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Pacific Harbor Seal (*Phoca vitulina richardii*) Monitoring at Point Reyes National Seashore and Golden Gate National Recreation Area: 2007 Annual Report

Natural Resource Technical Report NPS/SFAN/NRTR—2008/118

ON THE COVER
A Pacific harbor seal (*Phoca vitulina richardii*) nurses her pup in Point Reyes National Seashore
Photograph by: Judy Bourke

Pacific Harbor Seal (*Phoca vitulina richardii)* Monitoring at Point Reyes National Seashore and Golden Gate National Recreation Area: 2007 Annual Report

Natural Resource Technical Report NPS/SFAN/NRTR—2008/118

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June 2008

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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Please cite this publication as:

Truchinski K., E. Flynn, D. Press, D. Roberts, and S. Allen. 2008. Pacific harbor seal (*Phoca vitulina richardii)* monitoring at Point Reyes National Seashore and Golden Gate National Recreation Area: 2007 annual report. Natural Resource Technical Report NPS/SFAN/NRTR—2008/118. National Park Service, Fort Collins, Colorado.

NPS D-553, June 2008

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Abstract

Pacific harbor seals (*Phoca vitulina richardii*) are the dominant and only year-round resident pinniped in the San Francisco Bay Area, California. Long-term monitoring studies have been conducted at the largest harbor seal colonies in Point Reyes National Seashore and Golden Gate National Recreation Area since 1976. The objectives of monitoring each site and the population as a whole are to i) detect changes in population size, ii) detect changes in reproductive success by way of pup production, and iii) identify anthropogenic or environmental factors that may affect the condition of the population.

Harbor seal surveys were conducted throughout the 2007 breeding (March through May) and molting (June through July) seasons once to twice per week at the largest Point Reyes and Golden Gate harbor seal colonies, collectively referred to as Marin County locations. Members of the Harbor Seal Monitoring Volunteer Program completed 252 surveys at eight Marin County locations, contributing an estimated 2152 hours. During the breeding season, a maximum combined total of 2771 adults and immature seals and 903 seal pups were counted at all Marin County monitoring locations. Drakes Estero had the most adults (759), followed by Tomales Bay (481) and Double Point (469). Drakes Estero and Double Point accounted for 54% (488) of pups at Marin County haul outs. From June to July, 4218 animals molted at Marin locations. Disturbances to seals occurred, with 215 incidences recorded during surveys. The most frequent causes were human (35.3%), unknown (20.9%), and motor boat (14.4%). Regional surveys occurred 13 times throughout the season at locations in Sonoma, Marin, San Francisco, and San Mateo counties. Marin County locations accounted for 73.2% (2916/3979) of breeding adults and immatures, 84.4% (765/974) of pups, and 74.1% (3459/4787) of seals during the molting season.

Acknowledgements

We thank all the volunteers who hiked many miles through fog, rain, and wind to survey harbor seals, including J. Adams, J. Bourke, T. Bushore, R. Bograd, R. Catlin, K. Carolan, M. Conrad, L. Davidson, R. Ferris, J. Fitzpatrick, J. Ford, W. Holter, R. Kane, M. Koenen, P. King, K. Kirk, J. Lamphier, J. Lasnier, D. Leite, E. Leite, D. Lingelser, P. Lord, E. Moore, J. Mohr, P. Moschetti, S. Pender, T. Pete, R. Schweig, B. Siegel, E. Sojourner, S. Van Der Wal, M. Vanvelkenburg, E. Vermeulen, S. Waber, E. Wheeler, A. Whelan, D. Zierten, and S. Zurek.

We also thank the regional group of volunteers associated with various collaborative groups, including N. Bell, J. Bray, S. Bush, S. Durkin, M. Engelbrecht, M. Follis, D. Green, D. Greig, C. Hellwig, B. Jayne, S. Lenz, C. Miller, J. Mohr, J. Mortenson, B. Platos, L. Wheeler, B. Wilson and other agencies and organizations including the Farallones Marine Sanctuary Association, Gulf of the Farallones National Marine Sanctuary, The Stewards of the Coast and Redwoods, The Fitzgerald Marine Reserve, and The Marine Mammal Center for contributing numbers to the region-wide surveys.

Finally, we are grateful for the generous contributions from the Point Reyes National Seashore Association, the David and Vicki Cox Family Foundation, the San Francisco Bay Area Inventory and Monitoring Program, and the Marin Conservation Corps/AmeriCorps Program.

The following peer reviewers greatly improved this document: Bill Merkle (GOGA Wildlife Biologist), Ben Becker (Director, NPS Pacific Coast Science and Learning Center), Dave Graber (Chief Scientist, NPS Pacific West Region), and Denise Greig (Marine Biologist, The Marine Mammal Center).

Volunteer Dick Lingelser counting seals at Drakes Estero (photo courtesy of Judy Bourke).

Introduction

The information presented in this report is a summary of the harbor seal data collected at Point Reyes National Seashore and Golden Gate National Recreation Area during the 2007 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 2007, are also presented. This report is not intended to analyze long-term trends in the harbor seal data set, which are more appropriately investigated at five year intervals (i.e. Allen et al. 2004). Furthermore, this document is not intended to report on or analyze data specific to NPS management issues related to harbor seals.

Background

Pacific harbor seals (*Phoca vitulina richardii*) are the dominant and only year-round resident pinniped in the San Francisco Bay Area, California. The population at Point Reyes National Seashore represents the largest concentration of harbor seals in the State of California, and accounts for approximately 20% of the mainland molting population (Lowry et al. 2005). Much of the Point Reyes coastal zone remains relatively pristine and provides good marine and terrestrial habitat for seals to rest, molt, feed, and breed where human encroachment is minimal. The inaccessibility of much of the area has historically afforded some protection from human disruption during the seals' terrestrial resting periods; however, some pinniped populations in California are still recovering from a long period of exploitation that did not end until the passage of the Marine Mammal Protection Act in 1972 (Carretta et al. 2005). Human disturbance of seals at colonies is of interest to the National Park Service (NPS) because nearly 2.4 million visitors visit Point Reyes annually (Statistical Report, PRNS, 2007) and several million more visit the Golden Gate National Recreation Area, many of whom visit the tidepools, beaches and estuaries of the parks. The parks may implement management actions to reduce disturbance to seals at colonies, if appropriate.

Objectives

Long-term monitoring studies of harbor seals have been conducted at the largest colonies in Point Reyes National Seashore and Golden Gate National Recreation Area since 1976 (Allen and Huber 1984, Allen et al. 1989; Sydeman and Allen 1999; Allen et al. 2004). The objectives of monitoring each site and the population as a whole are to i) detect changes in population size, ii) detect changes in reproductive success by way of pup production, and iii) identify anthropogenic or environmental factors that may affect the condition of the population. The monitoring objectives and protocol are described in detail in the draft *San Francisco Bay Area Network Pinniped Monitoring Protocol*, scheduled for completion in 2008.

Methods

Study Area

The study area extends from Tomales Point south to San Francisco Bay. The Point Reyes peninsula extends from the mouth of Tomales Bay (Lat. 38° 30'N) south to Bolinas Lagoon (Lat. 37° 30'N). Point Bonita is located in the Marin Headlands, at the mouth of San Francisco Bay in the Golden Gate National Recreation Area. For this paper, the Point Reyes sites and Point Bonita are collectively referred to as Marin County locations. Point Reyes National Seashore, Golden Gate National Recreation Area, Gulf of the Farallones National Marine Sanctuary, the California State Parks, and the county parks share jurisdiction over segments of this coastline (Figure 1).

The topographic diversity of this coastal zone provides a broad range of substrates for harbor seals to come ashore. These include tidal mud flats, offshore and onshore rocky tidal ledges, and sandy beaches. A "haul out site" is defined as a terrestrial location where seals aggregate for periods of rest, birthing, and nursing of young (Harvey 1987, Thompson 1987). Each site, or location, is comprised of several "subsites", or distinct areas of beach, rock outcrops, or sandbars where harbor seals haul out. Coastal embayment sites include Tomales Bay, Drakes Estero, Bolinas Lagoon, and San Francisco Bay. Coastal sites surveyed include Tomales Point, Point Reyes Headlands, Duxbury Reef, Double Point, and Point Bonita (Figure 1).

The sample design and methods for this program were developed so that the data could be integrated with other regional surveys, allowing for the results to be interpreted in a regional context. Annually, the National Park Service participates in regional harbor seal breeding season surveys sponsored by NOAA, with the Point Reyes National Seashore Science Advisor as the coordinator for the central coast breeding season survey.

Regional survey sites include colonies in San Francisco Bay (Alcatraz, Mowry Slough, Castro Rocks, Yerba Buena Island, and Newark 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)).

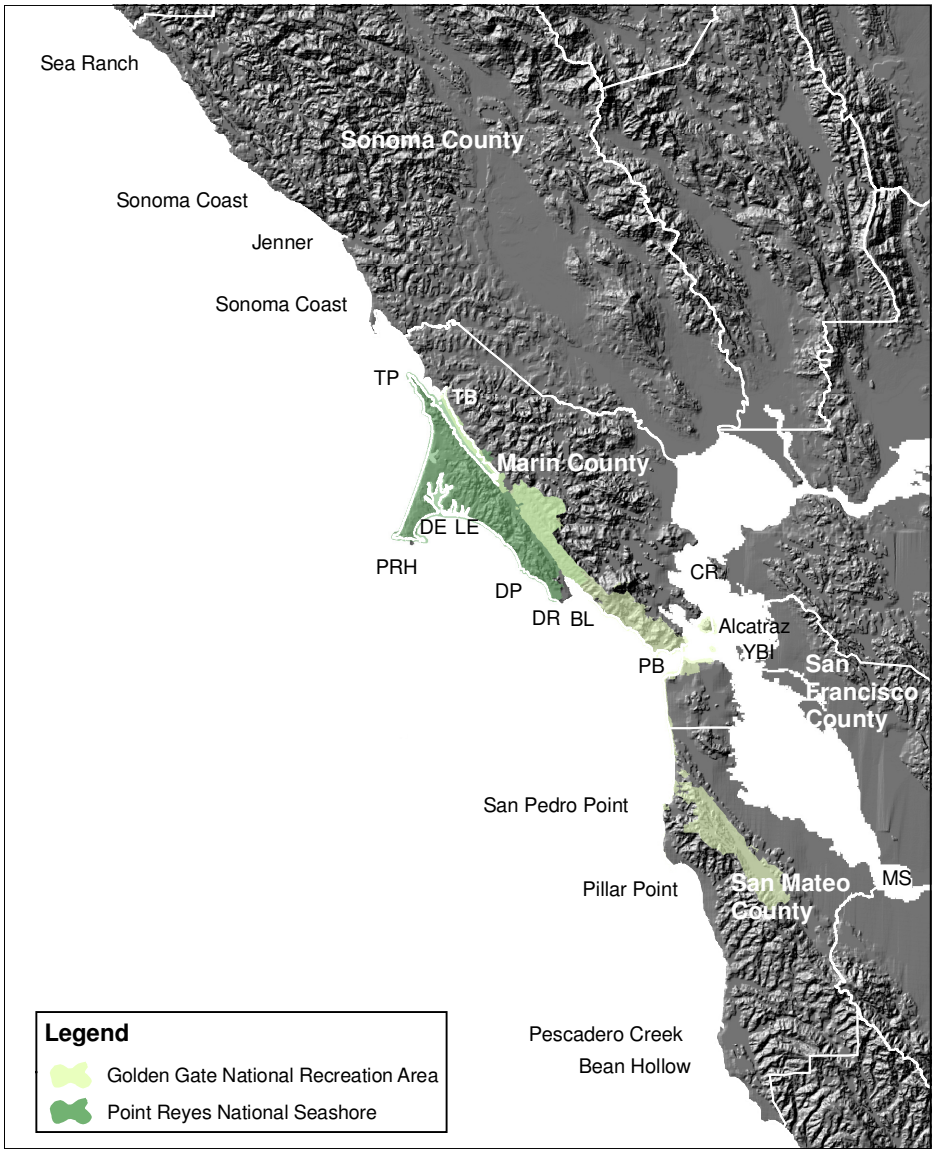

Figure 1. Regional survey sites in San Francisco Bay and Sonoma, Marin, and San Mateo counties, California. Map does not present all of the regional survey locations included in Sonoma and San Mateo counties. TB=Tomales Bay, TP=Tomales Point, DE=Drakes Estero, PRH=Point Reyes Headland, LE=Limantour Estero,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

Surveys

Volunteer observers were trained to monitor harbor seals at designated sites within Point Reyes and at Point Bonita during two classroom and three field sessions in March 2007. The majority of the volunteers had been previously trained and returned to the 2007 season with many years of experience. New volunteers were required to be mentored by returning volunteers at a site before they conducted a survey alone.

Harbor seal surveys were conducted throughout the breeding (March 1st through May 31st) and molting (June 1st through July 31st) seasons once to twice per week at each Marin County location. Surveys were conducted at medium to low tides (below 3ft) during the day. Surveys were not conducted in heavy fog because of poor visibility and they were not conducted in the rain because harbor seals haul out in lower numbers in the rain (Jemison and Pendelton 2001).

Volunteers surveyed for 2 hours from fixed observation points with all subsites counted approximately every 30 minutes for a total of 4 counts each survey. Subsites were counted and recorded separately on pre-formatted datasheets and then added for site totals every half hour. Three locations often had only two counts each survey due to hiking/traveling time between subsites: Tomales Point, Bolinas Lagoon, and Duxbury Reef.

For each subsite the observer recorded the time, number of adult and immature seals, pups, dead pups, red-pelaged seals, and fresh shark-bitten seals. Red pelage is easily identified and results from the deposition of iron oxide precipitates on the hair shaft; it usually extends from the head down to the shoulder and is of interest due to its rarity outside of the San Francisco Bay Area. (Allen et al. 1993). During the molting season (June-August) all animals were counted as adults and immature seals because of the difficulty in distinguishing large pups from immature seals.

Disturbances and potential disturbances were recorded as they occurred on a data form separate from seal numbers. Disturbances included any events that caused the seals to lift their head (head alert), flush, or flush into water, while potential disturbances were defined as any anthropogenic event within a defined haul out zone that had the potential to flush seals. Observers recorded the time, source, and effect of each disturbance. The information on the effect included the reaction of the seals, the numbers of seals that reacted, and when and where they re-hauled if they were flushed into the water. In some cases the disturbance was not directly observed, but surveyors recorded the number of animals affected with an "unknown" disturbance. Disturbances were recorded by fixed categories to assist with summary analyses. The categories were:

Source	Example
Motor-boat	Motorboat, Jet ski
Non Motor-boat	Canoe, Kayak, Sailboat, Wind surfer
Vehicle	Car, Bus, Motorcycle
Dog	Dog, Dog barking
Aircraft	Airplane, Helicopter, Hang glider, Ultralight
Human	Clammer, Researcher, Oyster Worker, Hiker, Horse rider
Bird	Turkey Vulture, Gull, Raven
Other	Coyote, Other Pinniped, Rock Slide, etc.

On alternating weekends, regional surveys were conducted at all sites included in regional counts (see Figure 1). Participants in the region-wide surveys included various organizations and volunteers. Regional counts could be conducted at anytime between Thursday and Monday over the selected regional survey weekends.

All count and disturbance datasheets completed during harbor seal surveys were entered into a relational Microsoft Access database during the course of the field season. At the end of the season, the database records were error-checked against the paper datasheets for accuracy. The records were further reviewed to ensure that only accurate and complete count data were used for analysis (see draft pinniped protocol for more details). For example, incomplete counts or counts that may have been hampered by poor weather conditions were noted in the database as poor quality surveys.

Data Management and Analysis

Although harbor seal data were collected according to subsites at each monitoring location, subsite data are not reported or analyzed within this report. By summing the subsite counts for each survey time interval, the maximum site total was identified for each survey and used for data summaries and analyses. The maximum total site count for each survey was then split into the adult/immature and pup age categories during the breeding months of March, April, and May.

The maximum number of seals counted at a site over the course of the entire season is often used for comparisons between years and sites. Because there is little to no movement of harbor seals between sites during the pupping and molting seasons, it was assumed that individual animals were not counted at more than one site (Harvey and Goley 2005). The maximum total count for each year within the study area was determined by taking the sum of the maximum count at each location. The maximum total count was determined separately for the breeding and molting seasons. Maximum counts at each location may have occurred on separate days (see Barlow et al. 2002). When compiling count summaries from the harbor seal data, only records noted as high quality counts were included. During the regional survey weekends, it was not uncommon for a site to be surveyed more than once. In these cases, the survey with the greater seal count was used for any regional summaries.

The total maximum count of breeding season adults/immatures, pups, and molting harbor seals were averaged separately across survey years 2000 to 2007 and compared to the 2007 data. Inclusion of all survey years in the average calculation accounts for the inherent inter-annual variability in the harbor seal population and reproductive output. Declines below one standard deviation from the mean, especially over the course of a few years, may merit further analysis of the data for statistical significance, additional research, or management actions.

When looking at disturbance events, only actual disturbances, those that elicited a head-alert or flush reaction from the seals, were used for analysis. Disturbance tallies were based on disturbance sources rather than the number of subsites or seals affected. Disturbance rates were calculated as the number of disturbance events that occurred during the time period from the first observation to the end of the final observation period. Because the disturbance data were not analyzed for effects on the seal count data in this report, all actual disturbance data were used for

analysis regardless of the quality of the associated seal count data. Potential disturbances (events that could potentially elicit a reaction from seals) were recorded by volunteers to quantify any given type of disturbance recurring at a particular site, but this information is not analyzed in this report. These data may be used to understand potential emerging disturbance issues at each location.

Please note that data quality standards and analysis procedures enacted in 2007 in preparation for this report have been applied to all data within the current monitoring database, which extends back to 2000. For this reason, summary data reported here for 2000 to 2006 may differ from data summaries published in previous harbor seal reports.

Results

Overall

In 2007, 36 volunteers completed 252 surveys at Marin County locations between March 1st and July 31st, completing an estimated 2152 hours. Each location was surveyed between 15 and 50 times, which includes 13 regional surveys. During the breeding season (March-May), a maximum of 2771 adults and 903 pups were observed in Marin locations, with the numbers growing to 4218 individuals during the molting season (June-July) (Table 1).

Table 1. Summary data of harbor seal colonies for the 2007 season. All reported numbers reflect the maximum number seen during a single census.

Location	Max # adults in breeding season[1]	Max # Pups in breeding season	Max # seals in molting season[2]	# Surveys		Max # Reds[3]	Max # Shark Bites[3]	Max # Dead Pups[3]
Bolinas Lagoon	262	126	448	Weekday: Weekend:	30 8	12	3	1
Double Point	469	215	1190	Weekday: Weekend:	20 10	5	5	18
Drakes Estero	759	273	1005	Weekday: Weekend:	22 18	15	2	5
Duxbury Reef	81	7	56	Weekday: Weekend:	25 8	0	1	0
Point Reyes Headlands	119	46	312	Weekday: Weekend:	15 1	1	0	0
Tomales Bay	481	72	415	Weekday: Weekend:	11 12	14	1	2
Tomales Point	374	158	626	Weekday: Weekend:	13 9	7	3	2
Point Bonita	226	6	166	Weekday: Weekend:	41 9	5	2	0
TOTAL	**2771**	**903**	**4218**		**252**	**59**	**17**	**28**

1. Max # Breed = adults and immatures during the breeding season, March 1 to May 31.
2. Max # Molt = all age classes during the molting season, June 1 to July 31.
3. The Max # Red, Shark Bites, and Dead Pups are the maximum number observed March 1 to July 31.

Adult and Pup Counts During the Breeding Season

Adults: The maximum number of adults hauling out during the 2007 breeding season was 2771 for 2007 (Table 1). This fell below but within one standard deviation of the mean number observed from 2000-07 (2954.8 ± 353.7, Figure 2). Drakes Estero had the most adults (759), followed by Tomales Bay (481) and Double Point (469).

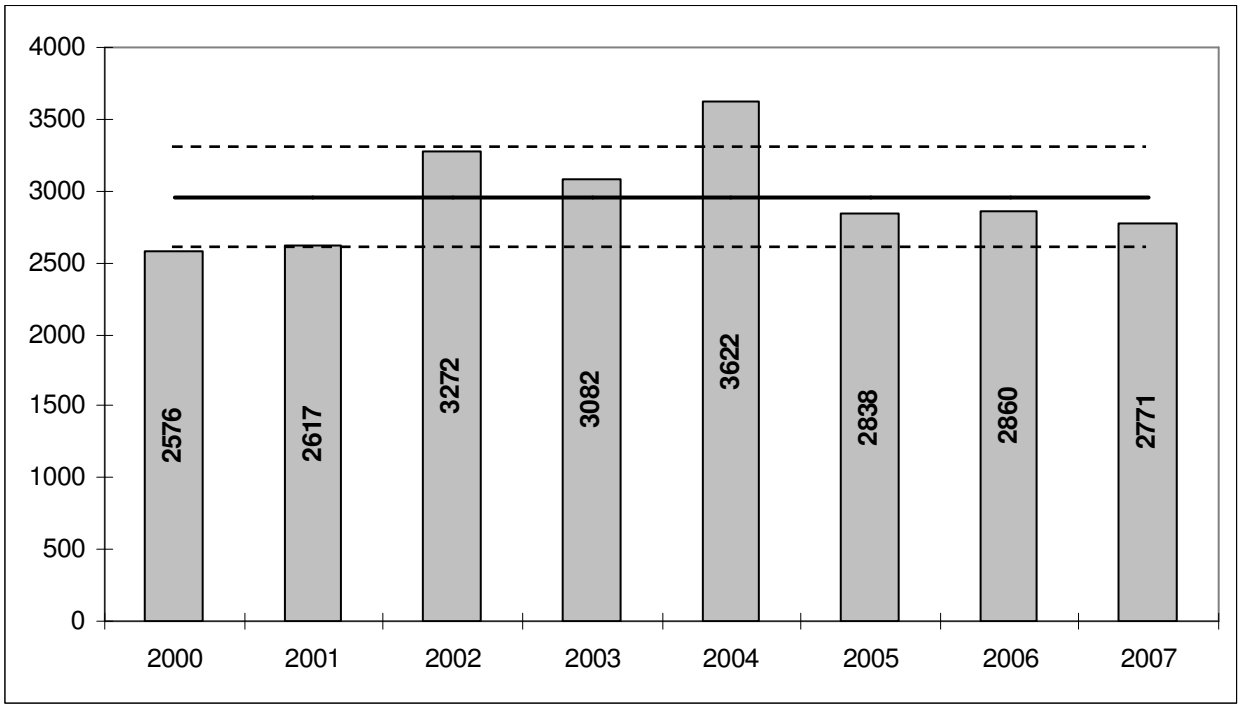

Figure 2. Maximum counts of harbor seal adults and immatures during the breeding season (March-May) at Marin County locations. The solid line on the graph represents the mean of the maximum adult counts from 2000-07 (2954.8), and the dashed lines represent one standard deviation from the mean (353.7).

Pups: The combined maximum pup count for all Marin County locations during the 2007 breeding season was 903 pups (Table 1). The 2007 maximum pup count was 21% lower than the mean maximum pup count from 2000-2007 (1154.5 ± 153.0). The maximum pup counts for 2006 and 2007 fell below one standard deviation from the mean maximum pup count from 2000-2007 (Figure 3). Since 2004 the maximum pup counts have decreased; however, further analyses are needed to determine if these decreases are statistically significant (Figure 3). Drakes Estero and Double Point accounted for 54% (488) of pups at Marin haul outs, which was consistent with the proportions of pups in the past.

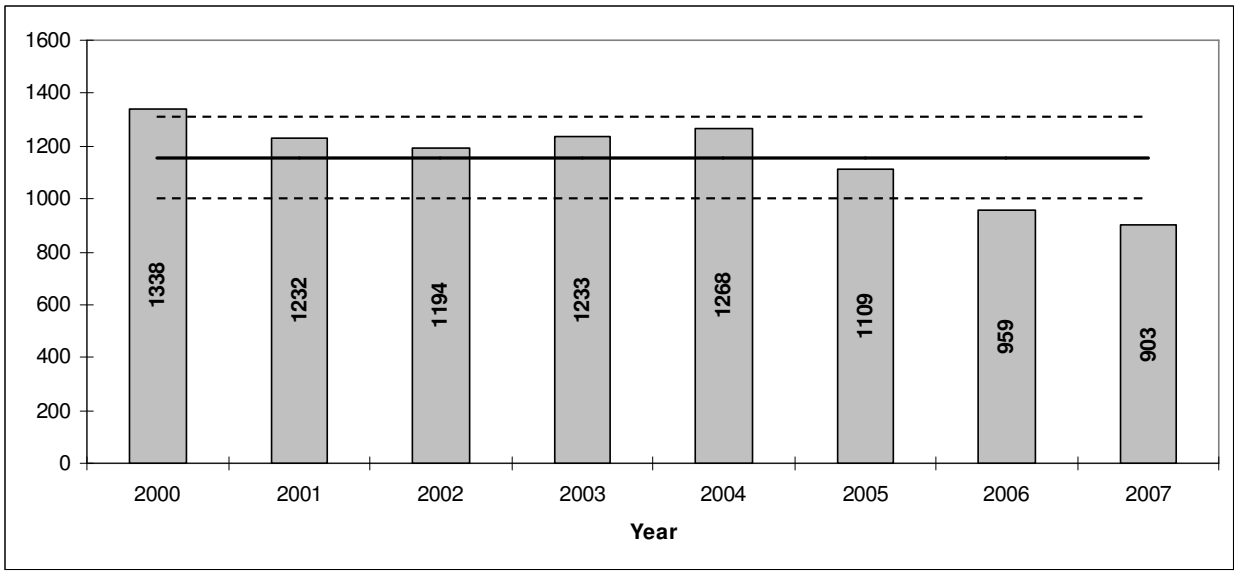

Figure 3. Maximum harbor seal pup counts for 2000-07 at Marin County locations. The solid line on the graph represents the mean of the maximum pup counts from 2000-07 (1154.5), and the dashed lines represent one standard deviation from the mean (153.0).

The first pup observed has been documented since 2000, and there was no apparent trend in the date or location of the first pup observed from 2000 to 2007 (Table 2). In 2007 three pups were observed at Tomales Bay on February 14th but were not seen after that date. It is suspected that these pups may have been premature. Because the pups were not observed closely and not confirmed, they were not included as the first date for the season. The first confirmed pup observed was at Double Point on March 2, 2007, within the normal birth date range.

Table 2. Date of first pup observed in the season by location, 2000-07.

Year	Date	Location
2000	March 14	Point Reyes Headlands
2001	March 16	Tomales Bay
2002	March 3	Drakes Estero
2003	March 27	Bolinas Lagoon
2004	March 20	Double Point
2005	March 6	Drakes Estero
2006	March 9	Double Point
2007	March 2	Double Point

Of the dominant pupping sites (Bolinas Lagoon, Double Point, Drakes Estero, Tomales Bay, and Tomales Point), only Tomales Point did not have a decline in pup numbers from 2006 to 2007 (Figure 4). Tomales Bay experienced the biggest difference (33%) in pup numbers from 2006 to 2007. However, in the past, seals have shifted annually between Tomales Bay and Tomales Point (Allen 2004), and the combined maximum pup counts for 2006 and 2007 were comparable (212 versus 230).

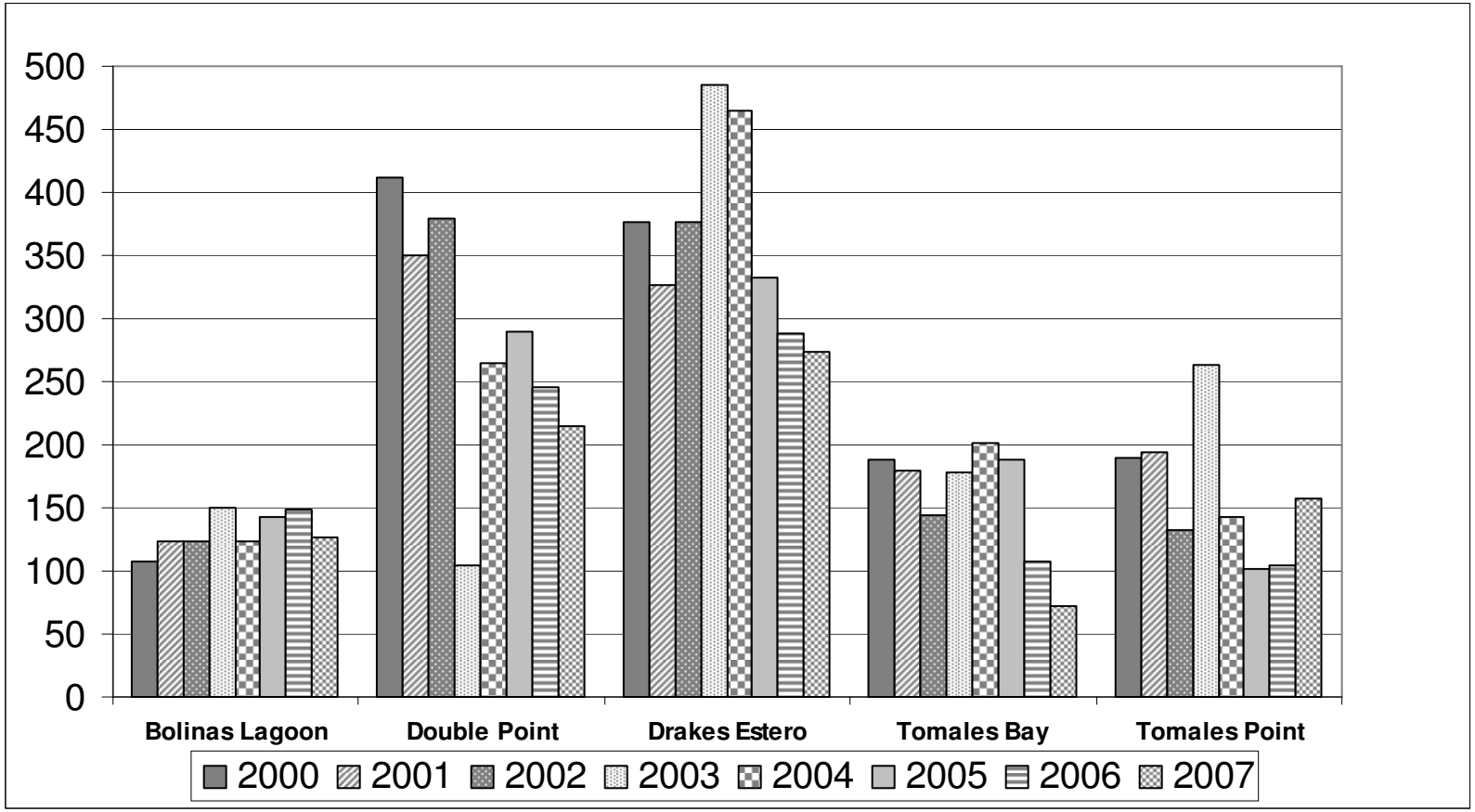

Figure 4. Maximum harbor seal pup counts (*Phoca vitulina richardii)* at the dominant Marin County pupping locations, 2000-2007. The maximums of each site may have been observed on different days.

Molting Counts

The maximum count of all seals during the 2007 molt season for all Marin County locations was 4218 seals. This fell below but within one standard deviation of the mean maximum molt count observed from 2000-07 (4331 ± 637.7, Figure 5). Similar to the pupping season, Drakes Estero and Double Point comprised 52% of the total seals counted during the molt season (Table 1).

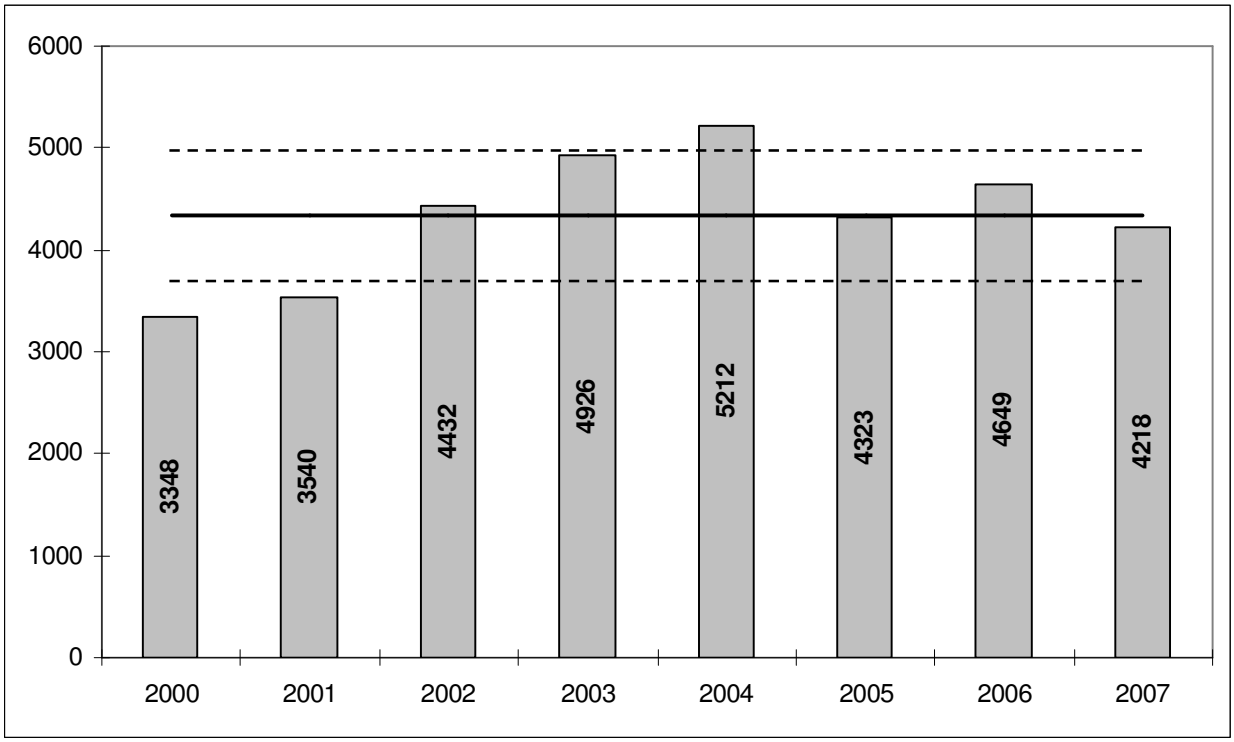

Figure 5. Maximum harbor seal counts during the molt season (June-July) for 2000-07 at Marin County locations. The solid line on the graph represents the mean of the maximum molt counts from 2000-07 (4331), and the dashed lines represent one standard deviation from the mean (637.7).

Disturbances

At the Marin County locations in 2007, 215 disturbances were recorded that elicited a response from harbor seals, representing the greatest number in the study period of 2000-07 (Table 3). Further analysis is required to determine if this increase in disturbances is statistically significant or related to an increase in survey effort. The most common disturbance source (76) was humans, which could have been a clammer, researcher, angler, or hiker (Table 3). Motorboats and non-motorboats had 51 disturbances combined, and a large portion of them were associated with the clammers in Tomales Bay. Bolinas Lagoon had the most disturbances (61), but Tomales Bay and Drakes Estero were close with 45 and 57 disturbances, respectively. Bolinas Lagoon has a subsite (Hwy 1) that is adjacent to a major roadway. This site is subject to loud, sudden noises from vehicles, as well as visitors that approach the seals. The disturbances at Tomales Bay were

Table 3. Identified sources of disturbances (head alert, flush, flush into water) for Marin County locations, from March 1st to July 31st, 2007.

	Motorboat		Non-Motor Boats		Vehicle		Dog		Aircraft		Human		Bird		Unknown		Other		Total
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
2000	14	10.6	9	6.8	0	0.0	0	0.0	14	10.6	30	22.7	20	15.2	41	31.1	4	3.0	**132**
2001	15	10.6	17	12.0	2	1.4	0	0.0	4	2.8	48	33.8	9	6.3	32	22.5	15	10.6	**142**
2002	16	8.9	20	11.1	8	4.4	0	0.0	9	5.0	72	40.0	10	5.6	38	21.1	7	3.9	**180**
2003	11	7.9	23	16.5	3	2.2	0	0.0	10	7.2	43	30.9	10	7.2	32	23.0	7	5.0	**139**
2004	1	1.0	10	10.0	7	7.0	2	2.0	3	3.0	39	39.0	7	7.0	24	24.0	7	7.0	**100**
2005	9	7.4	15	12.3	1	0.8	2	1.6	11	9.0	38	31.1	10	8.2	30	24.6	6	4.9	**122**
2006	13	7.9	16	9.7	4	2.4	1	0.6	8	4.8	59	35.8	16	9.7	36	21.8	12	7.3	**165**
2007	31	14.4	20	9.3	11	5.1	2	0.9	14	6.5	76	35.3	13	6.0	45	20.9	3	1.4	**215**
Average	**13.8**	**8.6%**	**16.3**	**11.0%**	**4.5**	**2.9%**	**0.9**	**0.6%**	**9.1**	**6.1%**	**50.6**	**33.6%**	**11.9**	**8.1%**	**34.8**	**23.6%**	**7.6**	**5.4%**	**149**

mostly related to passing boat traffic and recreational clammers. Hundreds of people dig for clams on the mudflats in Tomales Bay during low tide weekends. The Farallones Marine Sanctuary Association (FMSA) formerly coordinated a program that situated docents on the mudflats during these high visitation days to educate visitors and protect the seals, but this program was terminated in 2005. Disturbances at Drakes Estero, including Limantour Estero, resulted from hikers, clam diggers, and oyster operation activities. Tomales Point, Duxbury Reef, and Point Reyes Headlands received few to no disturbances (3, 0, 0) likely because of the inaccessibility of these sites.

In 2007, Bolinas Lagoon had the greatest disturbance rate (0.75 disturbances per hour), followed by Tomales Bay (0.68) (Figure 6). Of the sites that regularly have more than five disturbances per season, Point Bonita experienced the greatest change compared with 2006 with a 76.1% decrease in the disturbance rate (1.19 versus 0.28) (Figure 7). Double Point and Bolinas Lagoon saw a 67.2% and 16.7% increase in disturbance rates, respectively, while Tomales Bay and Drakes Estero had rates comparable to the previous season. The rates of disturbances vary greatly from year to year depending on activities at each location.

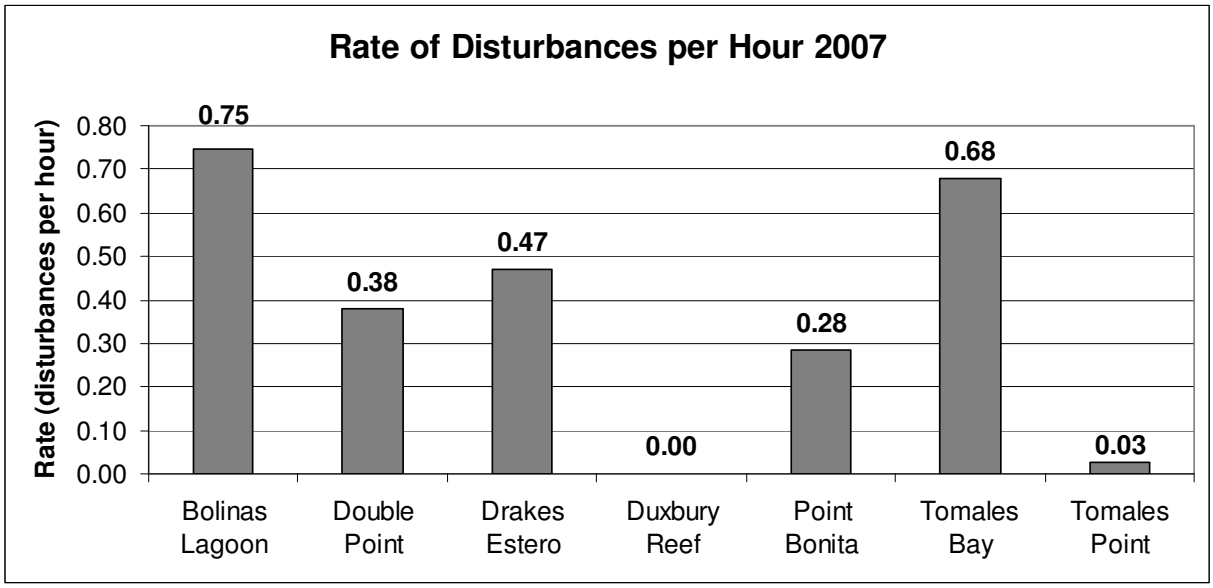

Figure 6. Rates of disturbances per hour at Marin County locations from March through July 2007. Only actual disturbances (head alert, flush, flush water) were used, and survey time was based on observation time for all complete surveys (with or without disturbances).

Summary by Site

Bolinas Lagoon

Bolinas Lagoon had 38 complete surveys between March 1st and July 31st, 2007. Of those surveys, 30 were on weekdays and 8 were on weekends. The maximum count during the breeding season had 262 adults and 126 pups. During the molting season, the maximum count was 448 seals (Table 1). Bolinas had the most disturbances of all sites in 2007 and the dominant

sources were humans and vehicles. This site is along scenic Highway 1 and many visitors stop to see the seals and approach them. Traffic noise also disturbs the seals. This was the only site that documented dog disturbances in 2007, and they were associated with human disturbances. One report documented visitors who drove by the haul-out site and "barked at seals". Bolinas Lagoon had the greatest disturbance rate of all locations in 2007 (0.75 disturbances per hour), and the rate increased 14.8% from 2006.

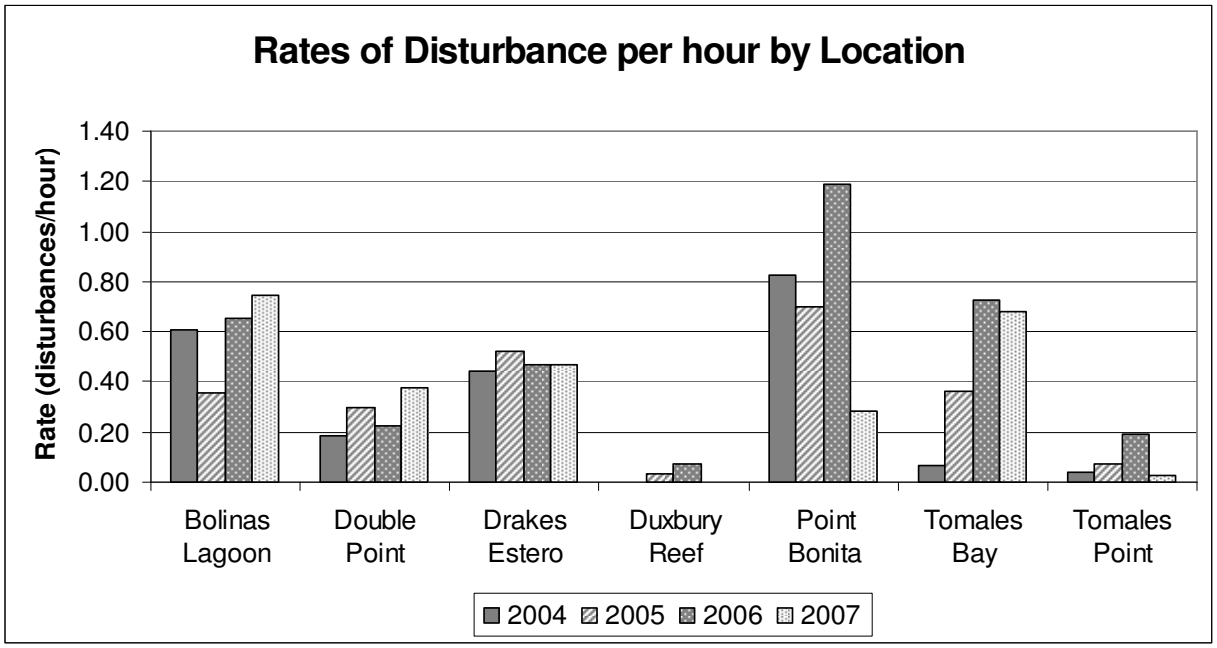

Figure 7. Rates of disturbances per hour at Marin County locations from March through July of 2004-2007. Only actual disturbances (head alert, flush, flush water) were used, and survey time was based on observation time for all complete surveys (with or without disturbances).

Double Point

Double Point had 30 complete surveys between March 1st and July 31st, 2007. Of those, 20 were on weekdays and 10 were on weekends. The maximum count during the breeding season was 469 adults and 215 pups. Molting season yielded a maximum count of 1190 seals (Table 1). Double Point's disturbances were moderate and came mostly from "unknown" sources and aircraft, which fly over the area at various heights. Rarely did the aircraft actually flush seals, but their noise at times elicited head alerts from the seals. Of the 25 actual disturbances, 14 were from an unknown source from the subsite *South Beach*. The bluffs over this beach are actively crumbling and perhaps small rockslides that observers can't see or hear elicited the flushes. Only once this season were people observed on the beach; it was during a weekend survey and no seals were hauled out on that portion of beach. Double Point had a substantial increase in the disturbance rate from last year (2006: 0.23, 2007: 0.38, 67.2% increase) due to increases in both aircraft and "unknown" sources.

Drakes Estero

The Drakes Estero complex which includes Limantour Estero had 40 complete surveys between March 1st and July 31st, 2007. Of those, 22 were on weekdays and 18 were on weekends. The maximum count during the breeding season was 759 adults and 273 pups, and the maximum molt count was 1005 (Table 1). Next to Bolinas Lagoon, Drakes Estero had the second highest disturbance count, with 57 disturbances within the breeding and molting seasons. The disturbance rate, however, was moderate compared to other sites (Figure 6). Most of the disturbances (26) were from human sources and this included hikers, anglers, swimmers, horseback riders, and recreational clammers. Clamming is popular on Drakes Beach, where seals do not always haul out in large numbers, but the activities at times affect seals on nearby sandbars. Fishermen are frequently seen on the tip of Limantour Spit in the exact area where seals haul out during the molting season. In addition, activities associated with the oyster operation in Drakes Estero at times disturbed harbor seals at the upper estero subsites. The disturbance rate for 2007 and 2006 were identical, with 0.47 disturbances per hour (Figure 7).

Duxbury Reef

Duxbury Reef had 33 complete surveys between March 1st and July 31st, 2007. Of those, 25 were on weekdays and 8 were on weekends. During the breeding season, the maximum adult count was 81 and the maximum pup count was 7, while during the molting season the maximum seal count was 56 (Table 1). Duxbury had the lowest number of seals and, as with the Point Reyes Headlands, no documented disturbances. Disturbances are rarely recorded at Duxbury Reef, possibly due to the low accessibility of the location.

Point Bonita

Point Bonita had 50 complete surveys between March 1st and July 31st, 2007. Of those, 41 were on weekdays and 9 were on weekends. During the breeding season, the maximum adult count was 226 and the maximum pup count was 6 pups, while during the molting season the maximum seal count was 166. In an effort to better document the seal numbers and disturbances, more pre-season surveys were conducted. The disturbances at Point Bonita were primarily from people on the beach, which often consisted of school groups. Because of repeated disturbances to harbor seals, the area below the paved walkway was closed to visitors in mid-June 2007. Future observations will tell the efficacy of this action. However, disturbance rates decreased substantially in 2007, with only 0.28 disturbances recorded per hour compared to the 2006 rate of 1.19 (76.1% decrease).

Point Reyes Headlands

Point Reyes Headlands had 16 complete surveys between March 1st and July 31st, 2007, and all but one of them were completed during weekdays. During the breeding season, the maximum adult count was 119 and the maximum pup count was 46, while during the molting season the maximum seal count was 312 (Table 1). This site rarely has disturbances because of its remoteness and inaccessibility. Most of the harbor seals were seen at a large elephant seal colony pocket beach. There were some vacated spaces on the beach during the elephant seal molt, but harbor seals were also seen in extremely close proximity to the elephant seals. Some surveys were hindered by heavy fog that is usually present in the Point Reyes Headlands.

Tomales Bay

Tomales Bay had 23 complete surveys between March 1st and July 31st, 2007. Of those, 11 were weekday and 12 were weekend surveys. During the breeding season, the maximum adult count was 226 and the maximum pup count was 72, while during the molting season the maximum seal count was 415 (Table 1). The pup count was the second lowest it has been since 2002 (Figure 4). There were 45 recorded disturbances, most of which were caused by boats and humans, including recreational clammers. Tomales Bay had the second highest disturbance rate of all locations, with 0.68 disturbances per hour, which was consistent with last year's rate. . The increase in disturbances in 2006 coincided with the cessation of a FMSA docent program that educated clammers to avoid seals from 1997 through 2005.

Tomales Point

Tomales Point had 22 complete surveys between March 1st and July 31st, 2007. Of those, 13 were on weekdays and 9 were on weekends. During the breeding season, the maximum adult count was 226 and the maximum pup count was 158, while during the molting season the maximum seal count was 626. Only three disturbances occurred at this location (human, bird, and unknown), and due to its remoteness, is not frequented by park visitors. Abalone divers were observed there during the breeding season, but they were never seen disturbing seals.

Regional Sites

Thirteen regional surveys occurred between March 10th and July 28th, 2007 at 20 different locations. Not all sites were surveyed on all scheduled days. Some sites were surveyed on days other than regional survey days, and therefore could not be used in this summary. Other sites had difficulty with weather on certain days. During the breeding season, a maximum of 3979 adults and 974 pups were observed, although the maximum counts may have occurred on different days for each location (Table 4). During the molting season, the combined maximum of all seals from each site was 4787. Marin County locations accounted for 73.2% (2916/3979) of the maximum adult/immature breeding count, 84.4% (765/974) of the maximum pup count, and 74.1% (3459/4787) of the maximum molt count.

Within the San Francisco Bay, high counts for seals occurred at Castro Rocks and Mowry Slough, as has been observed in the past. In San Mateo County the highest concentration of seals was on the coast at Fitzgerald Marine Reserve, but the most pups occurred at Pebble Beach (20). In Sonoma County, the Sonoma Coast location accounted for the most seals this year, which is consistent with previous data. No counts were conducted this year at Yerba Buena Island (in San Francisco Bay), or Fort Ross (in Sonoma County).

Disturbances in San Francisco Bay were only recorded at Castro Rocks, and it was from the CalTrans truck associated with the observers. At Fitzgerald Marine Reserve and Sonoma Coast, tide poolers and airplanes disturbed hauled out seals. At Jenner, kayakers, hikers, and divers caused disturbances.

Table 4. Regional surveys of harbor seal numbers in central California, March 1st through July 31st, 2007. Thirteen surveys were scheduled on alternating weekends, eight during the breeding season and five during the molt. ND=No data.

	Breeding Season					Molting Season			
Location	**n**	**Mean of adults**	**Standard error**	**Max of adults[1]**	**Max of pups[2]**	**n**	**Mean of adults**	**Standard error**	**Max of adults**
Sonoma County									
Sonoma Coast	5	146.4	18.33	190	35	3	203.7	23.84	251
Fort Ross	ND	ND	ND	ND	ND	ND	ND	ND	ND
Jenner	5	54.6	13.83	89	6	3	272.3	77.95	400
Marin County									
Tomales Bay	7	315.3	39.44	644	65	3	331	27.62	384
Tomales Point	7	190	41.19	506	105	2	301.5	230.5	532
Pt. Reyes Headland	6	34.67	8.22	119	46	2	79	6	278
Drakes Estero	6	573	61.07	683	273	3	650.33	141.05	932
Double Point	7	314.86	59.02	424	198	2	628	137	765
Duxbury Reef	8	26.3	8.81	84	4	5	17.2	10.74	56
Bolinas Lagoon	8	172.13	21.38	262	126	5	303.2	49.5	448
Point Bonita	7	74.29	21.74	148	5	5	105.8	18.46	153
San Francisco Bay									
Alcatraz	3	12	2.35	15	0	ND	ND	ND	ND
Castro Rocks	6	164	14.2	213	36	3	88.3	10.33	109
YBI	ND	ND	ND	ND	ND	ND	ND	ND	ND
Newark Slough	2	14	3	17	8	1	0	0	0
Mowry Slough	3	32.3	10.11	50	5	1	15	0	15
San Mateo County									
Point San Pedro	5	14.4	2.46	22	2	2	15.5	3.5	19
Cowell Ranch	4	70.3	10.94	86	18	2	79	1	80
Pescadero	5	32	4.22	41	6	3	29.7	12.25	54
Pebble Beach	5	75.6	13.22	117	20	3	95.3	4.37	104
Bean Hollow	5	6.8	2.63	15	1	3	13.3	2.91	18
Fitzgerald Marine Reserve	7	174.9	8.52	208	15	4	153	13.8	189
ALL LOCATIONS				**3979**	**974**				**4787**

[1]Based on the total for a single day

[2]Based on the total for the same single day as above

Conclusion

Highlights

- 36 volunteers completed 251 surveys at Marin County locations between March 1st and July 31st 2007, donating approximately 2152 hours of their time.

- A maximum of 2771 adults/immatures seals hauled out during the breeding season.
    - The 2007 maximum fell below but within one standard deviation of the mean number observed from 2000-07 (2954.8 ± 353.7).
    - The greatest number of adults hauled out at Drakes Estero (759), followed by Tomales Bay (481) and Double Point (469).

- A maximum of 903 pups were born in Marin haul outs.
    - The 2007 maximum pup count fell below one standard deviation from the mean maximum pup count from 2000-2007 (1154.5 ± 153.0).
    - The greatest number of pups was born at Drakes Estero (273), followed by Double Point (215).

- A maximum of 4218 animals molted at Marin County sites.
    - The 2007 maximum molt count fell below but within one standard deviation of the mean maximum molt count observed from 2000-07 (4331 ± 637.7, Figure 5).
    - Double Point had the most molting seals (1190), followed by Drakes Estero (1005).

- 215 disturbances were recorded during surveys.
    - The most common categories of disturbances were human (35.3%), unknown (20.9%), and motor boat (14.4%).

- Regional surveys occurred 13 times throughout the season, which include Sonoma, Marin, San Francisco, and San Mateo counties.
    - Marin County locations accounted for 73.2% (2916/3979) of breeding season adults/immatures, 84.4% (765/974) of pups, and 74.1% (3459/4787) of seals during the molting season.

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NPS D-553, June 2008

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