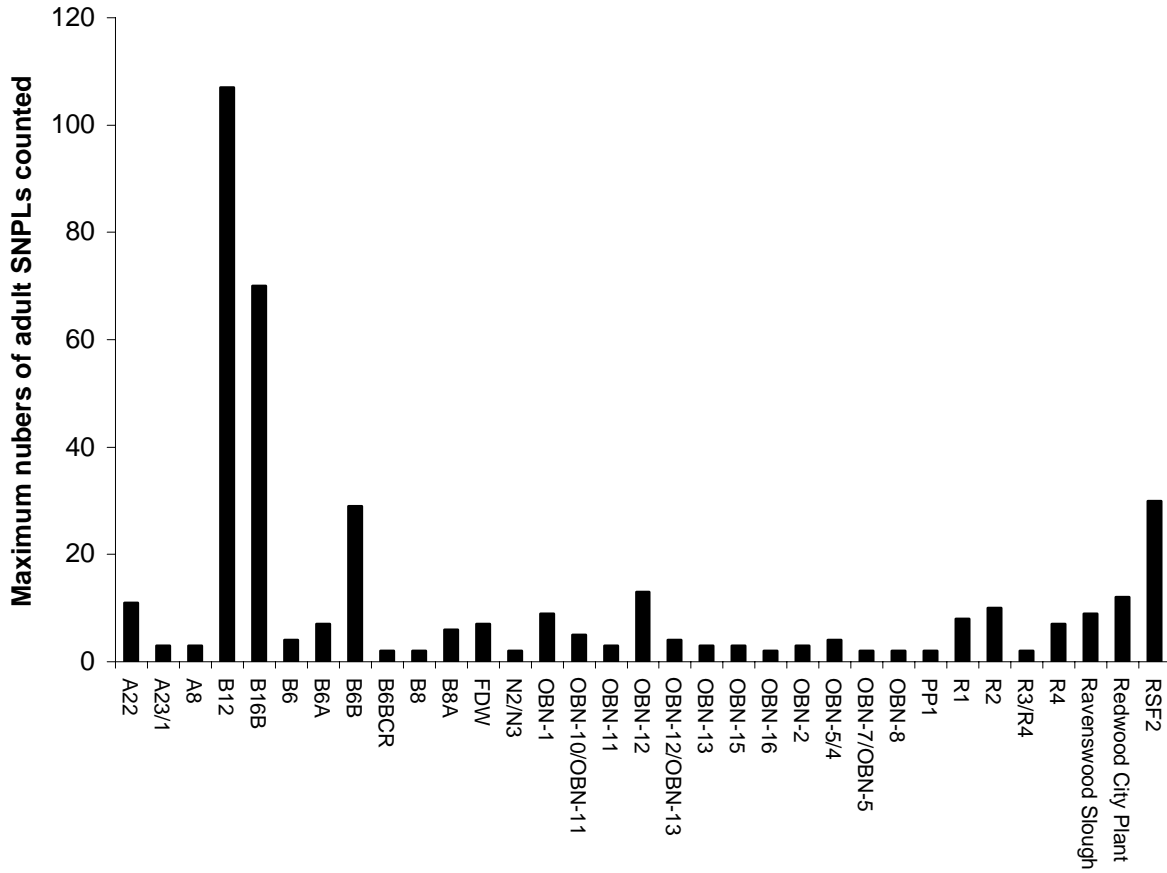


Figure 4. Maximum numbers of SNPL juveniles plus chicks counted in any complete survey during the 2003 breeding season. Areas with a single SNPL observation were deleted from the graph (see Appendix 1).

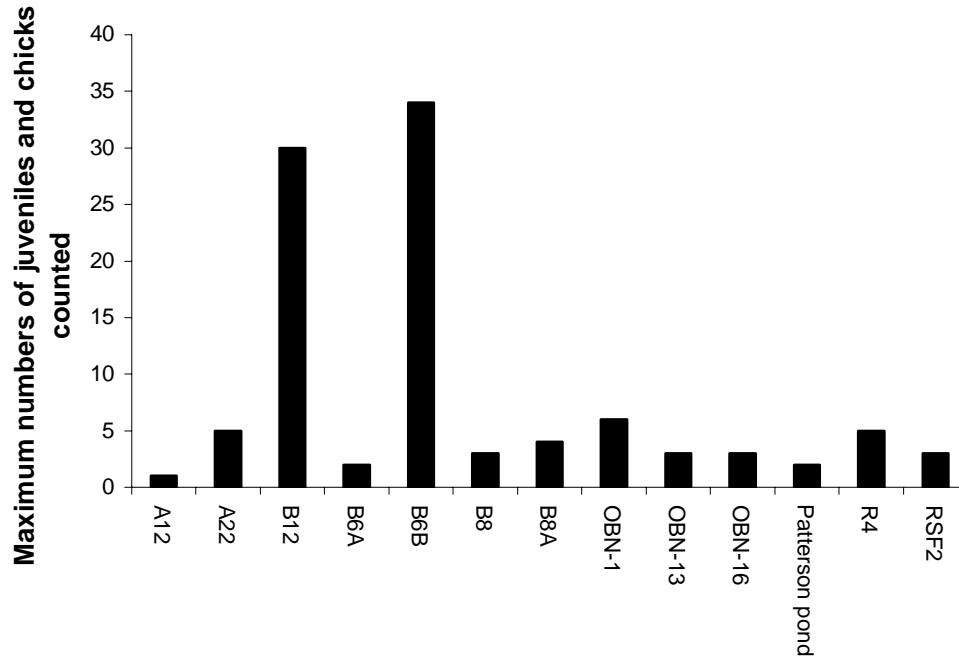


Table 2. Areas and ponds of known SNPL nests, 2003. Due to difficulties in observation and limited numbers of surveys, nest numbers are conservative.

Location	Pond number	Number of nests
Baumberg	B12	2
	B6	?
	B6A	?
	B6B	2
Dumbarton	N2/N3	?
Hayward	OBN-1	5
	OBN-12	?
	OBN-13	1
	OBN-5/4	?
	OBN-9	1
Ravenswood	R2	2
	RSF2	?
Warm Springs	A22/3	?
	A22/4	2
	A23/1	?

Avian predator surveys

The most common predators detected in all areas were gulls; including unidentified gulls, California gulls (*Larus californicus*), and western gulls (*L. occidentalis*) (Figure 5, Table 3). The highest numbers of gulls were recorded in areas with large California gull colonies (Alviso, Warm Springs, and Mowry, SFBBO unpub. data). Ring-billed gulls (*L. delawarensis*) were also detected, primarily in Hayward. Common ravens (*Corvus corax*), great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), American crows (*C. brachyrhynchos*), and black-crowned night herons (*Nycticorax nycticorax*) were the next most common species. Red-tailed hawks (*Buteo jamaicensis*) and northern harriers (*Circus cyaneus*) were the most common raptors.

Mammalian predators included red fox (*Vulpes vulpes*), grey fox (*Urocyon cinereoargenteus*), and feral cat (*Felis catus*).

Figure 5. Mean numbers of gulls by location counted during SNPL predator surveys, 2003.

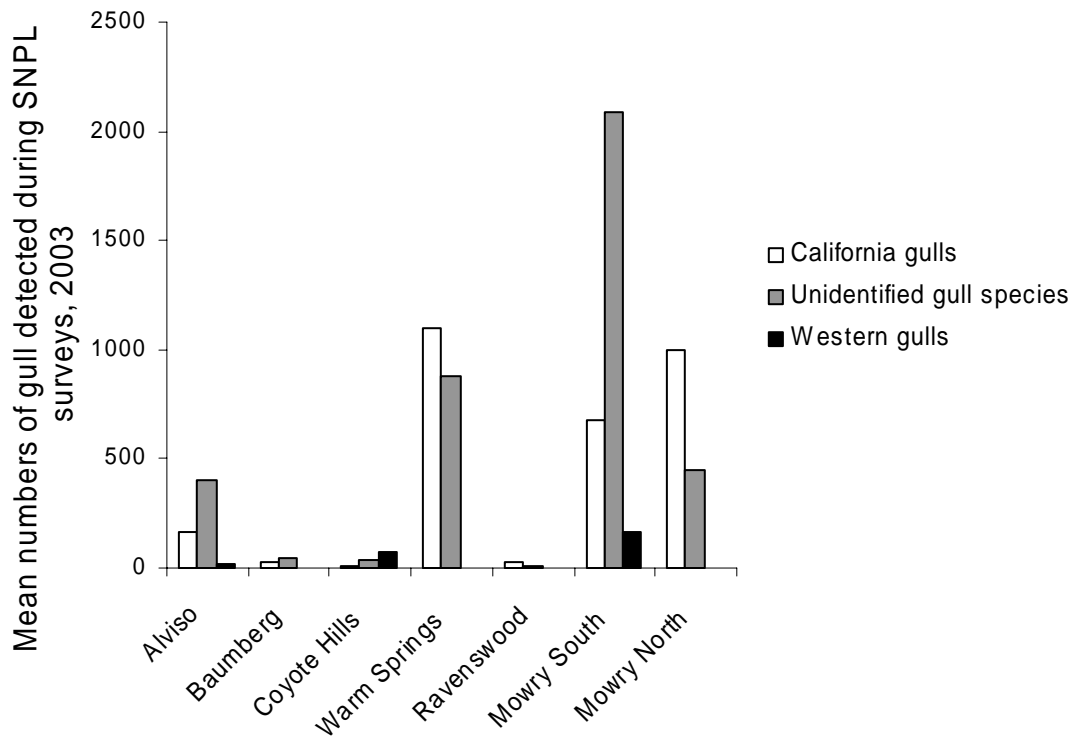


Table 3. Mean numbers of predators detected during SNPL surveys, 2003.

Predator Species	Alviso	Baumberg	Coyote Hills	Warm Springs	Ravenswood	Mowry South	Mowry North	Hayward	Dumbarton	Sum
Unidentified gull	400.00	43.93	32.80	881.00	7.57	2086.67	450.00	2.30	2.20	3906.47
California gull	161.70	28.73	8.50	1101.60	30.00	679.70	1000.00	1.00		3011.23
Western gull	21.17	2.00	69.00			162.50				254.67
Ring-billed gull	9.00		1.00		1.00	1.00		22.00		34.00
Common raven	2.12	1.80	2.00	3.69	2.00	3.25	2.00	1.50	1.12	19.48
Great egret	6.16	1.33	3.57	1.00	2.50	1.50	1.00	1.00	1.33	19.39
Snowy Egret	5.03		4.71			3.25				12.99
American crow	2.00	2.00		4.00	2.67			1.00		11.67
Black-crowned night heron	3.74	2.20				1.60		1.00	1.50	10.04
Great blue heron	1.61		1.00	1.50	1.40	1.20	1.00	1.00	1.00	9.71
Red-tailed hawk	1.33	1.25	1.00	1.12	1.20	1.00	1.45		1.17	9.52
Northern harrier	1.00	1.20	1.00	1.23	1.00	1.00	0.50	1.00	0.50	8.43
White-tailed kite	1.00	1.00	1.00	1.20					2.00	6.20
Unidentified hawk	1.00		1.00	1.00			3.00			6.00
American white pelican			4.00							4.00
Burrowing owl	1.00	2.50								3.50
Bonaparte's gull	2.00							1.00		3.00
Peregrine falcon	1.00	1.00			1.00					3.00
American kestrel	1.20			1.00						2.20
Golden eagle	1.00									1.00
Glaucous-winged gull	1.00									1.00
Little blue heron	1.00									1.00
Feral cat	1.00									1.00
Grey Fox	1.00						1.00			2.00
Red fox								1.00		1.00
Total	627.06	88.94	130.58	1998.34	50.34	2942.67	1459.95	33.80	10.82	7342.50

Discussion

Results from the 2003 breeding season confirm some important breeding areas for SNPLs: Baumberg, Hayward, and Warm Springs, and adds Ravenswood as a potentially important site. The numbers of adults in the Dumbarton N2/N3 ponds, Alviso pond A8 and Ravenswood R1 and R2 ponds indicate that they are important foraging

grounds.

Due to staff limitations, we were unable to quantify reproductive success or predation pressure. Surveys once or twice a week in large areas were insufficient to track individual nests. In addition, distances from observation areas (levees) and physical barriers such as long canals throughout the ponds limited our ability to access and pinpoint exact nest locations. In the future, more observers will need to spend more time in Baumberg, Ravenswood, and Warm Springs especially, to determine reproductive success.

Predation pressure may be correlated with nest density (Jones et al. *in press*). Management to enhance nesting habitat in one area may therefore increase predation as well as SNPL nest numbers. In this scenario, efforts to increase SNPL population numbers would need to include more predator management than is currently used. It would also be important to provide more habitat area, distributed among many locations in the south bay in order to spread out nesting plovers.

Foraging areas outside of the known nesting locations include Alviso, Dumbarton, and Ravenswood. These areas could potentially be enhanced to provide nesting habitat, provided that predator and human management exists in these areas. In addition to A8 within the Alviso location, the area near the Alvisio Marina Park is also known to harbor many foraging plovers outside of the breeding season (M. Mammoser, pers. comm.). More attention is necessary in foraging areas outside of the breeding season in order to ascertain the health of the overall Bay SNPL population.

Management recommendations

Nests found on active salt ponds or levees should be reported to the property manager immediately to avoid flooding or running over nests. Ideally water levels can be managed to minimize mammalian predation on nests and maintain brine fly production for foraging plovers.

Because exclosures can attract new predators and trap adult plovers (G. Page pers. comm.), their use must be justified by knowing the types of predators taking SNPL nests, and the predation pressure in each location. This will require more surveyors in areas of high nest concentrations.

A rotation of drying out different salt ponds in alternate years may help to spread out the plover nesting population and therefore not allow predators to cue into specific areas. This management regime may also accommodate a program of vegetation management and/or removal in marginal SNPL habitats.

Monitors, biologists and land managers should have at least one annual pre-breeding season meeting to agree on specific protocol for communication and to share information about water management and SNPL monitoring plans.

Current fencing and regulatory signs were not enough to keep people and their domestic animals out of SNPL nesting areas. Vehicular disturbance to plovers was especially bad in the Warm Springs area where off-road vehicles drove into plover nesting habitat. Due to lack of resources, management of recreational disturbance was not sufficient at the CDFG property where human and domestic animal trespassing was high. Barriers around nesting areas and increased law enforcement are needed to

protect snowy plover nesting areas.

Acknowledgments

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Appendix 1: Summary of SNPL observations by pond.

Locations and pond numbers of all SNPL sightings during 2003 breeding season surveys. Ponds without SNPL sightings were deleted from the table.

Location	Pond	Stats	Males	Females	Unknown adults	Juveniles	Chicks	Total	Number of surveys
Alviso	A12	Mean	0.00	0.00	0.00	0.25	0.00		4
		Sum	0.00	0.00	0.00	1.00	0.00	1.00	
	A8	Mean	0.00	0.75	0.33	0.00	0.00		6
		Sum	0.00	6.00	2.00	0.00	0.00	8.00	
Baumberg	B12	Mean	3.00	1.80	11.60	1.30	4.10		10
		Sum	30.00	18.00	116.00	13.00	41.00	218.00	
	B13B	Mean	1.00	0.00	0.00	0.00	0.00		5
		Sum	1.00	0.00	0.00	0.00	0.00	1.00	
	B16B	Mean	4.00	1.82	4.91	0.00	0.00		11
		Sum	44.00	20.00	54.00	0.00	0.00	118.00	
	B6	Mean	2.00	1.00	1.00	0.00	0.00		1
		Sum	2.00	1.00	1.00	0.00	0.00	4.00	
	B6A	Mean	1.40	0.40	1.80	0.00	1.40		5
		Sum	7.00	2.00	9.00	0.00	7.00	25.00	
	B6B	Mean	8.77	4.54	4.46	0.92	8.08		14
		Sum	114.00	59.00	58.00	12.00	105.00	371.00	
	B6B crystallizers	Mean	1.00	1.00	0.00	0.00	0.00		1
		Sum	1.00	1.00	0.00	0.00	0.00	2.00	
	B8	Mean	1.00	0.33	0.00	0.67	0.33		3
		Sum	3.00	1.00	0.00	2.00	1.00	7.00	
	B8A	Mean	1.67	0.67	0.00	1.33	0.00		3
		Sum	5.00	2.00	0.00	4.00	0.00	11.00	
	B4B	Mean	0.00	0.00	1.00	0.00	0.00		1
		Sum	0.00	0.00	1.00	0.00	0.00	1.00	
Coyote Hills	N9	Mean	0.00	0.17	0.00	0.00	0.00		6
		Sum	0.00	1.00	0.00	0.00	0.00	1.00	
	Patterson	Mean	0.00	0.00	0.20	0.00	0.40		5
		Sum	0.00	0.00	1.00	0.00	2.00	3.00	
	N4	Mean	0.00	0.00	1.00	0.00	0.00		1
		Sum	0.00	0.00	1.00	0.00	0.00	1.00	
Dumbarton	N2/N3	Mean	0.50	0.50	0.50	0.00	0.00		2
		Sum	1.00	1.00	1.00	0.00	0.00	3.00	
	PP1	Mean	0.33	0.33	0.67	0.00	0.00		3
		Sum	1.00	1.00	2.00	0.00	0.00	4.00	
Hayward	FDW	Mean	0.00	2.00	0.00	0.00	0.00		4
		Sum	0.00	8.00	0.00	0.00	0.00	8.00	
	OBN-1	Mean	0.86	2.57	0.14	0.86	0.00		7
		Sum	6.00	18.00	1.00	6.00	0.00	31.00	
	OBN-10	Mean	0.00	0.10	0.00	0.00	0.00		10
		Sum	0.00	1.00	0.00	0.00	0.00	1.00	
OBN-10/OBN-11	Mean	2.00	3.00	0.00	0.00	0.00		1	

Location	Pond	Stats	Males	Females	Unknown adults	Juveniles	Chicks	Total	Number of surveys
		Sum	2.00	3.00	0.00	0.00	0.00	5.00	
	OBN-11	Mean	0.00	0.30	0.00	0.00	0.00		10
		Sum	0.00	3.00	0.00	0.00	0.00	3.00	
	OBN-12	Mean	0.67	1.56	0.56	0.00	0.00		9
		Sum	6.00	14.00	5.00	0.00	0.00	25.00	
	OBN-12/OBN-13	Mean	0.50	2.00	0.00	0.00	0.00		2
		Sum	1.00	4.00	0.00	0.00	0.00	5.00	
	OBN-13	Mean	0.20	0.30	0.10	0.00	0.30		10
		Sum	2.00	3.00	1.00	0.00	3.00	9.00	
	OBN-15	Mean	0.10	0.20	0.00	0.00	0.00		10
		Sum	1.00	2.00	0.00	0.00	0.00	3.00	
	OBN-16	Mean	0.20	0.00	0.00	0.00	0.30		10
		Sum	2.00	0.00	0.00	0.00	3.00	5.00	
	OBN-2	Mean	0.10	0.10	0.10	0.00	0.00		10
		Sum	1.00	1.00	1.00	0.00	0.00	3.00	
	OBN-5/4	Mean	2.00	1.00	1.00	0.00	0.00		1
		Sum	2.00	1.00	1.00	0.00	0.00	4.00	
	OBN-7/OBN-5	Mean	0.00	0.00	2.00	0.00	0.00		1
		Sum	0.00	0.00	2.00	0.00	0.00	2.00	
	OBN-8	Mean	0.22	0.00	0.00	0.00	0.00		9
		Sum	2.00	0.00	0.00	0.00	0.00	2.00	
	OBN-9	Mean	0.00	0.20	0.00	0.00	0.00		10
		Sum	0.00	2.00	0.00	0.00	0.00	2.00	
Ravenswood	R1	Mean	1.00	1.00	1.25	0.00	0.00		4
		Sum	4.00	4.00	5.00	0.00	0.00	13.00	
	R2	Mean	1.00	0.80	2.80	0.00	0.00		5
		Sum	5.00	4.00	14.00	0.00	0.00	23.00	
	R3/R4	Mean	1.00	1.00	0.00	0.00	0.00		1
		Sum	1.00	1.00	0.00	0.00	0.00	2.00	
	R4	Mean	2.33	1.00	0.00	1.67	0.00		3
		Sum	7.00	3.00	0.00	5.00	0.00	15.00	
	RSF2	Mean	3.00	3.63	4.88	0.63	1.13		8
		Sum	24.00	29.00	39.00	5.00	9.00	106.00	
Warm Springs	A22	Mean	2.40	2.60	3.33	0.27	2.73		15
		Sum	36.00	39.00	50.00	4.00	41.00	170.00	
	A23	Mean	0.50	0.75	0.25	0.00	0.00		4
		Sum	2.00	3.00	1.00	0.00	0.00	6.00	
1222.00									

Appendix 2: Weekly Cargill pond salinity readings (ppt).

location	pond number	28-Feb-03	07-Mar-03	14-Mar-03	21-Mar-03	28-Mar-03	04-Apr-03	11-Apr-03
Alviso	A1	24.1	n/a	23.1	25.1	24.1	25.1	28.1
	A2	33.1	n/a	34.1	34.1	37.2	37.2	37.2
	A3W	35.2	n/a	35.1	37.2	37.2	37.2	38.2
	B1	24.1	n/a	25.1	25.1	25.1	24.1	27.1
	B2	26.1	n/a	24.1	25.1	33.1	25.1	25.1
	A3N	33.1	n/a	32.1	34.1	34.1	34.1	35.2
	A5	52.4	n/a	53.4	54.4	56.5	51.4	47.3
	A7	53.4	n/a	54.4	55.4	57.5	53.4	63.7
	A8	73.0	n/a	74.0	72.0	76.0	74.0	74.0
	A9	n/a	32.1	27.1	32.1	32.1	n/a	33.1
	A10	n/a	36.2	33.1	35.1	36.2	n/a	35.2
	A11	n/a	76.0	69.8	72.0	75.0	n/a	73.0
	A12	n/a	67.8	70.8	73.0	75.0	n/a	75.1
	A13	n/a	74.0	75.0	n/a	77.2	n/a	79.3
	A14	n/a	81.5	81.5	n/a	85.5	n/a	83.5
	A15	n/a	83.5	84.5	83.5	85.5	n/a	83.5
	A16	n/a	99.3	99.3	97.0	100.3	n/a	96.1
	A17	n/a	100.3	100.3	99.3	101.3	n/a	99.3
	A19	182.0	n/a	192.3	179.0	171.9	169.9	164.3
	A20	200.0	n/a	201.6	208.3	192.3	192.3	176.5
	A21	209.3	n/a	211.3	222.8	222.8	220.8	205.9
	A22	203.6	n/a	179.0	164.3	181.0	194.3	199.1
	A23	261.5	n/a	267.5	273.4	267.5	264.5	271.0
Baumberg	B1	33.1	34.1	35.1	37.2	37.2	37.2	37.2
	B2	36.2	35.1	35.1	36.2	37.2	39.2	38.2
	B4	38.2	37.2	37.2	37.2	39.2	41.2	40.2
	B5	43.2	39.2	40.2	40.2	44.2	78.2	115.2
	B6	43.2	39.2	40.2	40.2	44.2	78.2	115.2
	B7	37.2	38.2	39.2	39.2	41.2	41.2	42.2
	B8	132.4	135.8	137.8	141.3	154.3	156.8	133.6
	B9	119.6	119.6	122.6	121.6	126.0	127.0	129.2
	B10	29.1	30.1	28.1	30.1	34.1	30.1	33.1
	B11	43.2	45.2	42.2	44.2	48.3	49.3	51.4
	B12	134.8	135.8	138.8	137.8	145.8	147.8	151.1
	B13	134.8	135.8	138.8	137.8	145.8	147.8	151.1
	B14	114.2	114.2	115.2	118.2	125.0	126.0	131.4
	B6A	56.5	58.5	57.5	58.5	60.7	64.7	66.8
	B6B	59.5	62.7	62.7	63.7	67.8	71.0	68.8
	B8A	164.3	166.3	165.3	131.4	137.8	160.8	169.9
	B1C	35.1	36.2	38.2	40.2	44.2	46.3	48.3
	B2C	35.1	36.2	37.2	38.2	42.2	45.2	50.4
B3C	35.1	36.2	37.2	42.2	46.3	46.3	49.3	
B4C	37.2	38.2	39.2	39.2	45.2	47.3	50.4	
B5C	36.2	38.2	39.2	38.2	46.3	46.3	52.4	
B6C	42.2	39.2	40.2	39.2	43.2	48.3	60.6	

location	pond number	28-Feb-03	07-Mar-03	14-Mar-03	21-Mar-03	28-Mar-03	04-Apr-03	11-Apr-03
Ravenswood	RSF2	82.5	95.0	99.3	98.3	101.3	132.4	147.8
	R1	40.2	37.2	38.2	40.2	43.2	46.3	44.2
	R2	107.6	108.9	119.6	125.0	139.8	152.3	158.8
	R3	185.7	192.3	203.6	222.8	225.5	250.8	235.8
	R4	132.4	144.3	149.8	156.8	164.3	175.4	176.5
	R5	132.4	144.3	149.8	156.8	164.3	175.4	176.5
	RS2	n/a	n/a	n/a	n/a	n/a	n/a	n/a

location	pond number	18-Apr-03	25-Apr-03	02-May-03	09-May-03	16-May-03	23-May-03
Alviso	A1	33.1	25.1	n/a	25.1	27.1	23.1
	A2	32.1	35.2	32.1	31.1	29.1	32.1
	A3W	38.2	46.3	36.2	37.2	37.2	37.2
	B1	26.1	29.1	25.1	27.1	27.1	30.1
	B2	26.1	n/a	26.1	27.1	27.1	30.1
	A3N	36.2	39.2	36.2	38.2	37.2	41.2
	A5	48.3	49.3	n/a	51.4	51.4	50.4
	A7	56.5	56.5	n/a	57.5	56.4	63.7
	A8	67.8	75.1	n/a	73.0	74.0	76.1
	A9	32.1	35.2	n/a	33.1	35.2	38.2
	A10	37.2	38.2	n/a	37.2	35.2	38.2
	A11	74.0	74.0	n/a	75.1	74.0	76.1
	A12	76.1	76.1	77.2	77.2	78.2	80.3
	A13	n/a	n/a	77.2	81.4	82.4	83.5
	A14	82.4	n/a	86.6	85.6	88.7	83.5
	A15	83.5	82.4	82.4	83.5	83.5	84.5
	A16	89.8	89.8	n/a	96.1	91.9	95.1
	A17	95.1	94.0	n/a	99.3	94.0	98.2
	A19	153.3	154.4	148.9	158.8	164.3	159.9
	A20	159.9	161.0	161.0	162.1	165.4	169.9
	A21	186.7	183.3	179.9	181.0	183.3	192.3
	A22	200.2	199.1	198.0	201.4	198.0	223.1
	A23	245.2	276.9	275.8	279.3	279.3	275.8
Baumberg	B1	39.2	38.2	36.2	37.2	38.2	40.2
	B2	38.2	37.2	36.2	38.2	40.2	40.2
	B4	40.2	38.2	38.2	40.2	41.2	43.2
	B5	116.3	115.2	105.7	99.3	105.7	109.9
	B6	116.3	115.2	105.7	99.3	105.7	109.9
	B7	43.2	41.2	40.2	43.2	41.2	43.2
	B8	111.0	92.9	86.6	99.3	115.2	126.0
	B9	126.0	131.4	130.3	158.8	168.8	150.0
	B10	33.1	34.1	31.1	32.1	32.1	32.1
	B11	49.3	49.3	50.4	51.4	52.4	44.2
	B12	146.7	150.0	148.9	147.8	158.8	168.8
	B13	146.7	150.0	148.9	147.8	158.8	168.8
	B14	127.1	150.0	127.1	129.2	140.1	148.9
	B6A	61.7	61.7	60.6	62.7	68.8	77.2

location	pond number	18-Apr-03	25-Apr-03	02-May-03	09-May-03	16-May-03	23-May-03
Baumberg	B6B	64.7	68.8	61.7	n/a	75.1	98.2
	B8A	157.7	145.6	135.7	154.4	172.1	169.9
	B1C	50.4	54.4	62.7	79.3	102.5	109.9
	B2C	46.3	57.5	62.7	68.6	75.1	84.5
	B3C	48.3	55.5	70.9	69.9	78.2	85.6
	B4C	52.4	62.7	80.3	68.8	83.5	85.6
	B5C	59.6	67.8	84.5	89.8	100.4	107.8
Ravenswood	B6C	72.0	84.5	95.1	98.2	105.7	109.9
	RSF2	133.6	133.6	136.8	150.0	174.3	190.1
	R1	42.2	42.2	40.2	42.2	47.3	50.4
	R2	153.3	162.1	158.8	169.6	198.0	216.2
	R3	238.1	236.9	239.3	242.8	256.9	275.8
	R4	178.8	182.1	202.5	196.9	225.4	244.0
	R5	178.8	182.1	202.5	196.9	225.4	244.0
	RS2	n/a	n/a	n/a	n/a	n/a	n/a

location	pond number	30-May-03	06-Jun-03	13-Jun-03	23-Jun-03	27-Jun-03	04-Jul-03	11-Jul-03
Alviso	A1	24.1	28.1	27.1	28.1	31.1	NR	27.1
	A2	34.1	34.1	36.2	34.1	32.1	NR	26.1
	A3W	39.2	41.2	44.2	43.2	42.2	NR	41.2
	B1	32.1	35.2	58.5	32.1	26.1	NR	27.1
	B2	32.1	34.1	38.2	34.1	35.2	NR	27.1
	A3N	45.3	48.3	52.4	43.2	43.2	NR	41.2
	A5	48.3	49.3	52.4	51.4	50.4	NR	52.4
	A7	65.8	65.8	70.9	66.8	62.7	NR	66.8
	A8	77.2	81.4	81.4	81.4	82.4	NR	85.6
	A9	43.2	40.2	36.2	28.1	36.2	NR	27.1
	A10	42.2	41.2	46.3	41.2	36.2	NR	32.1
	A11	78.2	80.3	86.6	74.0	65.8	NR	51.4
	A12	83.5	81.4	89.8	87.7	82.4	NR	80.3
	A13	85.6	84.5	90.8	91.9	87.7	NR	91.9
	A14	89.8	89.8	95.1	100.4	101.4	NR	100.4
	A15	86.6	85.6	90.8	92.9	92.9	NR	96.1
	A16	99.3	95.1	101.4	100.4	99.3	NR	105.7
	A17	100.4	100.4	106.7	104.6	105.7	NR	108.8
	A19	162.1	159.9	167.7	164.3	162.1	NR	169.9
	A20	172.1	173.2	172.1	171.0	172.1	NR	178.8
	A21	191.2	190.1	194.6	192.3	195.7	NR	194.6
	A22	269.9	N/A	MT	MT	MT	NR	MT
	A23	279.3	N/A	MT	MT	MT	NR	MT
Baumberg	B1	43.2	44.3	36.2	33.1	37.2	42.2	46.3
	B2	43.2	46.3	46.3	46.3	47.3	50.4	52.4
	B4	48.3	49.3	51.4	51.4	50.4	52.4	56.5
	B5	119.5	129.2	142.3	151.1	158.8	176.5	190.1
	B6	119.5	129.2	142.3	151.1	158.8	176.5	190.1
	B7	47.3	47.3	52.4	53.4	55.5	58.5	59.6

location	pond number	30-May-03	06-Jun-03	13-Jun-03	23-Jun-03	27-Jun-03	04-Jul-03	11-Jul-03
Baumberg	B8	142.3	158.8	168.8	183.3	185.6	193.4	188.9
	B9	109.9	155.5	162.1	143.4	123.8	134.6	117.4
	B10	36.2	43.2	39.2	34.1	34.1	34.1	34.1
	B11	47.3	50.4	52.4	45.3	40.2	46.3	35.2
	B12	174.3	198.0	204.7	227.7	247.5	281.7	286.4
	B13	174.3	198.0	204.7	227.7	247.5	281.7	286.4
	B14	167.7	192.3	204.7	226.5	248.6	280.5	282.9
	B6A	86.6	N/A	MT	MT	MT	MT	MT
	B6B	n/a	N/A	MT	MT	MT	MT	MT
	B8A	161.0	159.9	173.2	157.7	135.7	130.3	126.0
	B1C	129.2	148.9	62.7	50.4	64.7	38.2	55.5
	B2C	103.5	120.6	129.2	144.5	156.6	177.6	193.4
	B3C	99.3	116.3	126.0	140.1	151.1	169.9	186.7
	B4C	100.4	117.4	124.9	142.3	152.2	169.9	190.1
	B5C	119.5	133.6	127.1	116.3	129.3	97.2	140.1
	B6C	116.3	126.0	133.6	143.4	147.8	162.1	174.3
Ravenswood	RSF2	192.3	N/A	MT	MT	MT	MT	MT
	R1	51.4	54.4	59.6	51.4	53.4	52.4	60.6
	R2	220.8	267.5	279.3	288.6	MT	MT	MT
	R3	280.5	290.9	MT	MT	MT	MT	MT
	R4	247.5	N/A	MT	MT	MT	MT	MT
	R5	247.5	N/A	MT	MT	MT	MT	MT
	RS2	n/a	N/A	N/A	N/A	N/A	NR	MT

location	pond number	18-Jul-03	25-Jul-03	01-Aug-03	08-Aug-03	15-Aug-03	22-Aug-03	29-Aug-03
Alviso	A1	28.1	29.1	NR	27.1	34.1	32.1	27.1
	A2	30.1	31.1	NR	33.1	33.1	39.2	29.1
	A3W	38.2	37.2	NR	38.2	38.2	41.2	37.2
	B1	24.1	24.1	NR	27.1	25.1	27.1	24.1
	B2	27.1	27.1	NR	25.1	26.1	38.2	27.1
	A3N	39.2	37.2	NR	37.2	32.1	32.1	31.1
	A5	49.3	50.4	49.3	51.4	52.4	51.4	52.4
	A7	68.8	68.8	70.9	69.9	68.8	68.8	68.8
	A8	88.7	88.7	89.8	87.7	89.8	88.7	89.8
	A9	26.1	26.1	27.1	27.1	26.1	27.1	29.1
	A10	29.1	30.1	30.1	29.1	28.1	30.1	31.1
	A11	52.4	48.3	47.3	50.4	45.3	49.3	47.3
	A12	69.9	67.8	67.8	70.9	60.6	60.6	63.7
	A13	83.5	80.3	80.3	73.0	74.0	67.8	70.9
	A14	88.7	88.7	87.7	90.8	82.4	97.2	91.9
	A15	94.0	94.0	92.9	94.0	89.8	92.9	84.5
	A16	104.6	102.5	103.5	104.6	104.6	99.3	102.5
	A17	108.8	106.7	106.7	109.9	18.1	106.7	107.8
	A19	174.3	NR	187.8	185.6		184.4	183.3
	A20	181.0	NR	188.9	194.6	196.9	195.7	193.4
	A21	203.6	NR	201.4	211.6	208.2	208.2	220.8

location	pond number	18-Jul-03	25-Jul-03	01-Aug-03	08-Aug-03	15-Aug-03	22-Aug-03	29-Aug-03
Alviso	A22	MT	MT	MT	MT	NR	MT	MT
	A23	MT	MT	MT	MT	NR	MT	MT
Baumberg	B1	51.4	NR	38.2	39.2	37.2	35.2	34.1
	B2	54.4	NR	48.3	49.3	46.3	44.2	34.1
	B4	60.6	NR	57.5	54.4	54.4	51.4	46.3
	B5	199.1	NR	196.9	108.8	84.5	76.1	72.0
	B6	199.1	NR	196.9	108.8	84.5	76.1	72.0
	B7	65.8	NR	62.7	62.7	59.6	55.5	54.4
	B8	182.1	NR	187.8	194.6	200.2	205.9	119.5
	B9	122.8	NR	112.0	129.2	131.4	135.7	176.5
	B10	39.2	NR	39.2		38.2	35.2	40.2
	B11	53.4	NR	59.6		59.6	67.8	65.8
	B12	292.0	NR	300.9	306.5	MT	MT	MT
	B13	292.0	NR	300.9	306.5	MT	MT	MT
	B14	290.9	NR	298.7	MT	MT	MT	MT
	B6A	MT	NR	MT	MT	MT	MT	MT
	B6B	MT	NR	MT	MT	MT	MT	MT
	B8A	121.7	NR	121.7	126.0	134.6	136.8	175.4
	B1C	46.3	NR	56.5	79.3	50.4	73.0	45.3
	B2C	215.0	NR	245.2	265.1	279.3	271.0	245.2
B3C	202.5	NR	240.5	249.8	259.2	260.3	238.1	
B4C	205.9	NR	235.8	218.5	231.1	205.9	172.1	
B5C	126.0	NR	148.9	184.4	167.7	162.1	135.7	
B6C	186.7	NR	207.0	158.8	146.7	137.9	109.9	
Ravenswood	RSF2	MT	MT	MT	MT	MT	MT	MT
	R1	57.5	60.6	60.6	66.8	66.8	66.8	74.0
	R2	MT	MT	MT	MT	MT	MT	MT
	R3	MT	MT	MT	MT	MT	MT	MT
	R4	MT	MT	MT	MT	MT	MT	MT
	R5	MT	MT	MT	MT	MT	MT	MT
	RS2	MT	MT	NR	MT	MT	MT	MT