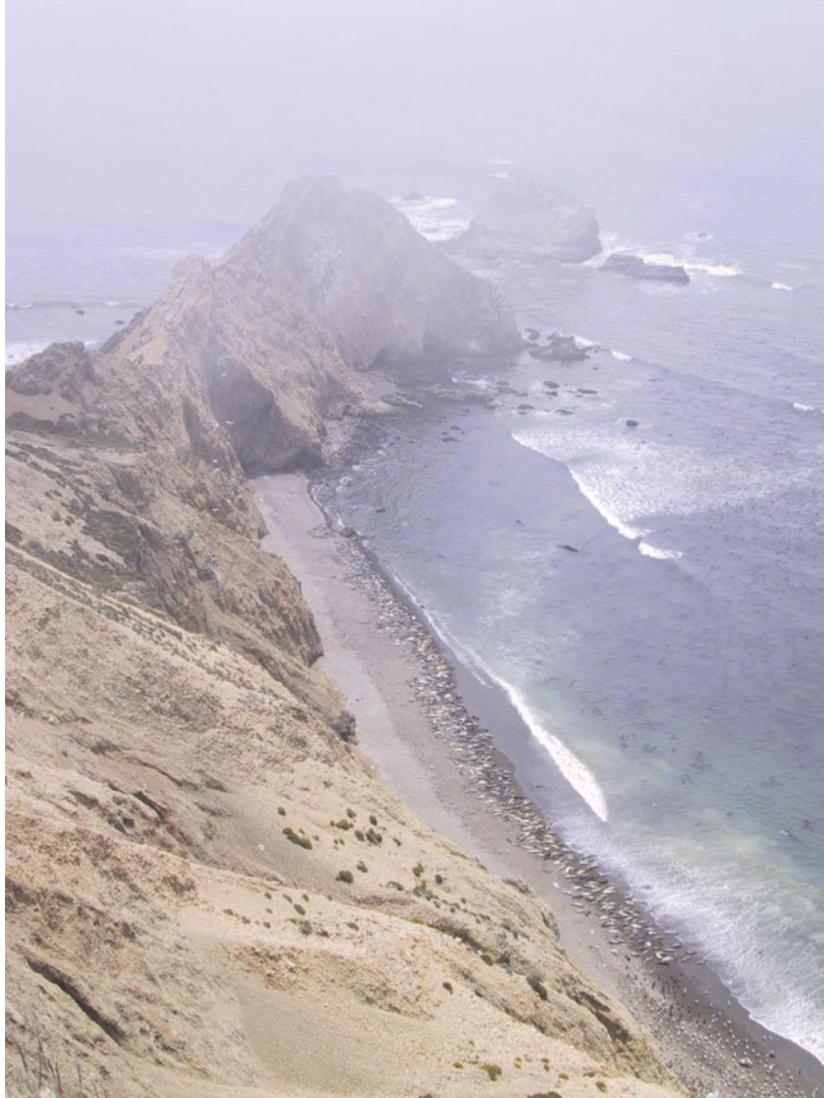


Harbor Seal Monitoring

San Francisco Bay Area

**Annual Report
National Park Service
2006**



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Acknowledgements

We thank all the volunteers who hiked many miles through fog, rain, and wind to survey harbor seals, including Jane Adams, Frank Binney, Judy Bourke, Tara Bushore, Elissa Chasen, Kate Carolan, Ruth Catlin, Michele Conrad, Ed Downing, Nina Downing, Richard Ferris, Wayne H. Lynn Harrison, Holter, Katie Kirk, Peter Krag, Joan Lamphier, Dal Leite, Elizabeth Leite, Dick Lingelser, Katie Kirk, Joanne Lasnier, Eric Olsen, Marsha Maslan, Cristina Mun, , Emma Moore, Paul Moschetti, Susan Pender, Judy Rodoni, Bob Siegel, Elizabeth Sojourner, Susan Van Der Wal, Michael Vanvelkenburg, Ed Vermeulen, Sue Waber, Elizabeth Wheeler, Amy Whelan, Rick Whitney, and many more.

We also thank the regional group of volunteers associated with various collaborative groups, including Norton Bell, Joelle Buffa, Sandra Bush, Michelle Cooper, Steven Durkin, Molly Engelbrecht, Mary Follis, Chris Hellwig, Mary Ellen King, Sarah Lenz, Joanne Mohr, Joe Mortenson, Bonnie Platos, Alan Schreiber, Jackie Sones, Sage Tezak, Bob Wilson and other agencies and organizations including the Farallones Marine Sanctuary Association, Gulf of the Farallones National Marine Sanctuary, the Friends of Slavianka, The Fitzgerald Marine Reserve, the Marine Mammal Center, U.S. Fish and Wildlife Service, and the San Francisco State University Harbor Seal Project for contributing numbers to the region-wide surveys.

In addition, we are grateful to the Park Rangers at Point Reyes for transporting volunteers by boat to sand bars in Tomales Bay, and to Christie and Steve Anastasia, Ben Becker, Bill Merkle, Marcus Koenen, and Dawn Adams for their programmatic support. We are also thankful to Kristen Truchinski for updating the regional survey data. Finally, we are grateful for the generous contributions from the Point Reyes National Seashore Association, the Cox Family Fund, the San Francisco Bay Area Inventory and Monitoring Program, and the Marin Conservation Corps/Americorps Program.



Volunteer training at Double Point.

Introduction

Harbor seals (*Phoca vitulina richardii*) are the dominant and only year round resident pinniped in the San Francisco Bay Area, California. Within the San Francisco Bay Area, the population at Point Reyes represents the largest concentration of harbor seals in the State of California, other than the Channel Islands, accounting for 20% of the mainland breeding population (Lowry and Carretta 2003). Much of the Point Reyes coastal zone remains fairly pristine and provides excellent marine and terrestrial habitat for seals to rest, molt, feed, and breed where human encroachment is minimal.

Long-term monitoring studies of harbor seals have been conducted at selected colonies at Point Reyes since 1976 (Allen et al. 1989, Sydeman and Allen 1999, Allen et al. 2004, Vanderhoof and Allen 2005). The objectives of monitoring are to 1) detect changes in population numbers, 2) detect changes in reproductive success, and 3) identify anthropogenic or environmental factors that might affect population status and trends. The monitoring objectives and protocol are described in detail in Hester et al. (draft protocol). The information presented here is a summary of the data collected in Point Reyes National Seashore and Golden Gate National Recreation Area during the 2006 breeding and molting seasons, March-July. Summary data collected as part of a region-wide survey effort including adjacent areas, (San Francisco Bay, San Mateo County and Sonoma County) where NPS surveys were conducted in conjunction with other agencies and organizations for 2006, are also presented.

Methods

Study Area

The study area extends from Tomales Point south to San Francisco Bay. The Point Reyes peninsula extends from Tomales Bay (Lat. 38° 30'N) south to Bolinas Lagoon (Lat. 37° 30'N) and is referred collectively as the Point Reyes sites. Point Bonita, in the Marin Headlands, is the southern most seal haul out site within the study area and is located at the mouth of San Francisco Bay in Golden Gate National Recreation Area. Coastal embayments include Tomales Bay, Drakes Estero and Limantour Estero, Bolinas Lagoon, and San Francisco Bay. The Point Reyes National Seashore (PORE), Golden Gate National Recreation Area (GOGA), Gulf of the Farallones National Marine Sanctuary (GFNMS), and the Marin County Department of Parks and Recreation share jurisdiction over segments of this coastline.

The topographic diversity of this coastal zone provides a broad range of substrates upon which harbor seals haul out. These include tidal mud flats, offshore and onshore rocky tidal ledges, and sandy beaches. "Haul out site" is defined as a terrestrial location where seals aggregate for periods of rest, birthing, and suckling of young (Harvey 1987, Thompson 1987). Coastal locations regularly surveyed included Tomales Point, Point Reyes Headland, Duxbury Reef, Double Point, and Point Bonita; estuarine locations surveyed included Tomales Bay, Drakes and Limantour Esteros, and Bolinas Lagoon (Figure 1).

Regional survey sites included colonies in San Francisco Bay (Alcatraz, Mowry Slough, Castro Rocks, Yerba Buena Island, and Newark's Slough), Sonoma County (Sea Ranch, South Sonoma sites, Fort Ross, and Jenner) and San Mateo County (Fitzgerald Marine Reserve, Pescadero, Pebble Beach, Point San Pedro, Bean Hollow, and Cowell Ranch Beach (Figure 1).

Surveys

Harbor seal surveys were conducted during the breeding and molting seasons, which run from March 1st to May 30th and June 1st to July 31st, respectively.

National Park Service (NPS) biologists trained volunteers to conduct surveys of harbor seals during two in-class sessions and four field sessions. Many of the volunteers were previously trained and seasoned, having surveyed seals in previous years. Volunteers and park biologists surveyed each Point Reyes site a minimum of once per week, twice during the peak of the breeding and molting seasons, weather and logistics permitting. Point Bonita was also surveyed according to the same schedule. The Point Reyes Headland and the regional survey sites were surveyed once every two weeks on concurrent weekends. Surveys occurred primarily during low to medium tides, the time when the maximum numbers of seals haul out in the San Francisco Bay region (Fancher 1979, Allen et al. 1982).



Harbor seals at Tomales Bay.

Survey periods were designed to last approximately two hours, with counts occurring at half-hour intervals, depending on location. Each sub-site was surveyed separately, and then summed to give a total for the site at each time interval. All sub-sites were visible from one location with the exception of Tomales Point and Bolinas Lagoon. For each of these sites, each sub-site was counted from two to four times per survey, due to driving or hiking distance between the sub-sites.

For each sub-site, the observer recorded the total number of adult/immature seals, pups, dead pups, red-pelaged seals, and any fresh shark bitten animals present. Because of the difficulty in distinguishing adult from immature seals, these two age classes were lumped together. Pups were the young of the year and after weaning, were difficult to distinguish from yearling seals. Consequently, pup numbers were reliable only between March and June 1. Red pelage results from the deposition of iron oxide precipitates on the hair shaft and usually extends from the head down to the shoulder (Allen et al. 1993).

All actual and potential disturbances to harbor seals were recorded during surveys from the period of March 1st to July 31st. The total number of surveys where disturbances were recorded was 221 (Table 1). Observers recorded the time and the source of the disturbance. The seals' response to a disturbance was classified as no response, head alert, flush, flush into water, or unknown. In the case of a flush or flush into water, the observer noted the number of seals that flushed, the number of pups that were left alone, and the number of seals that remained in place. After a flush into water, the time when the seals rehailed was also recorded. In some cases, an unknown disturbance and unknown response was recorded if the disturbance occurred before the survey had started, and so the nature and extent of the disturbance was not directly observed. The rate of disturbances was calculated based on the number of disturbances per survey period (survey period was usually 2 hours but may have varied by ½ hour). In future reports, disturbance rate will be calculated based on the number of disturbances per survey hour, in order to compare to other disturbance studies.

Regional surveys occurred every two weeks March through July on weekends, Friday – Sunday that had low tides around mid-day. All of the PORE and GOGA sites, as well as the San Francisco Bay and Sonoma sites, were surveyed during these weekends. Participants in the region-wide surveys included the GFNMS and FMSA, San Francisco State University, US Fish and Wildlife Service, Stewards of Slavianka, a non-profit conservation group based in Sonoma County, the Marine Mammal Center and Fitzgerald Marine Reserve.

Results and Discussion

Overall

In 2006, volunteers completed 221 surveys at sites in Marin County at PORE and GOGA between March 1st and July 31st. The combined maximum pup count total for all sites during the breeding season was 1,056 pups (Table 1). The maximum pup count total for just PORE sites, excluding Point Bonita pup numbers in order to compare to previous years, was 1,042 (Table 2). The 2006 pup count is only 6% lower than 2005. Pup numbers appeared to decrease since 2004, and 2006 was the lowest pup count recorded since 1998; however, we did not test for statistical significance (Figure 2). Drakes Estero and Double Point continue to show the highest numbers of pups, together producing 56% of the pups seen for 2006 at PORE and GOGA (Table 1; Figure 3).

The first pup observed in 2006 was on March 9 compared to March 6 in 2005. There is no apparent trend in the date of first pup observed between 2000 and 2006 or in location (Table 4).

The decline in the overall number of pups produced in 2006 compared to the previous five years may be related to changes in marine conditions. Upwelling was much reduced in 2006 and similar to 2005, resulting in reduced krill, which in turn may have affected food availability for harbor seals.

Many, but not all, haul out sites experienced a decline in pup numbers. Pup numbers at Tomales Bay decreased 43% compared to 2005 and were much lower when compared to the mean over the past 4 years. The maximum pup count for Tomales Bay in 2006 fell well below the range of one standard deviation from the five-year mean (Figure 5). Bolinas Lagoon and Drakes Estero, though, both had an increase in pup numbers in 2006, most likely resulting from the decrease in pups at Double Point. Similar fluctuations between these sites have been seen in previous years, such as in 2003 when a northern elephant seal (*Mirounga angustirostris*) disrupted the colony at Double Point resulting in an increase in the number of pups at Drakes Estero and Bolinas Lagoon (Figure 4).

The maximum total count of all seals during the molt season for all sites at PORE and GOGA was 4,709 seals (Table 1). For just PORE sites, the maximum count was 4,560. This count is 6% higher than in 2005 (Table 2). The 2006 molt count total was the highest in the past nine years except for in 2004 when the count was 5,633 (Figure 6). Seals from Drakes Estero and Double Point accounted for 49% of the maximum molt count for PORE and GOGA combined (Table 1; Figure 7).

At PORE, surveyors recorded 135 disturbances between March 1st and July 31st. 120 of these were actual disturbances (disturbances that resulted in a seal response), while 15 were potential disturbances (4% of all disturbances). Of these potential disturbances, 47% (7) were human, 20% (3) were clambers, 20% (3) were motorboats, and 13% (2) were barking dogs. The average rate of actual disturbances per survey in 2006 for PORE sites was 0.76 disturbances per survey. This can be compared to 0.54 disturbances per survey in 2005. Tomales Bay and Tomales Point colonies had the most significant increase in disturbances when compared to previous years (Figure 9). Bolinas Lagoon had the highest rate of disturbance (1.3 disturbances per survey), followed by Tomales

Bay (1.2 disturbances per survey; Figure 8). In 2005, Drakes Estero had the highest rate of disturbance, 1.03 disturbances per survey (Figure 9). Forty-three percent (52) of all disturbances in 2006 resulted in seals flushing into the water.

Twenty-one percent of the actual disturbances in 2006 were caused by humans (Figure 10). Other identifiable disturbances were from non-motorboats (13%), motor boats (11%), and birds (10%). Nineteen percent of disturbances were from unknown sources. These percentages were similar to disturbance data collected from 2002-2005. There was an increase in 2006 in disturbances from motorboats and vehicles and a decrease in disturbances from aircrafts compared to 2005. This decrease is related to a decline in disturbances from “ultralights,” low flying aircrafts, in 2006. No aircraft disturbances from 2006 were from “ultralights.” Sources of disturbance that produced an increase in the “other” category included construction noise at a residence near Bolinas Lagoon and coyotes on the sandbars at Drakes Estero (Table 3).

There were no observed major mortality events in 2006. Pup numbers declined at Double Point after rebounding from a northern elephant seal disturbance in 2002-2003. The decline in numbers at Double Point mid-season were not explained from field surveys; however, law enforcement rangers reported that a person was rescued by helicopter adjacent to Double Point during the time that the seal numbers declined. Tomales Bay and Bolinas Lagoon pup numbers were the only sites found to have maximum counts significantly different than their average range when compared to the past 5 years.

Two harbor seal pups were picked up by park visitors at Point Reyes in 2006, mistaking the pups for being abandoned. Both pups were picked up from McClurres Beach, one on 4/13/06 and the other on 4/19/06. The pups were taken to the Marine Mammal Center for care. The Marine Mammal Center also released 3 harbor seal pups at Point Reyes at Chimney Rock, one on 7/1/06 and 2 on 6/03/06.



Pup nursing at Point Reyes.

Summary by site

Bolinas Lagoon

29 surveys were completed at Bolinas Lagoon between March 1st and July 31st. Bolinas Lagoon had a high pup count of 174 the week of May 8th, and a peak molt count of 448 the week of July 10th (Table 1). Due to Bolinas Lagoon's close proximity to a highway, the seals are very exposed to humans and traffic and had the highest rate of disturbance this year, 1.3 disturbances per survey (Figure 8). Forty-six percent (17) of disturbances were caused by humans. On more than one occasion, humans were seen walking on the mudflats where seals haul out and one time four children were seen running along the mudflats chasing seals into the water. Twenty-two percent (8) of disturbances were caused by birds. Two of these were from large flocks of Brown Pelicans (*Pelecanus occidentalis*). Bolinas Lagoon had a maximum Brown Pelican count of 1,350 in 2006 which is more than double the number seen in 2005 when the max count was 553. Sixteen percent of disturbances were from vehicles, all being motorcycles. There was construction going on at a nearby residence causing a few of the disturbances early in the season. Although this site had the highest level of disturbance, maximum pup and molt counts did not seem to be affected.

Double Point

30 surveys were completed at Double Point between March 1st and July 31st. Double Point had a high pup count of 247 the week of April 17th, and a peak molt count of 1,086 the week of July 3rd (Table 1). Double Point had one of the lowest disturbance rates, 0.33 disturbances per survey (Figure 8). The remoteness of this site coupled with being surrounded by high cliffs reduces the exposure to human disturbances and may prevent surveyors from identifying the natural sources for disturbance. 40% of the disturbances were from unknown causes and the other few were from aircrafts and motorboats far offshore. The peak pup count in 2006 is one week earlier than all previous years at Double Point, and likely the colony experienced a major disturbance related to a helicopter rescue at the fourth week of April, resulting in seals moving to Bolinas Lagoon (which was much higher in 2006) and Drakes Estero. Unfortunately, no observers were present to document the likely disturbance.

Drakes Estero

33 surveys were completed at Drakes Estero between March 1st and July 31st. Drakes Estero had a high pup count of 347 the week of May 1st, and a peak molt count of 1,228 the week of July 3rd (Table 1). Drakes Estero had the highest pup and molt numbers, and one of the highest levels of disturbance, 0.97 disturbances per survey (Figure 8). Park regulations allow kayaks and canoes back in Drakes Estero after July 1st. After that date 50% of disturbances were a result of these non-motorboats. Prior to July 1st most disturbances were of unknown cause, 47%. Surveyors documented a bobcat and a coyote disturbing seals on sandbars in Drakes Estero. Other sources included low flying large birds such as turkey vultures, hikers and clam diggers on Limantour and Drakes Beaches, and kayaks after July at the end of the seasonal closure.

Duxbury Reef

25 surveys were completed at Duxbury Reef between March 1st and July 31st. Duxbury Reef had a high pup count of 17 the week of May 15th, and a peak molt count of 75 the

week of July 24th (Table 1). Duxbury Reef had one of the lowest rates of disturbance, 0.12 disturbances per survey (Figure 8). The only recorded disturbance that resulted in seals flushing into the water was when two dogs ran out to the haul out site chasing all the seals into the water.

Point Bonita

44 surveys were conducted at Point Bonita. Point Bonita was added to the study area in 2005. The high pup count was 14 which is much higher than the previous year's data and the maximum molt count was 149 (Tables 1). Disturbance data was compiled at GOGA and will be analyzed in future reports.

Point Reyes Headland

17 surveys were completed at Point Reyes Headland (PRH) between March 1st and July 31st. PRH had a high pup count of 44 the week of May 8th and a peak molt count of 462 the week of July 17th (Table 1). PRH had the lowest rate of disturbance, 0.06 with only one disturbance recorded, the source of which was a researcher (Figure 8). This haul out site is a primary colony for northern elephant seals. The peak count for northern elephant seals between March 1st and July 31st was 896 the second week of May, which coincides with the peak molt period for elephant seals (PRNS, unpubl. data). The headland is often enshrouded in fog, and consequently, surveys are limited.

Tomales Bay

22 surveys were completed at Tomales Bay (TB) between March 1st and July 31st. Tomales Bay had a high pup count of 108 during the week of May 1st, and a peak molt count of 681 the week of July 17th (Table 1). The disturbance rate doubled in the past year from 0.6 disturbances per survey in 2005 to 1.2 disturbances per survey in 2006 which is significantly greater than the average range of disturbances over the past 4 years (Figure 8; Figure 9). This site also had a significant decrease in pup numbers as well (Figure 5). 38% of disturbances were from motorboats, and represents the most motorboat incidences seen over the season. 23% of the disturbances were from non-motorboats. Other disturbance sources include clambers, aircrafts, and birds.

Tomales Point

21 surveys were completed at Tomales Point (TP) between March 1st and July 31st. Tomales Point had a high pup count of 105 the week of April 17th, and a peak molt count of 580 the week of July 5th (Table 1). The disturbance rate was 0.62 disturbances per survey (Figure 8). 54% of these disturbances were caused by humans, either hikers on the beach or abalone divers. The rate of disturbance continues to increase at Tomales Point, this year being significantly higher than the average range of previous years (Figure 9). The point is often enshrouded in fog, and consequently, surveys are limited.

Regional Sites

Twelve regional surveys were completed, starting on March 4, and ending July 29, at 22 locations. The seasonal peak for pups was during the week of May 6 and the peak for molting seals was during the week of July 15. The maximum number of seals during the breeding season was 5,101 and the average was 3209.2. The maximum number of seals during the molt was 5,285, with an average of 4,152.8 (Table 5). Point Reyes had the highest concentration of seals with Double Point and Drakes Estero accounting for 35%

of adults during the breeding season, 46% of pups produced, and 37% of molting seals. The maximum count of pups was 1,157 and the first pups were identified at Double Point on March 4th. Of the 22 areas surveyed simultaneously, only 3 produced >100 pups (Tomales Point, Drakes Estero, and Double Point). Within San Francisco Bay, Castro Rocks accounted for the majority of seals, followed by Mowry Slough, a reversal of last year's surveys. Sonoma County coast haul out sites were composed of a number of small sites with larger concentrations at Sea Ranch and Jenner. San Mateo County coast sites were also composed of a number of small sites adding up to larger concentrations at Pebble Beach and Fitzgerald Marine Reserve. No seals were counted during surveys at Bean Hollow during the entire season. Cowell Ranch Beach and Fitzgerald Marine Reserve accounted for most of the seals counted in the county, but few pups were recorded there (45).

Disturbances during surveys ranged from a male northern elephant seal attacking harbor seals at Jenner to people on foot, tide pooling at Point Bonita. Seals at Double Point were disturbed by a helicopter during a cliff rescue of a park visitor, resulting in reduced pupping at this site compared to the previous year. The primary sources for disturbance at San Francisco Bay were loud vehicles on the Richmond San Rafael Bridge at Castro Rocks, aircraft and motor boats at Yerba Buena Island.

Collaboration

Point Reyes National Seashore and Golden Gate National Recreation Area collaborated with multiple government agencies, non-profit organizations and individuals on projects related to the harbor seal population of central California. The parks collaborated with NOAA on a Tomales Bay stewardship program called SEALS. Park rangers ferried docents on boats out onto the mud flats in Tomales Bay to educate visitors and clam diggers about seals twice during the pupping season. The parks also collaborated with the Marine Mammal Center on a study of harbor seal health that will be initiated in 2007 at Tomales and San Francisco Bays.



Harbor seals on floats in Tomales Bay.

Summary

Compared to 2005, the total pup numbers at PORE and GOGA were lower in 2006 and the molt numbers were higher. The numbers for both seasons were comparable to previous years and within the normal range of variation, but the maximum pup count for 2006 was the lowest recorded since 1998. The pup counts at PORE sites appear to be decreasing since 2004; however, we did not test the statistical significance of this decline. The molt counts for 2006 were the highest recorded in the last nine years other than in 2004. The rate of disturbances per survey on the weekends at PORE sites have increased since 2005. Disturbances were site specific; however, humans on foot and boaters remain the two most frequent sources of human related disturbance across all sites.



Harbor seal haul out at Tomales Point

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Table 1. Summary data of harbor seal colonies for the 2006 season. All reported numbers reflect the maximum number seen during a single census over the entire season, March 1 to July 31. Max # Breed = adults, immatures and pups during the breeding season, March 1 to May 31. Max # Molt =all age classes during the molting season, June 1 to July 30. The percent of red seals is a percentage of the maximum total number of seals recorded at each site the day the red seal count was at a maximum. The number of surveys and disturbances are from March 1 to July 31, only disturbances that caused a response were used.

Site	Max # Breed	Max # Pups	Max #Molt	# Surveys	# Disturbances	Reds	% Reds	Shark Bites	Dead Pups
Bolinas Lagoon	361	174	448	Weekday: 18 Weekend: 11	Weekday: 9 Weekend: 28	14	6 %	4	4
Double Point	579	247	1086	Weekday: 19 Weekend: 11	Weekday: 6 Weekend: 4	5	.6 %	3	3
Drakes Estero	784	347	1228	Weekday: 18 Weekend: 15	Weekday: 22 Weekend: 10	13	1.5 %	3	3
Duxbury Reef	72	17	75	Weekday: 17 Weekend: 8	Weekday: 1 Weekend: 2	0	0 %	0	1
Point Reyes Headlands	129	44	462	Weekday: 15 Weekend: 2	Weekday: 1 Weekend: 0	1	1.4 %	0	1
Tomales Bay	503	108	681	Weekday: 8 Weekend: 14	Weekday: 10 Weekend: 16	12	2.9 %	2	1
Tomales Point	362	105	580	Weekday: 9 Weekend: 12	Weekday: 6 Weekend: 5	5	.9 %	0	1
Point Bonita	114	14	149	Weekday: 34 Weekend: 10	Weekday: 45 Weekend: 7	3	2.5 %	1	0
2006 Total:	2,904	1,056	4,709	221	172	53		13	14

Table 2. Summary of survey data for 1997-2006, combining all sites at Point Reyes (excluding Point Bonita for comparison between years). Maximum # of Breed and Molt, and Average # Breed include all age classes. Number of surveys and disturbances are the number completed or recorded from the start of the year (Jan 01 to July 31).

YEAR	Max # Breed	Average Breed	Max # Pups	Max # Molt	# Surveys	# Disturbances	Disturbances Per Survey
1997	3,268	1,830.50	983	NA	Weekday: 44	Weekday: 9	0.2
		SE = 379			Weekend: 29	Weekend: 37	1.3
		N = 4			Total: 73	Total: 46	
1998	2,481	1,744.60	528	3,070	Weekday: 79	Weekday: 24	0.3
		SE = 122.5			Weekend: 64	Weekend: 46	0.7
		N = 8			Total: 143	Total: 70	
1999	3,325	1,779.90	1,068	2,863	Weekday: 139	Weekday: 71	0.5
		SE = 173.5			Weekend: 69	Weekend: 54	0.8
		N = 10			Total: 208	Total: 125	
2000	3,506	2,511.10	1,342	3,108	Weekday: 106	Weekday: 78	0.7
		SE = 224.4			Weekend: 91	Weekend: 116	1.3
		N = 7			Total: 197	Total: 194	
2001	3,485	2,218.80	1,247	3,769	Weekday: 112	Weekday: 57	0.5
		SE = 244.8			Weekend: 119	Weekend: 107	0.9
		N = 4			Total: 231	Total: 164	
2002	4,180	2651.3	1193	4297	Weekday: 123	Weekday: 67	0.5
		SE = 119.7			Weekend: 144	Weekend: 102	0.7
		N = 8			Total: 267	Total: 169	
2003	3820	2280	1117	4534	Weekday: 172	Weekday: 86	0.5
		SE = 303.9			Weekend: 115	Weekend: 83	0.7
		N = 9			Total: 287	Total: 169	
2004	4534	2518.3	1267	5633	Weekday: 161	Weekday: 52	0.3
		SE = 348.6			Weekend: 97	Weekend: 53	0.5
		N = 10			Total: 258	Total: 105	
2005	2,733	2182.3	1,109	4,283	Weekday: 166	Weekday: 80	0.5
		SE = 195.1			Weekend: 78	Weekend: 29	0.4
		N = 11			Total: 244	Total: 109	
2006	2,790	2316.8	1,042	4,560	Weekday: 130	Weekday: 56	0.5
		SE = 225			Weekend: 76	Weekend: 66	0.9
		N = 12			Total: 206	Total: 122	

Table 3. Causes for disturbance during 2002-2006 for Point Reyes sites; percent is of total actual disturbances from March 1st to July 31st.

Year	Type of Disturbance								
	Motor boat	Non-motor boat	Vehicle	Dog	Aircrafts	Human pedestrian	Bird	Unknown	Other
2002	13%	16%	6%	0.50%	11%	24%	6%	21%	2%
2003	13%	20%	2%	0%	9%	21%	7%	23%	6%
2004	5%	10%	8%	2%	3%	39%	7%	25%	2%
2005	8%	13%	1%	0%	15%	25%	9%	23%	6%
2006	11%	13%	5%	1%	7%	21%	10%	19%	13%

Table 4. Date of first pup by year at Point Reyes, including all sites.

Year	Date
2000	14-Mar
2001	16-Mar
2002	3-Mar
2003	27-Mar
2004	20-Mar
2005	6-Mar
2006	9-Mar

Table 5. Regional surveys of harbor seals in central California, March 1 through July 31 2006. Twelve surveys were scheduled, 7 during the breeding season and 5 during the molt, but some sites could not be surveyed all dates because of logistics or weather. ND=nod data.

Location	Breeding Season				Molt Season		
	Average	SE	Total* Max	Pup* Max	Average	SE	Total Max
Sonoma County							
Sonoma Coast	140.50	93.96	248	71	239.50	47.59	302
Fort Ross	49.00	28.93	97	14	ND		
Jenner	78.80	62.77	179	30	294.50	174.66	418
Marin County							
Tomaes Bay	418.25	64.05	503	88	584.25	97.60	681
Tomaes Point	264.13	123.02	462	105	399.00	153.85	540
Point Reyes Headland	85.63	64.39	219	35	363.75	134.74	462
Drakes Estero/Limantour							
Double Point	657.50	240.81	1002	288	850.25	132.70	975
Duxbury Reef	506.50	123.05	723	237	680.25	231.76	904
Bolinas Lagoon	43.25	16.88	73	17	35.75	29.08	75
Point Bonita	189.50	66.65	286	82	360.00	111.30	448
Point Bonita	46.25	35.50	106	13	77.75	32.44	119
San Francisco Bay							
Alcatraz	4.17	1.94	6	0	1.00	ND	1
Castro Rocks	202.40	94.46	339	37			
YBI	61.50	10.71	81	4	140.33	64.08	190
Newark Slough	18.20	14.70	38	11	2.25	4.50	9
Mowry Slough	112.00	74.38	229	58	124.25	30.70	161
San Mateo County							
Point San Pedro	15.00		15	0	ND		
Cowell Ranch	73.60	27.37	112	20	ND		
Pescadero	28.80	21.99	55	6	ND		
Pebble Beach	59.20	15.59	82	25	ND		
Bean Hollow	0.00	0.00	0	0	ND		
Fitzgerald Marine Reserve	155.00	81.96	246	16	ND		
ALL SITES	3209.17		5101	1157	4152.83		5285

*Based on the total for a single day.

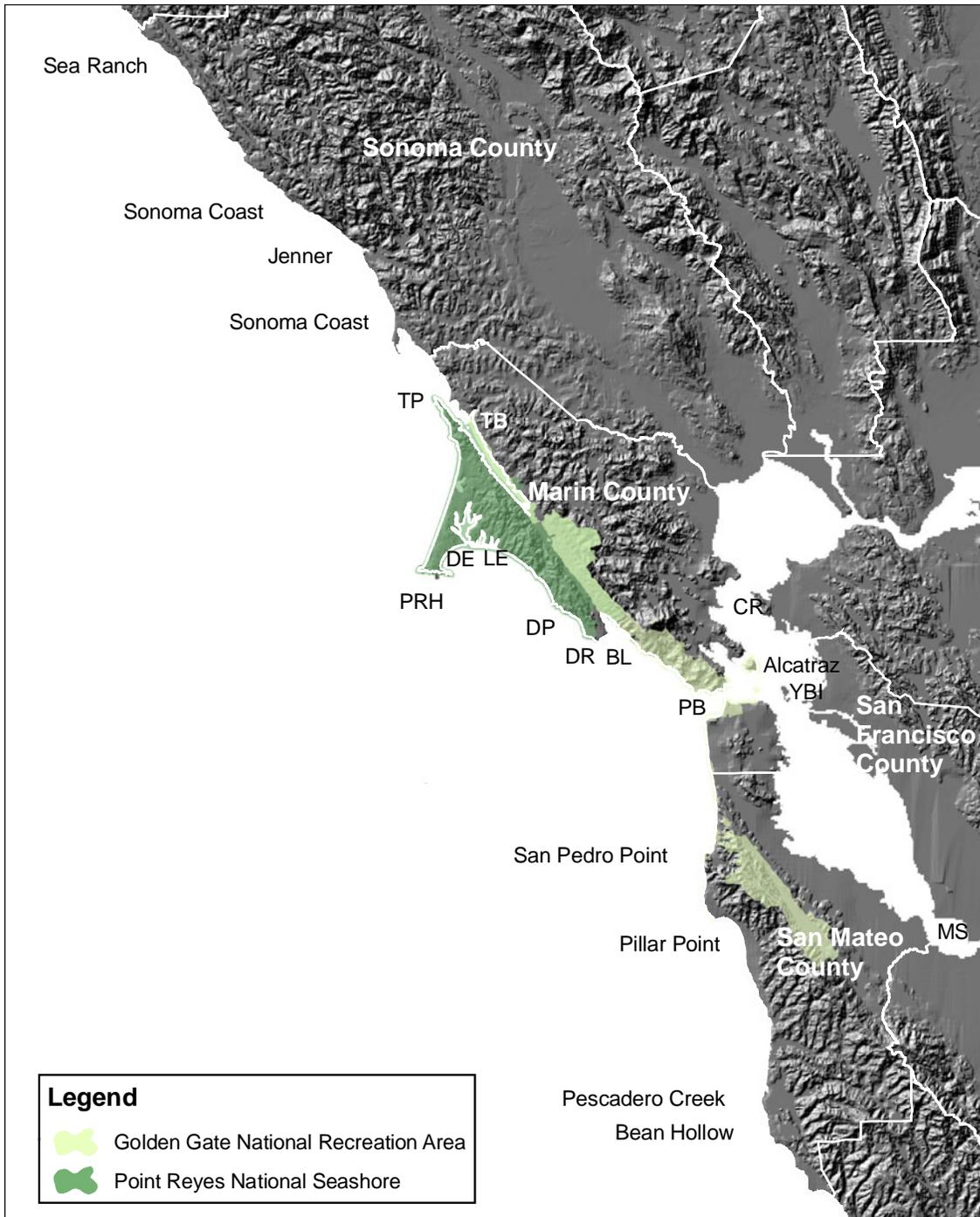


Figure 1. Harbor seal haul out sites in Marin County and San Francisco Bay, California. Map does not present all of the regional survey locations included in Sonoma and San Mateo counties. TB=Tomales Bay, TP=Tomales Point, DE=Drakes Estero, PRH=Point Reyes Headland, LE=Limantour Estero, DP=Double Point, DR=Duxbury Reef, BL=Bolinas lagoon, PB=Point Bonita, CR=Castro Rocks, YBI=Yerba Buena Island, MS=Mowry Slough.

Figure 2. Total Pup Counts at PORE (excluding Point Bonita) from 1997-2006 seasons. See text for methods.

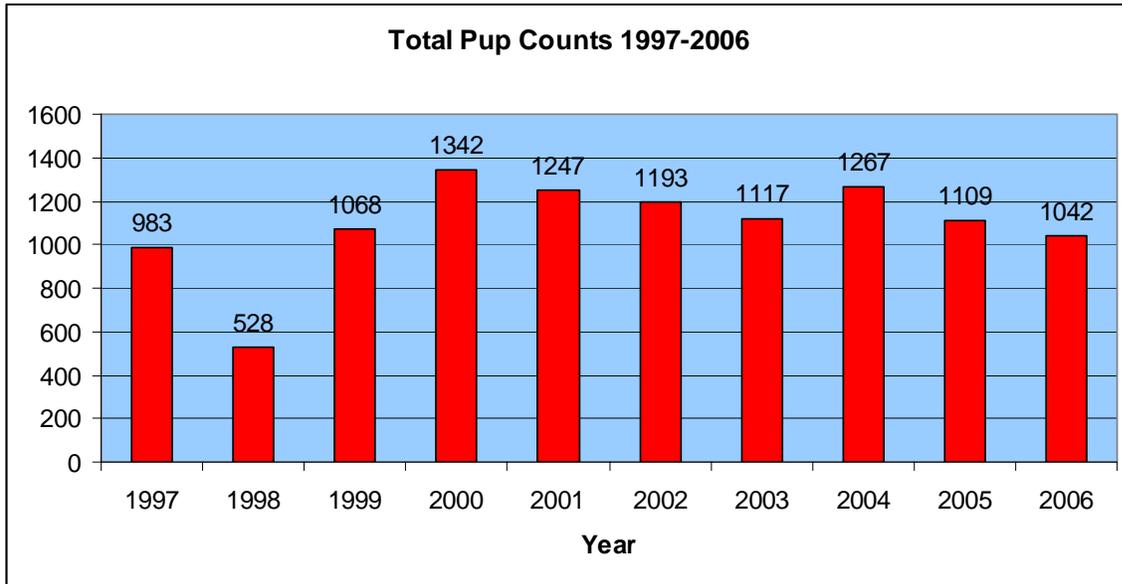


Figure 3. Maximum pup counts by site at PORE and GOGA during the 2006 season. See text for methods.

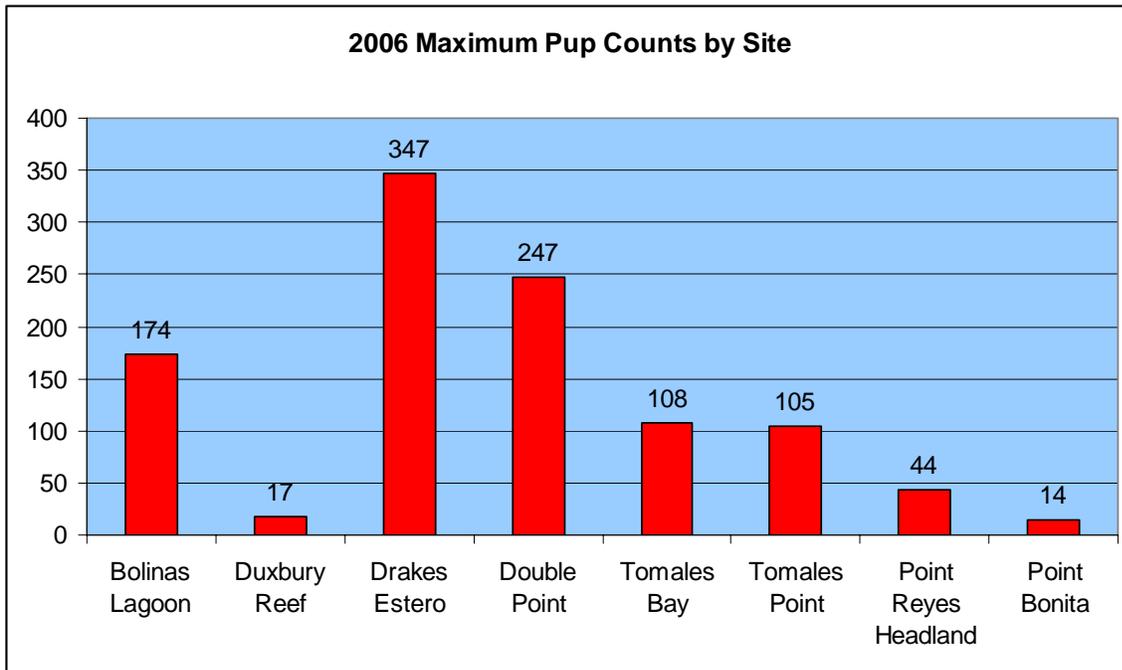


Figure 4. Maximum pup counts by site at PORE, 2002-2006 seasons. See text for methods.

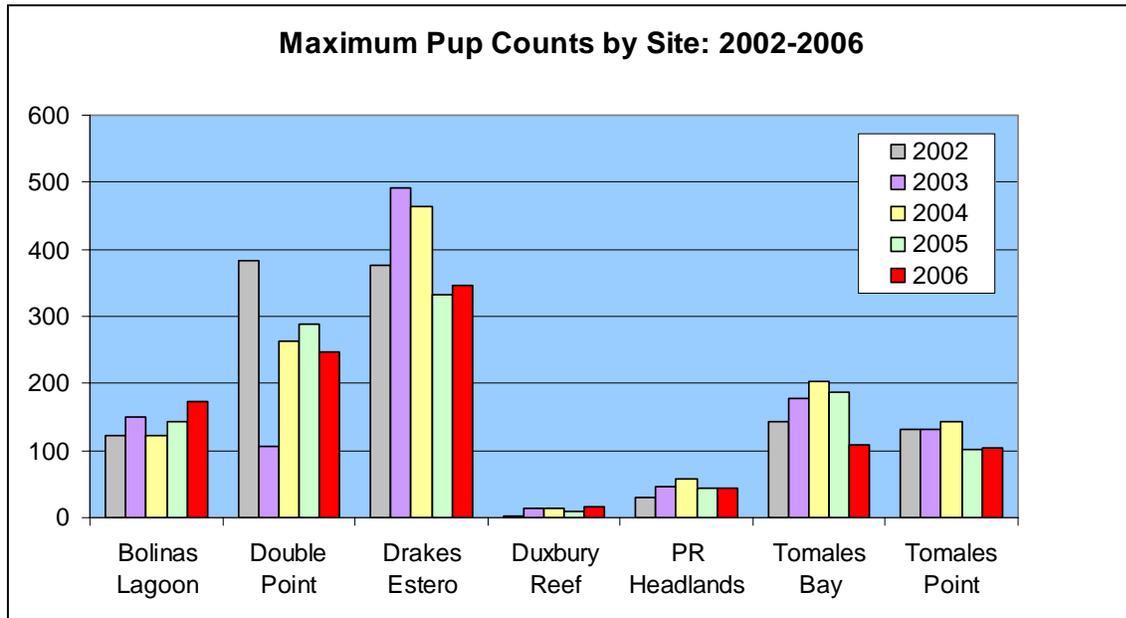


Figure 5. Maximum pup counts for Tomales Bay 2002-2006 showing a range of (mean \pm one standard deviation). See text for methods.

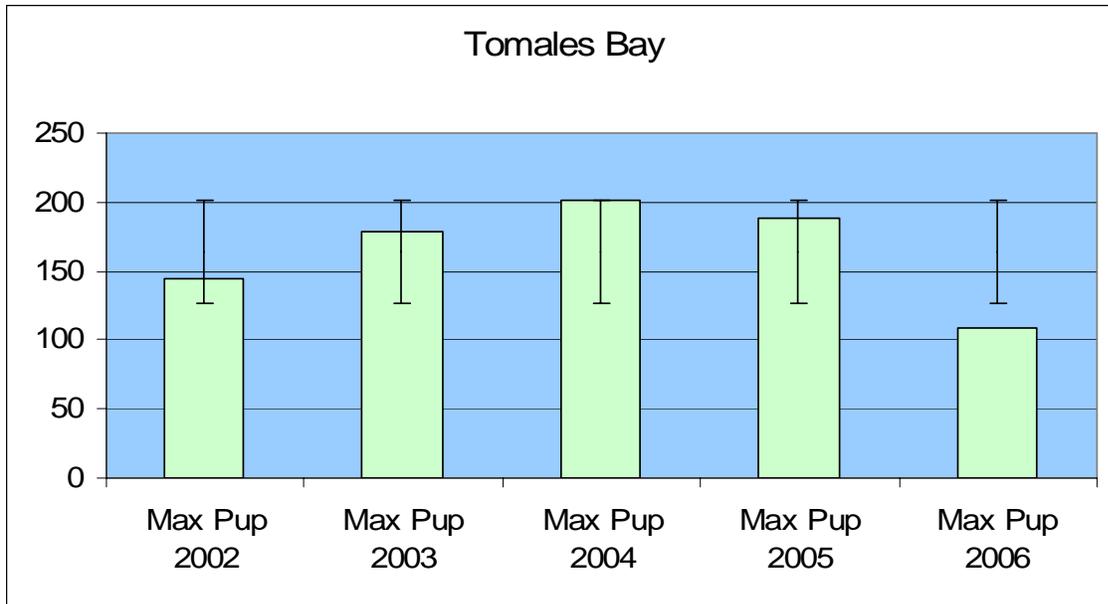


Figure 6. Total molt counts for PORE (excluding Point Bonita) from 1998-2006 seasons. See text for methods.

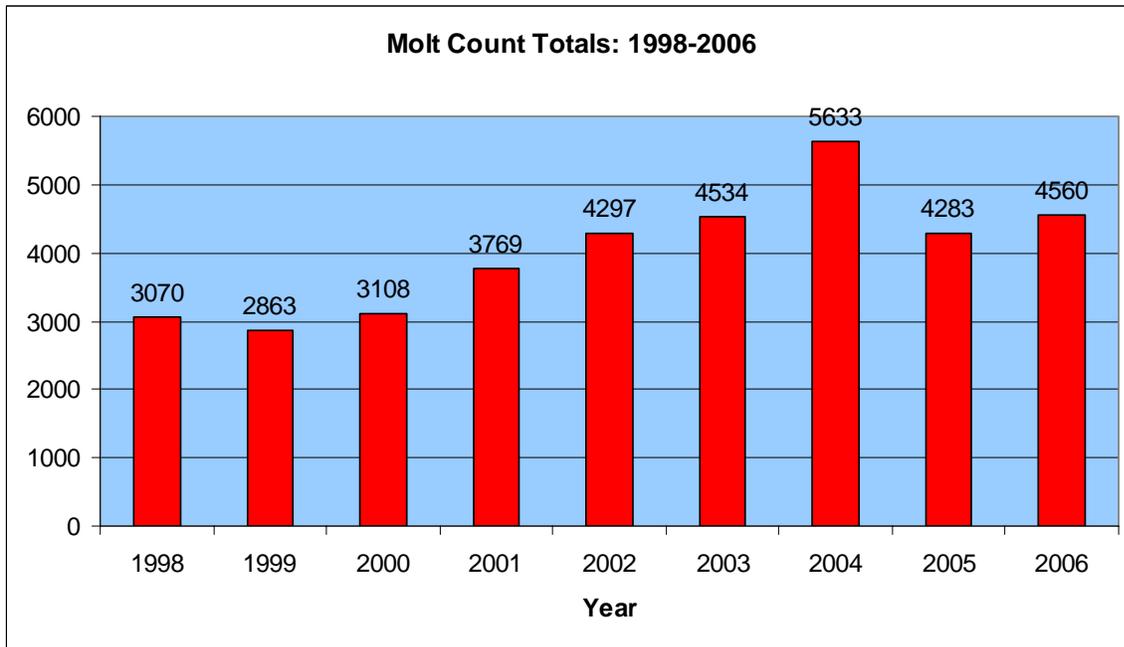


Figure 7. Maximum molt counts by site for PORE and GOGA during the 2006 season. See text for methods.

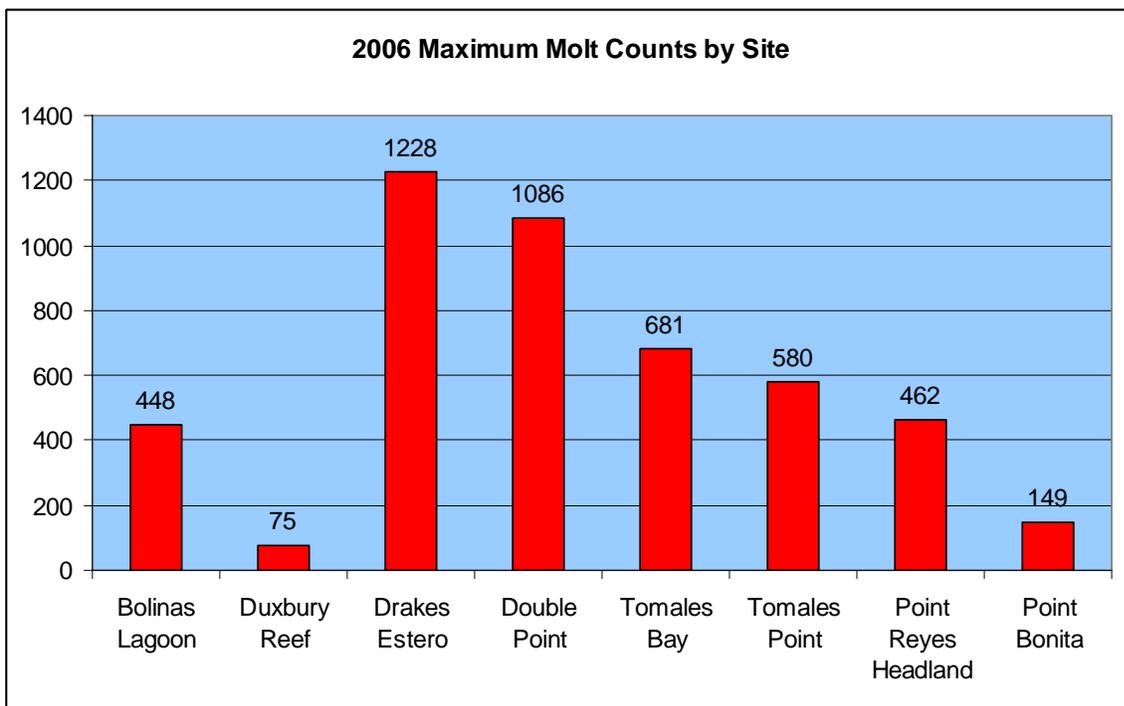


Figure 8. Average number of disturbances per survey, by site at Point Reyes, 2006. See text for methods.

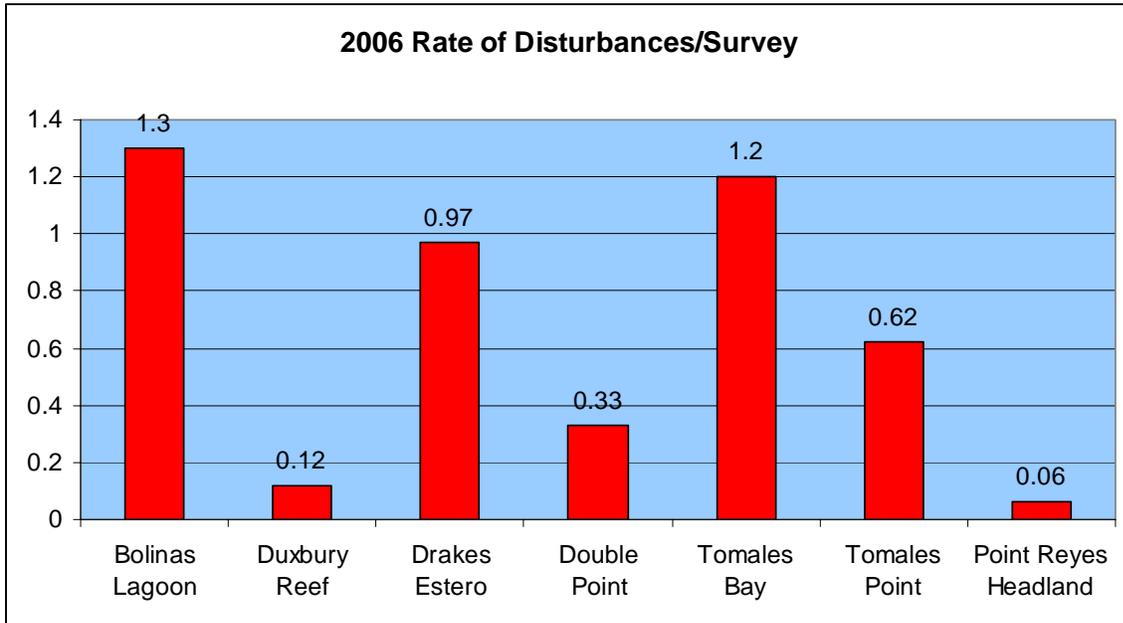


Figure 9. Average number of disturbances per survey, by site at Point Reyes for 2003-2006. See text for methods.

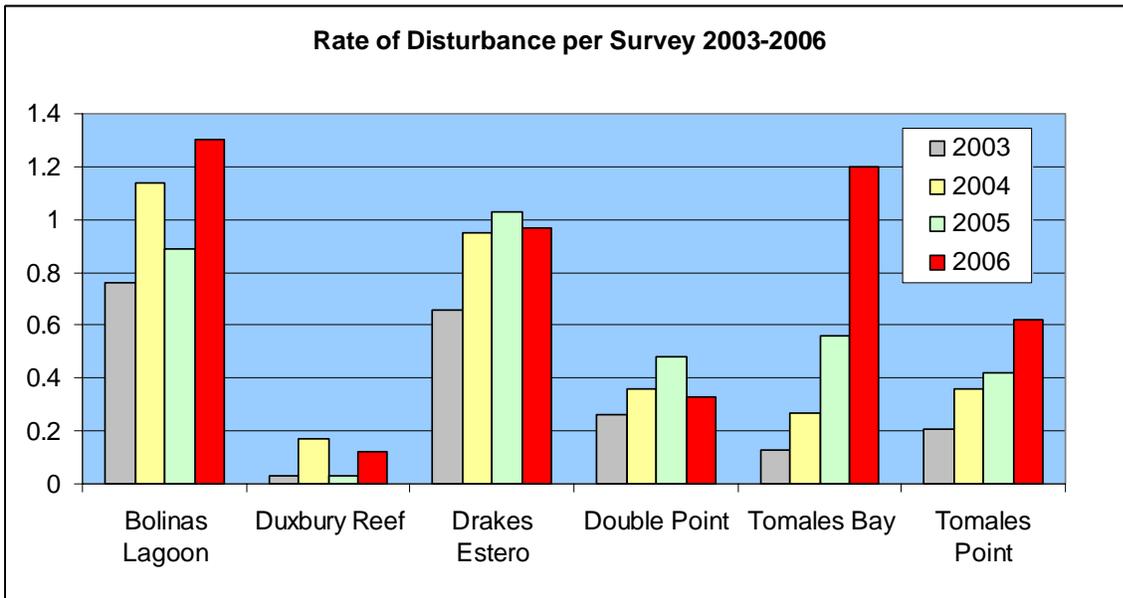
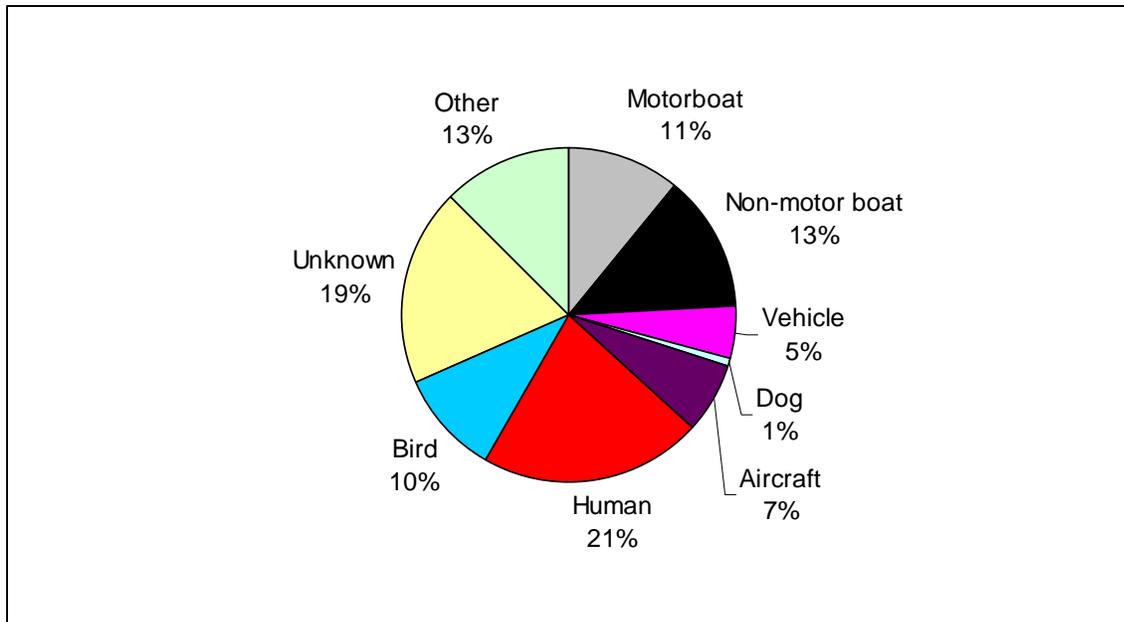


Figure 10. Causes for disturbance by percent for all of Point Reyes sites in 2006.



Volunteer training at Drakes Estero.