ABOUT THIS MAP

Figure 4.11 is an overview map for Pacific harbor seal (*Phoca vitulina richardsii*) summarizes the at-sea sightings and effort and the locations of haulouts and known pupping sites within the study area. At-sea sightings are based on eight surveys ranging from 1980-2003. For context, the combined, at-sea survey effort (kilometers of trackline) for all surveys in the CDAS data set (1980-2003) is shown, summarized in 10'x10' cells. Dark blue lines indicate the National Marine Sanctuary boundaries of Cordell Bank, Gulf of the Farallones, and Monterey Bay. Locations of haulouts and rookeries on the overview map are based on aerial survey data collected in May–July 2004; the number of harbor seals at these sites can vary significantly from year to year. See Figure 4.12 and related text for an inset map of harbor seal land use of the Pt. Reyes area.

DATA SOURCES AND METHODS

At-sea sightings and are based on the CDAS central California data set (1980-2003), developed using software called Marine Mammal and Seabird Computer Data Analysis System (CDAS), by the R.G. Ford Consulting Co. This data set contains data from eight survey programs (five aerial surveys, three ship surveys) conducted between 1980 and 2003; the data extends from Pt. Arena to Pt. Sal in the study area. See the Data and Analyses section of this chapter for additional information on the at-sea survey data sets. Due to insufficient harbor seal sightings associated with low densities, seasonal at-sea density maps were not produced. At-sea sightings show locations of animals seen, but sightings are affected by many factors, including time and location of survey effort, platform (e.g., plane or ship) oceanographic and meteorological conditions, and animal behavior (i.e., marine mammals are often submerged). At sea survey effort was summarized for pinnipeds by 10'x10' cell for this analysis.

The haulout information on the overview map are from aerial photographic survey data provided by Mark Lowry of the Southwest Fisheries Science Center, NOAA's National Marine Fisheries Service, La Jolla, CA. The overview map shows a summary of the numbers of seals observed hauled out during the molt period during an aerial photographic census conducted in California during 18 May – 19 July 2004. Each of three sections along the coast of California was surveyed on different dates to compensate for latitudinal differences in the timing of the molt (Lowry *et al.,* 2005). Surveys in central California were conducted 22-25 June 2004 and in northern California during 5-9 July and 18-19 2004. Surveys occurred during the low-low tide cycle. The Lowry survey is limited to molt season only and does not represent pupping sites or numbers. The latitude/longitude coordinates of harbor seals on land were used to plot the individual sightings. Locations of haulout sites are mapped coordinates provided by Mark Lowry. See Lowry *et al.,* (2005) and Allen *et al.,* (2004) for details on survey methods. Note that the haulout data shown on the Overview map is from a different source that shown on the Pt. Reyes map.

Information on pupping was from the following individuals: D. Greig, The Marine Mammal Center in Sausalito; E. Grigg at University of California (UC), Davis; P. Morris, UC, Santa Cruz; D. Lee, PRBO Conservation Science, S. Allen, National Park Service, Pt. Reyes National Seashore, and Mark Lowry, NOAA's Southwest Fisheries Science Center.

RESULTS AND DISCUSSION

The subspecies of Pacific harbor seal that occurs in the study area, *P. v. richardsii*, is distributed from the Pribilof Islands in Alaska to Baja California. There are three stocks recognized for this subspecies; the map presented here is the California stock. When Pacific harbor seals are ashore, they occur on sandy beaches, mudflats, rocks along the open coast, and in estuaries and rivers. Data from this study indicate that Pacific harbor seals forage

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throughout coastal waters; the at-sea distribution of harbor seals occurred mostly in shelf habitats of all three national marine sanctuaries.

Pacific harbor seals are present in the study area year round; they usually do not make extensive migrations, and tend to remain relatively close to their haulout sites. Pacific harbor seals usually occur less than five miles from shore and are generally not captured in aerial or at-sea surveys (S. Allen, pers. comm.). Pacific harbor seals have, however, been known to range farther than previously believed (Grigg, 2003). Results of 2002 tagging studies showed that individuals from San Francisco Bay traveled to Duxbury Reef and out to the Farallon Islands to forage (Allen, pers. comm., 2003; Nickel, 2003). This species has been documented to range up to 500 km (Allen Miller, 1988, unpub. data).

In the study area, breeding and pupping vary by latitude, and in general, breeding occurs March – June; pupping generally occurs March – June (March 1st – May 30th at Pt. Reyes); and molting generally occurs May – July. Duration of lactation is 21 – 42 days. Harbor seals feed on seasonally abundant prey that includes topsmelt, night smelt, white croaker, English sole (Harvey *et al.,* 1995), salmonids (Weise, 2001), squid and octopus (Riedman, 1990).

Overview Map – At-Sea Sightings and Effort. The CDAS data set shows harbor seals at sea were distributed in shelf habitats in relatively low densities in all three national marine sanctuaries; therefore, insufficient data precluded generating seasonal maps. Harbor seals are inconspicuous at sea and this may explain the relatively low numbers of animals surveyed in the CDAS data set (sightings: n=192; individuals: n=235). Furthermore, because at-sea sightings are influenced by survey effort (and the survey effort in CDAS surveys was unequal and coverage was less along the coast; see Figure 4.1), this overview map likely does not accurately represent the complete foraging/at-sea distribution of harbor seals in the study area. And although not evident in the maps, densities are generally higher in the Gulf of the Farallones than the rest of the study area because there are more and larger haulout sites in this area (Allen *et al.,* 2002).

Overview Map – Haulout and Pupping Sites. In the study area, haulout sites (Lowry, 2004) are shown along the coast from Pt. Arena south to Pt. Sal, and at the Southeast Farallon Islands; haulout sites on the overview map represent the numbers of seals hauled out during the molt period at a given instant during low-low tide, and do not account for the multiple environmental factors and disturbances that can affect haulout behavior at site-specific locations. Use of the haulout sites by harbor seals varies seasonally (Allen, pers. comm.). Factors that affect the number of seals onshore include: life history stage (e.g., breeding, pupping, molting), time of day, tidal state, weather conditions, disturbance related to human activities (Harvey and Goley, 2005) and year (Grigg *et al.*, 2004). Seals have a tendency to move regularly within a region, and individual seals may use several haulout sites through the year (Grigg, 2003). In general, however, seals use one site exclusively within the breeding and molt season and often use multiple sites during the rest of the year (Thompson, 1989 In: Grigg 2003 and Allen Miller 1988). Although pupping may occur at any of the haulout sites, within the study area, pupping occurs more commonly on mudflats and sandy beaches.

Data summarized on this map clearly indicate the widespread harbor seal use of the central coast (and within San Francisco Bay) during the breeding/pupping/molting season (May – July). Pupping sites include the Point Reyes area (see detailed map below) and except for the Channel Islands, the Point Reyes population of harbor seals represents the largest concentration of harbor seals in the State of California, accounting for ~20% of the mainland breeding population (Sydeman and Allen, 1999; Lowry and Carretta, 2003). Pupping sites are also located at Año Nuevo Island (Morris, pers. comm.), Elkhorn Slough, Hopkins Marine Station, Cypress Point, Fanshell Beach, Cypress Point, San Lorenzo River and Point Lobos (Greig, pers. comm.). Additional haulout sites along the coast south of San Francisco may exist at Pescadero and Bean Hollow (not mapped), but these sites are poorly documented (Greig, pers. comm.). Note also that a few pups (less than five) were also produced on South Farallon Island (USFWS, 2000; Lee, pers. comm., 2007). Although harbor seal mothers and pups haul-out on rocks offshore of the Año Nuevo mainland, it is not known whether they

deliver their pups in these locations or deliver out on the island and its offshore rocks and then move to the mainland offshore rocks as the pups become more competent swimmers (Morris, pers. comm., 2006). Within San Francisco Bay (SFB), pupping sites are also known to occur at Mowry Slough (encompasses Newark Slough) and Castro Rocks (major pupping sites). Smaller pupping sites within SFB include Greco Island, Corkscrew Slough, Corda Madera Marsh, and Yerba Buena Island (Grigg, pers. comm., 2006). Within the Delta, harbor seals haulout at Ryer Island in Grizzley/ Suisun Bay (numbers at this site have risen from 10 seals in 1993 to 53 in 2002) (Grigg, 2003; Read, pers. comm.). Pupping can occur at any haulout site, but the haulout sites listed above and mapped were known to have pupping.

In California, 563 harbor seal haulout sites are widely distributed along the mainland and offshore islands, and include rocky shores, beaches and intertidal sandbars (Lowry *et al.,* 2005). Statewide, the population of Pacific harbor seals appears to be increasing, however the rate of increase is lower than in the 1980s and 1990s (Lowry *et al.,* 2005). Overall, the greatest number of seals in the study area occurred between 37.50º N and 37.99º N (Lowry *et al.,* 2005). Because a number of harbor seals are generally away from the haulout sites at all times, and because pups enter the water quickly after birth, a total count of harbor seals is not possible (Carretta *et al.,* 2002).

Strandings. Between January 1992 and December 2001, 940 Pacific harbor seals were stranded live along the central California coast (Colegrove *et al.,* 2005). Trauma (87%), malnutrition (51.8%) and respiratory disease (9.6%) were the most common causes of strandings; secondary factors included human interaction. An ocular disease coincided with a moderate ENSO in 1992-1993. In the past ten years, human interference in stranding events increased and were most commonly reported on beaches near heavily populated areas (Colegrove *et al.,* 2005).

Fisheries Interactions. Other human-related sources of injury and mortality include: set gillnet (halibut/angel shark), gillnet, hook-and-line fisheries, boat collisions, entrainment in power plants, illegal shootings, and all-terrain vehicle (ATV) collisions (Carretta *et al.,* 2006). Fishery mortality is considered to be significant because the average rate of incidental fishery mortality for this stock is likely to be greater than 10% of the calculated potential for biological removal (Carretta *et al.,* 2006).

Contaminants. Although there are no habitat issues of particular concern for the Pacific harbor seal, there is evidence that environmental contaminants and pollutants can affect reproductive success and may impair the seals' immune systems. Because harbor seals frequent coastal habitats often altered by industrial centers, heavy marine traffic, and urban and agricultural runoff, harbor seals typically experience relatively high exposures to contaminants. Harbor seals use coastal habitats, bays, and estuaries for resting, foraging, and reproduction, and are thus likely to be excellent indicators of the health of coastal/estuarine systems (Kopec and Harvey, 1995; Grigg, 2002). Maternal transfer of persistent marine contaminants (PCBs and DDE) to harbor seal pups in north/central California via milk has been documented (Neale *et al.,* 2005b); contaminant-induced immune alterations have also been found in north-central California harbor seals (Neale *et al.,* 2002; Neale, 2003). Although PCB residues decreased during the past decade in a comparison study on harbor seals within San Francisco Bay, they remained at levels great enough that adverse reproductive and immunological effects might be expected (Neale *et al.,* 2005; Grigg, 2003). Exploring causal links between chronic exposure and seal health has been identified as an area of future research in this at-risk population (Neal *et al.,* 2005a).

Other Threats. Marine debris is another threat to the seals (and most marine life) - nets, plastic materials or debris can be ingested accidentally or can become caught around their necks, strangling the seals as they grow. Natural predators of harbor seals include sharks (their primary predator), killer whales, and Steller sea lions (minimal predator).