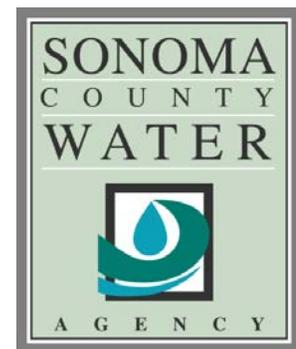


Russian River Estuary Management Project

Marine Mammal Protection Act Incidental Harassment Authorization

Report of Activities and Monitoring Results – January 1 to December 31, 2015



Prepared for
Office of Protected Resources and
Southwest Regional Administrator
National Marine Fisheries Service

Prepared by
Andrea Pecharich
Jessica Martini-Lamb
Sonoma County Water Agency



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EXECUTIVE SUMMARY

The purpose of this report of activities and monitoring results is to comply with the requirements of the Incidental Harassment Authorization (IHA) issued pursuant to Section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C 1361 et seq.) to take small numbers of marine mammals, by Level B harassment, incidental to the Sonoma County Water Agency's (Water Agency) Russian River Estuary Water Level Management Activities (April 20, 2015, NMFS IHA).

The Water Agency applied in 2009 to the National Marine Fisheries Service (NMFS) Office of Protected Resources for an IHA under the Marine Mammal Protection Act (MMPA) for activities associated with water level management activities in the Russian River estuary. NMFS issued an original IHA to the Water Agency on March 30, 2010 and in each subsequent year. This report provides the results of all monitoring of baseline conditions and water level management activities for the 2015 calendar year, and additional summary information for all related activities.

The estuary may close throughout the year as a result of a barrier beach forming across the mouth of the Russian River. Closures result in the formation of a lagoon behind the barrier beach and, as water surface levels rise in the estuary, flooding may occur. The Water Agency's artificial breaching activities are conducted in accordance with the Russian River Estuary Management Plan recommended in the Heckel (1994) study. The purpose of artificially breaching the barrier beach is to alleviate potential flooding of low-lying properties along the estuary. The Water Agency and the U.S. Army Corps of Engineers (Corps) consulted with NMFS under Section 7 of the Endangered Species Act (ESA) regarding the potential effects of their operations and maintenance activities, including the Water Agency's estuary management program, on federally-listed steelhead (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*). As a result of this consultation, NMFS issued the Russian River Biological Opinion (NMFS 2008) finding that artificially elevated inflows to the Russian River estuary during the low flow season (May through October) and historic artificial breaching practices have significant adverse effects on the Russian River's estuarine rearing habitat for steelhead trout. The historic method of artificial sandbar breaching, which is done in response to rising water levels behind the barrier beach, adversely affects the estuary's water quality and freshwater depths.

The Biological Opinion (NMFS 2008) concludes that the combination of high inflows and breaching practices impact rearing habitat because they interfere with natural processes that cause a freshwater lagoon to form behind the barrier beach. Fresh or brackish water lagoons at the mouths of many streams in central and southern California often provide depths and water quality that are highly favorable to the survival of rearing salmon and steelhead.

The Biological Opinion's Reasonable and Prudent Alternative (RPA) 2 (NMFS 2008) requires the Water Agency to collaborate with NMFS and to modify estuary water level management in order to reduce marine influence (high salinity and tidal inflow) and promote a higher water surface elevation in the estuary (formation of a fresh or brackish lagoon) for purposes of enhancing the quality of rearing habitat for juvenile (age-0+ and -1+) steelhead from May 15 to October 15 (the lagoon management period). A program of potential, incremental steps are prescribed to accomplish this, including adaptive management of a lagoon outlet channel on the barrier beach.

The Biological Opinion also requires the Water Agency to study the potential influences of an existing jetty at the mouth of the Russian River on water surface elevations in the estuary. In accordance with

the Biological Opinion's RPA 2 the Water Agency commissioned a study plan to analyze the effects and role of the existing, remnant Goat Rock State Beach jetty on beach permeability, seasonal sand storage and transport, seasonal flood risk, and seasonal water surface elevations in the Russian River estuary (ESA PWA 2011). Implementation of this study plan began in 2014 and included the installation and maintenance of monitoring wells and geophysical surveys.

Harbor seals (*Phoca vitulina richardsi*) regularly haul out at the mouth of the Russian River (Jenner haul-out). California sea lions (*Zalophus californianus*) and northern elephant seals (*Mirounga angustirostris*) are occasionally observed at the haul-out. There are also several known resting areas in the river at logs and rock piles. The Water Agency applied for an IHA under the MMPA for activities associated with Russian River estuary management activities, which occur in the vicinity of these haul-outs, including:

- excavation and maintenance of a lagoon outlet channel that would facilitate management of a summer lagoon to improve rearing habitat for listed steelhead as required by the Russian River Biological Opinion (NMFS 2008);
- artificially breaching the barrier beach to minimize the potential for flooding of low-lying properties along the estuary;
- biological and geophysical monitoring activities associated with the management actions described above;
- construction and maintenance of monitoring wells on the barrier beach south of the jetty; and
- geophysical surveys conducted at the barrier beach.

Pinniped monitoring was performed in accordance with the requirements of the NMFS IHA issued April 20, 2015, and the Russian River Estuary Management Activities Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2011).

In an attempt to understand possible relationships between use of the Jenner haul-out and nearby coastal and river (peripheral) haul-outs, several other haul-outs on the coast and in the Russian River estuary were monitored. These haul-outs include North Jenner and Odin Cove to the north, Pocked Rock, Kabemali, and Rock Point to the south, and Penny Logs, Paddy's Rock, and Chalanchawi in the Russian River estuary.

Baseline monitoring was performed to gather additional information about the population of harbor seals utilizing the Jenner haul-out including population trends, patterns in seasonal abundance and the influence of barrier beach condition on harbor seal abundance. Pinniped monitoring was also conducted in relation to Water Agency water level management events (lagoon outlet channel implementation and artificial breaching). Each of the peripheral haul-outs was monitored concurrent with Jenner baseline monitoring and monitoring of water level management activities. Estuary management monitoring occurred during the Water Agency's monthly topographic surveys of the barrier beach, Jetty Study investigations, and biological and physical monitoring of the estuary. The purpose of estuary management monitoring is to record any pinniped disturbances during the above activities.

A barrier beach was formed eleven times during 2015, but only during four of these closure events did the Water Agency artificially breach the sand bar. The Russian River mouth was closed to the ocean for a total of 115 days (or 32%) in 2015, mostly during the fall months. Pinniped monitoring occurred no more than 3 days before, the day of, and the day after each water level management activity.

The Water Agency's biological and physical monitoring activities of the estuary are included in the NMFS IHA. The Water Agency surveys the sandbar (or barrier beach) monthly to collect a topographic map of the beach, as required by the Russian River Biological Opinion. A monitor is present during these surveys to record any disturbances of the Jenner haul-out during the survey. In 2015 the Water Agency completed the Jetty Study Plan (ESA PWA 2011) and a pinniped monitor was present to record any disturbances of the Jenner haul-out, similar to the monthly topographic surveys. Additionally, Water Agency field staff conducting biological and physical monitoring in the estuary recorded any pinnipeds they encountered hauled out and any disturbance to pinnipeds associated with their activities.

The Russian River estuary management and monitoring activities in 2015 resulted in incidental harassment (Level B harassment) of 2,383 harbor seals and 1 California sea lion, well under the total allowed by NMFS IHA. The Russian River estuary management activities in 2014, 2013, 2012, 2011 and 2010 resulted in incidental harassment (Level B harassment) of 2,121, 1,351, 208, 42 and 290 harbor seals, respectively.

INTRODUCTION

The purpose of this report of activities and monitoring results is to comply with the requirements of the Incidental Harassment Authorization (IHA) issued pursuant to Section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C 1361 et seq.) to take small numbers of marine mammals, by Level B harassment, incidental to the Sonoma County Water Agency's (Water Agency) Russian River estuary water level management activities (April 20, 2015, NMFS IHA).

The Water Agency applied in 2009 to the National Marine Fisheries Service (NMFS) Office of Protected Resources for an IHA under the Marine Mammal Protection Act (MMPA) for activities associated with water level management activities in the Russian River estuary. NMFS issued an original IHA to the Water Agency on March 30, 2010 and in each subsequent year. This report provides the results of all baseline monitoring, water level management activities, and activities related to the Jetty Study Plan (ESA PWA 2011) for the 2015 calendar year, and additional summary information for all related activities.

BACKGROUND

The Russian River estuary is located about 97 kilometers (km; 60 miles) northwest of San Francisco in Jenner, Sonoma County, California (Figure 1). The Russian River watershed encompasses 3,847 square kilometers (km) (1,485 square miles) in Sonoma, Mendocino, and Lake Counties. The estuary extends from the mouth of the Russian River upstream approximately 10 to 11 km (6 to 7 miles) between Austin Creek and the community of Duncans Mills (Heckel 1994).

The estuary may close throughout the year as a result of a barrier beach forming across the mouth of the Russian River. The mouth is located at Goat Rock State Beach (California Department of Parks and Recreation). Closures result in formation of a lagoon behind the barrier beach and, as water surface levels rise in the estuary, flooding may occur. Natural breaching events occur when estuary water surface levels exceed the capability of the barrier beach to impound water, causing localized erosion of the barrier beach and creation of a tidal channel that reconnects the Russian River to the Pacific Ocean.

The barrier beach has also been artificially breached for decades; first by local citizens, then the County of Sonoma Public Works Department, and, since 1995, by the Water Agency. The Water Agency's artificial breaching activities are conducted in accordance with the Russian River Estuary Management Plan recommended in the Heckel (1994) study. The purpose of artificially breaching the barrier beach is to alleviate potential flooding of low-lying properties along the estuary.



Figure 1

Biological Opinion and the Estuary

The Water Agency and the U.S. Army Corps of Engineers (Corps) consulted with the NMFS under Section 7 of the Endangered Species Act (ESA) regarding the potential effects of their operations and maintenance activities, including the Water Agency's Estuary Management Program, on federally-listed steelhead (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*). As a result of this consultation, NMFS issued the Russian River Biological Opinion (NMFS 2008) finding that artificially elevated inflows to the Russian River estuary during the low flow season (May through October) and historical artificial breaching practices have significant adverse effects on the Russian River's estuarine rearing habitat primarily for steelhead trout. The historical method of artificial sandbar breaching, which is done in response to rising water levels behind the barrier beach, adversely affects the Estuary's water quality and freshwater depths.

The historical artificial breaching practices create a tidal marine environment with shallow freshwater depths and high salinity. Salinity stratification contributes to low dissolved oxygen at the bottom in some areas. The Biological Opinion (NMFS 2008) concluded that the combination of high inflows and breaching practices impacted rearing habitat by interfering with natural processes that form a freshwater lagoon behind the barrier beach. Fresh or brackish water lagoons at the mouths of many streams in central and southern California often provide depths and water quality that are highly favorable to the survival of rearing salmon and steelhead.

The Biological Opinion's Reasonable and Prudent Alternative (RPA) 2 (NMFS 2008) requires the Water Agency to collaborate with NMFS to modify estuary water level management to reduce marine influence on the estuary (tidal inflow and high salinity) and to promote a higher water surface elevation in the estuary to form a fresh or brackish lagoon to enhance rearing habitat for juvenile (age-0+ and -1+) steelhead from May 15 to October 15 (the lagoon management period). The Biological Opinion outlines a program of potential, incremental steps to accomplish this, including adaptive management of a lagoon outlet channel on the barrier beach.

In accordance with the Biological Opinion's RPA 2 the Water Agency commissioned a study plan to analyze the effects and role of the existing, remnant Goat Rock State Beach jetty on beach permeability, seasonal sand storage and transport, seasonal flood risk, and seasonal water surface elevations in the Russian River Estuary (ESA PWA 2011). Implementation of this study plan began in March 2014 and included the installation and maintenance of monitoring wells and geophysical surveys.

Harbor seals (*Phoca vitulina richardsi*) regularly haul out at the mouth of the Russian River (Jenner haul-out) (Figure 1). California sea lions (*Zalophus californianus*) and northern elephant seals (*Mirounga angustirostris*) are occasionally observed at the haul-out. There are also several known resting sites in the river at logs and rock piles in the estuary (Figure 1). The Water Agency applied for an IHA under the MMPA for activities associated with Russian River estuary management activities, including:

- excavation and maintenance of a lagoon outlet channel that would facilitate management of a summer lagoon to improve rearing habitat for listed steelhead as required by the Russian River Biological Opinion (NMFS 2008);
- artificially breaching the barrier beach to minimize the potential for flooding of low-lying properties along the estuary;
- biological and geophysical monitoring activities associated with the management actions described above;

- construction and maintenance of monitoring wells on the barrier beach south of the jetty; and
- geophysical surveys conducted at the barrier beach.

The purpose of the Russian River Estuary Management Project Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2011) is to detect the response of pinnipeds to estuary management activities at the Russian River estuary. Specifically, the following questions are of interest:

1. Under what conditions do pinnipeds haul out at the Russian River estuary mouth at Jenner?
2. How do seals at the Jenner haul-out respond to activities associated with the construction and maintenance of the lagoon outlet channel and artificial breaching activities?
3. Does the number of seals at the Jenner haul-out significantly differ from historic averages with formation of a summer (May 15th to October 15th) lagoon in the Russian River estuary?
4. Are seals at the Jenner haul-out displaced to nearby river and coastal haul-outs when the mouth remains closed in the summer?

METHODS

Monitoring was performed in accordance with the requirements of NMFS IHA issued April 20, 2015, and the Russian River Estuary Management Project Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2011).

Water Agency biologists and Stewards of the Coast and Redwoods (Stewards) volunteers and staff monitored pinnipeds at Jenner and peripheral haul-outs. The Stewards and Water Agency provide annual training for all volunteers; the most recent training occurred on February 24, 2015. Water Agency biologists participating in the monitoring program also attended the training session. The training agenda covered:

- the Marine Mammal Protection Act;
- anticipated IHA monitoring requirements;
- the Russian River Estuary Management Activities Pinniped Monitoring Plan and monitoring methods therein, including completion of data sheets;
- field identification of pinnipeds of the California coast, including harbor seals, California sea lions, Steller sea lions, northern elephant seals, northern fur seals and Guadalupe fur seals;
- field identification of neonates (pups less than 1 week old);
- care and use of field equipment (e.g. cameras, spotting scopes, binoculars); and
- field visits to each haul-out monitoring location.

Twice monthly baseline monitoring of the Jenner haul-out was shared by Water Agency biologists and trained Stewards volunteers (each group monitored once a month), with Stewards volunteers monitoring the peripheral haul-outs for all baseline surveys. Monitoring of water level management activities (lagoon outlet channel and artificial breaching) at the Jenner haul-out was also shared, but Water Agency biologists monitored artificial breaching activities on the day of the event (no lagoon outlet channel activities occurred in 2015). Pre-breaching and post-breaching monitoring was shared by the organizations depending on the availability of volunteers and Water Agency staff. Water Agency biologists also monitored pinnipeds during monthly topographic surveys of the beach, Jetty Study investigations, and biological and physical monitoring of the estuary.

Baseline

Baseline monitoring was performed to gather information about the population of harbor seals utilizing the Jenner haul-out including population trends, patterns in seasonal abundance and the influence of barrier beach condition on harbor seal abundance. Baseline monitoring of the peripheral haul-outs was completed concurrently with the monitoring of the Jenner haul-out. Baseline counts were scheduled for two days out of each month with the intention of capturing a low and high tide each in the morning and afternoon. Weather conditions were recorded at the beginning of each survey. These included temperature, visibility, ocean conditions (Beaufort scale) and wind speed. Tide levels and estuary water surface elevations were correlated to each monitoring day.

Jenner Haul-out Use

Pinnipeds at the Jenner haul-out were surveyed twice monthly. Surveys began at local dawn and continued for 8 hours. All pinnipeds hauled out on the beach were counted every 30 minutes from the overlook on the bluff along Highway 1 adjacent to the haul-out using binoculars or a high-powered spotting scope. Depending on time of year and how the sandbar is formed, harbor seals may haul out in multiple groups. At each 30-minute count, the observer would indicate where groups of seals are hauled out on the sandbar (e.g. Site A, Site B mapped on datasheet) and provide a total count for each group.

Pupping Season

Adults and pups were counted separately through June, after which it became difficult to differentiate between age classes. All neonates (less than 1 week old) were also recorded and were identified using one or more of the following characteristics: less than 15 kg, thin for their body length, an umbilicus or natal pelage present, wrinkled skin, awkward or “jerky” movement. If any potentially abandoned pup was observed during monitoring, the Water Agency would contact the NMFS stranding response network (Marine Mammal Center in Sausalito, CA) immediately and report the incident to NMFS’ Southwest Regional Office and NMFS Headquarters within 48 hours. Monitors were instructed not to approach or move the pup. Monitors used the following potential indications that a pup may be abandoned: no observed contacts with adult seals, no movement of the pup, and the pup’s attempts to nurse were rebuffed.

Peripheral Haul-out Use

To understand possible relationships between use of the Jenner haul-out and nearby coastal and river (peripheral) sites, monitoring occurred at several other sites on the coast and in the Russian River estuary (Figure 1). These sites include North Jenner and Odin Cove to the north; Pocked Rock, Kabemali, and Rock Point to the south; Penny Logs, Paddy’s Rock, and Chalanchawi in the estuary. These areas are known harbor seal sites that have been monitored by Joe Mortenson for over 25 years. The peripheral sites were visited for 10 minutes four times during each baseline monitoring day. All pinnipeds hauled

out during the 10 minutes were counted from the same vantage points using a high-powered spotting scope or binoculars.

Disturbance of Seals

In addition to the count data, disturbances of seals on the haul-outs were recorded. The methods for recording disturbances followed those in Mortenson (1996). Disturbances were recorded on a three-point scale that represents an increasing seal response to the disturbance (Table 1). The time, source, and duration of the disturbance, as well as an estimated distance between the source and seals, were recorded.

Table 1. Levels of pinniped response to disturbance used for Russian River Estuary Management Project pinniped monitoring. For permitting purposes a “take” or Level B harassment would include only moving or flight responses.

Level	Type of Response	Definition
1	Alert	Seal head orientation in response to disturbance. This may include turning head towards the disturbance, craning head and neck while holding the body rigid in a u-shaped position, or changing from a lying to a sitting position.
2	Moving	Movements away from the source of disturbance, ranging from short withdrawals over short distances to hurried retreats many meters in length.
3	Flight	All retreats (flushes) to the water, another group of seals, or over the beach.

SOURCE: Mortenson, J. 1996. Human interference with harbor seals at Jenner, California, 1994-1995. Prepared for Stewards of Slavianska and Sonoma Coast State Beaches, Russian River/Mendocino Park District. July 11, 1996.

Water Level Management Activities

Pinniped haul-outs were monitored during Water Agency water level management events (lagoon outlet channel implementation and artificial breaching). Peripheral haul-outs were monitored concurrently with the Jenner haul-out during water level management activities. This provided an opportunity to investigate possible correlation between water level management activities and number of seals using these nearby haul-outs. Since the movements of individual seals are not tracked, the number of seals displaced from the Jenner haul-out to the peripheral haul-outs cannot be quantified; however, potential trends may be observed.

The monitoring methods for water level management activities followed a deliberate pattern. To begin, a one-day, pre-event survey was made within 1 to 3 days prior to all water level management events. On the day of the management event, pinniped monitoring began at least one hour prior to the crew and equipment accessing the beach work area and continued during the duration of the event until at least one hour after the crew and equipment left the beach. Monitoring continued on the day following each water level management event to document the number of seals utilizing the haul-outs. Methods followed the count and disturbance monitoring protocols described in the “Baseline” section above.

Prior to each breaching or lagoon outlet channel implementation, the Water Agency monitor participated in the onsite tailgate safety meeting to discuss the location(s) of pinnipeds at the Jenner

haul-out that day and methods of avoiding and minimizing disturbances to the haul-out as outlined in NMFS IHA.

Biological and Physical Monitoring

The NMFS IHA also provides incidental take for Level B harassment of pinnipeds that may result from monitoring of biological resources and physical processes in the estuary. Water Agency field staff record the presence of pinnipeds hauled out in the estuary in the vicinity of their activities and record any resulting disturbances. The Russian River Biological Opinion also requires monthly topographic surveys of the sandbar at the mouth of the Russian River. A Water Agency biologist was present during topographic surveys to provide guidance to the survey crews on minimizing disturbance of the haul-out and to observe pinniped response to the survey work in the vicinity of the Jenner haul-out. Beginning on May 30, 2013, the methods for conducting the monthly topographic surveys of the barrier beach changed. Due to the frequent and prolonged river mouth closures there was an increased need to gather complete information about the topography and berm crest elevation of the beach to best inform water level management activities. This necessitated the survey crew to access the entire beach, including any area where seals were hauled out. Provided that no neonates or nursing pups were on the haul-out, the survey crew approached the haul-out slowly on foot and allowed for the seals to gradually vacate the beach before the survey proceeded. A pinniped monitor was present for all of these surveys and carefully documented the seals' response and total number of animals disturbed.

RESULTS

The NMFS IHA (April 20, 2015) requires the following information be provided in this report:

- (a) the number of seals taken, by species and age class (if possible)
- (b) behavior prior to and during water level management events
- (c) start and end time of activity
- (d) estimated distances between source and seals when disturbance occurs
- (e) weather conditions (e.g., temperature, wind, etc.)
- (f) haul-out reoccupation time of any seals based on post activity monitoring
- (g) tide levels and estuary water surface elevation
- (h) seal census from bi-monthly and nearby haul-out monitoring
- (i) specific conclusions that may be drawn from the data in relation to the four questions of interest in SCWA's Pinniped Monitoring Plan, if possible

Estuary water surface elevations are recorded at the Jenner gauge (operated by the Water Agency), located at the State Parks visitor center in the town of Jenner. Appendix A includes the estuary water surface elevations associated with pinniped monitoring in 2015, including baseline, water level management events and estuary management investigations.

Baseline

In 2015 a total of 24 baseline surveys, 10 beach topographic surveys, 4 breaching surveys, 8 pre-breaching, 4 post-breaching and 1 jetty study survey were conducted (Appendix A). One baseline survey also functioned as a post-breaching survey and one post-breaching survey also functioned as a pre-breaching survey. In April a scheduled breaching event and a beach topographic survey were canceled due the presence of harbor seal neonates on the beach. In December a scheduled breaching event and a topographic survey were cancelled due to dangerous, high wave conditions. Two other breaching events were canceled when the barrier beach opened due to natural forces prior to the scheduled breach.

Jenner Haul-out Use

Peak seal abundance, as measured by the single greatest count of harbor seals at the Jenner haul-out, was on July 9 (548 seals). Using the average number of seals hauled out by month, seal abundance at Jenner was greatest in July (mean = 373 ± 10.3 s.e., $n = 35$; Unequal N HSD multiple comparisons test, $p < 0.001$) (Figure 2). Seal abundance was lowest in October (mean = 33 ± 7.6 s.e., $n = 22$) compared to all other months except September and November (Unequal N HSD multiple comparisons test, $p < 0.001$) (Figure 2). When compared to previous years combined, there were significantly more seals at the Jenner haul-out in June and July (Unequal N HSD multiple comparisons test, $p < 0.05$).

While it is difficult to separate the effect of river mouth condition (closed versus open) from time of year, fewer seals are present during closed conditions (mean = 49.3 ± 2.62 s.e., $n = 969$) compared to open conditions (mean = 139.1 ± 1.60 s.e., $n = 2,590$; ANOVA $p < 0.001$). However, the overall trend was an increase in seal abundance compared to earlier years (Figure 3). The influence of mouth condition remains when the effect of season is considered (Figure 4) (Unequal N HSD multiple comparisons test, $p < 0.001$).

Pupping Season

Pups have been observed at the Jenner haul-out as early as March (SCWA 2012, 2013). In 2015 the first pups were observed on April 8, with the latest observation of pups occurring on June 11 (the last neonate was observed on April 28). Pups are counted during surveys through June, after which time it becomes difficult to distinguish pups from sub-adult seals. No distressed or abandoned pups were reported by Water Agency or Stewards monitors in 2015.

Pup production at the Jenner haul-out was 18.7% of adult seals as calculated from the peak pup count recorded on April 28 and the number of adult harbor seals present at the same time. Pup production decreased slightly since last year when 23.2% of adult seals was reported. However, the average number of pups observed (when pups were present) during April and May was up slightly for 2015: 16.4 pups compared to 13.9 pups in 2014.

Peripheral Haul-out Use

In addition to monitoring harbor seal abundance at the Jenner haul-out, eight coastal and estuary haul-outs were monitored. Similar to previous years, most of these peripheral haul-outs had very low seal abundance with three sites averaging less than one seal (North Jenner = 0.3, Penny Logs = 0.1, Paddy's Rock = 0) and three sites averaging less than 4 seals (Odin Cove = 2.8, Chalanchawi = 1.3 and Pocked Rock = 3.3), as observed during baseline surveys. The two southernmost coastal haul-outs included in our monitoring surveys, Kabemali and Rock Point, had the highest abundance of seals with a baseline average of 7.1 and 9.3 respectively. Seasonal increases in seal abundance were most apparent at Odin Cove, Kabemali, and Rock Point, where seal abundance peaked during May and June for Odin Cove and Kabemali; June, October and November for Rock Point (Table 2).

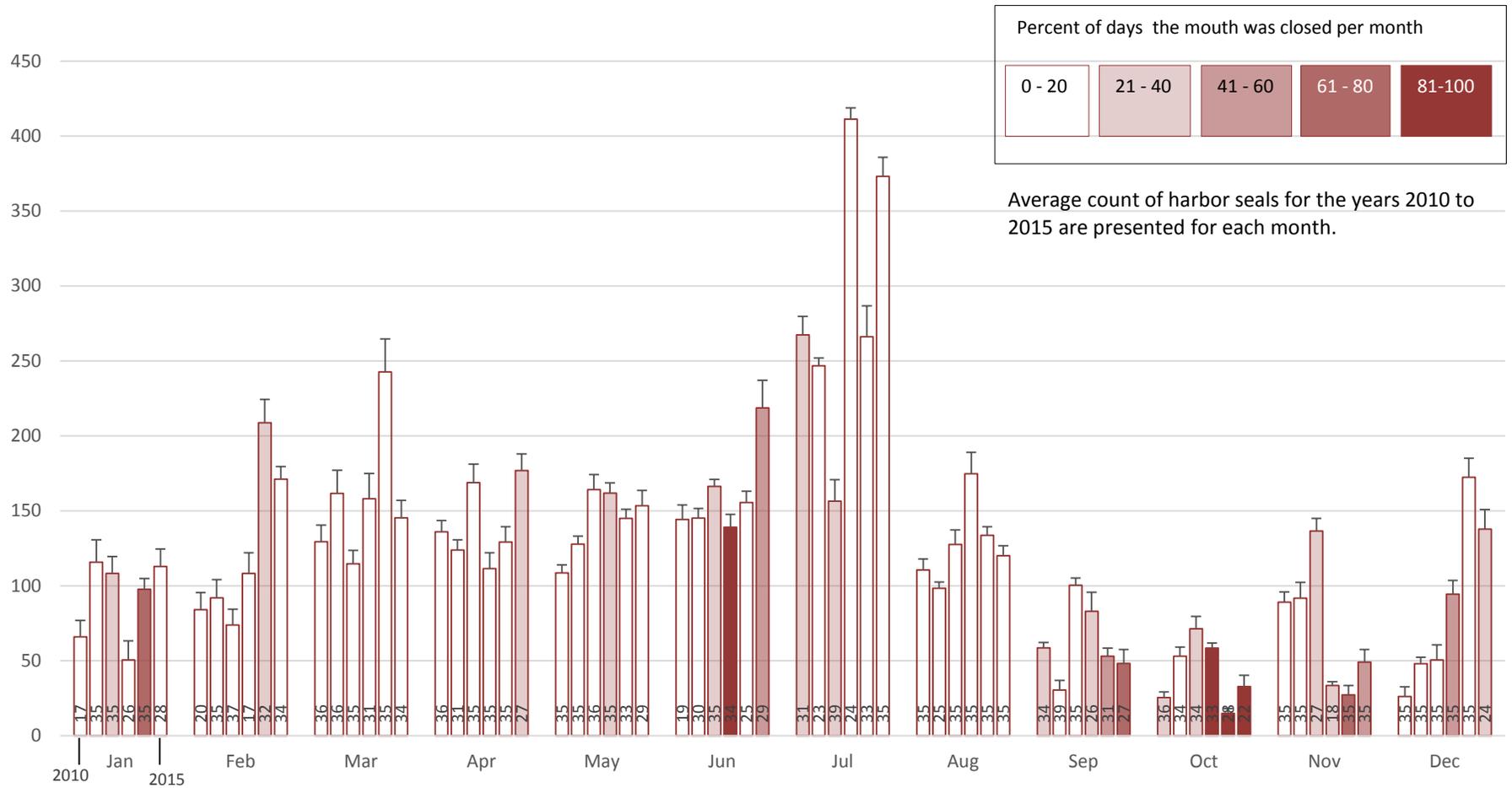


Figure 2. The average number of harbor seals hauled out at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) as counted during baseline surveys for each year (January 2010 – December 2015) categorized by month. Error bars represent standard error and sample size used to calculate means are presented inside the bars.

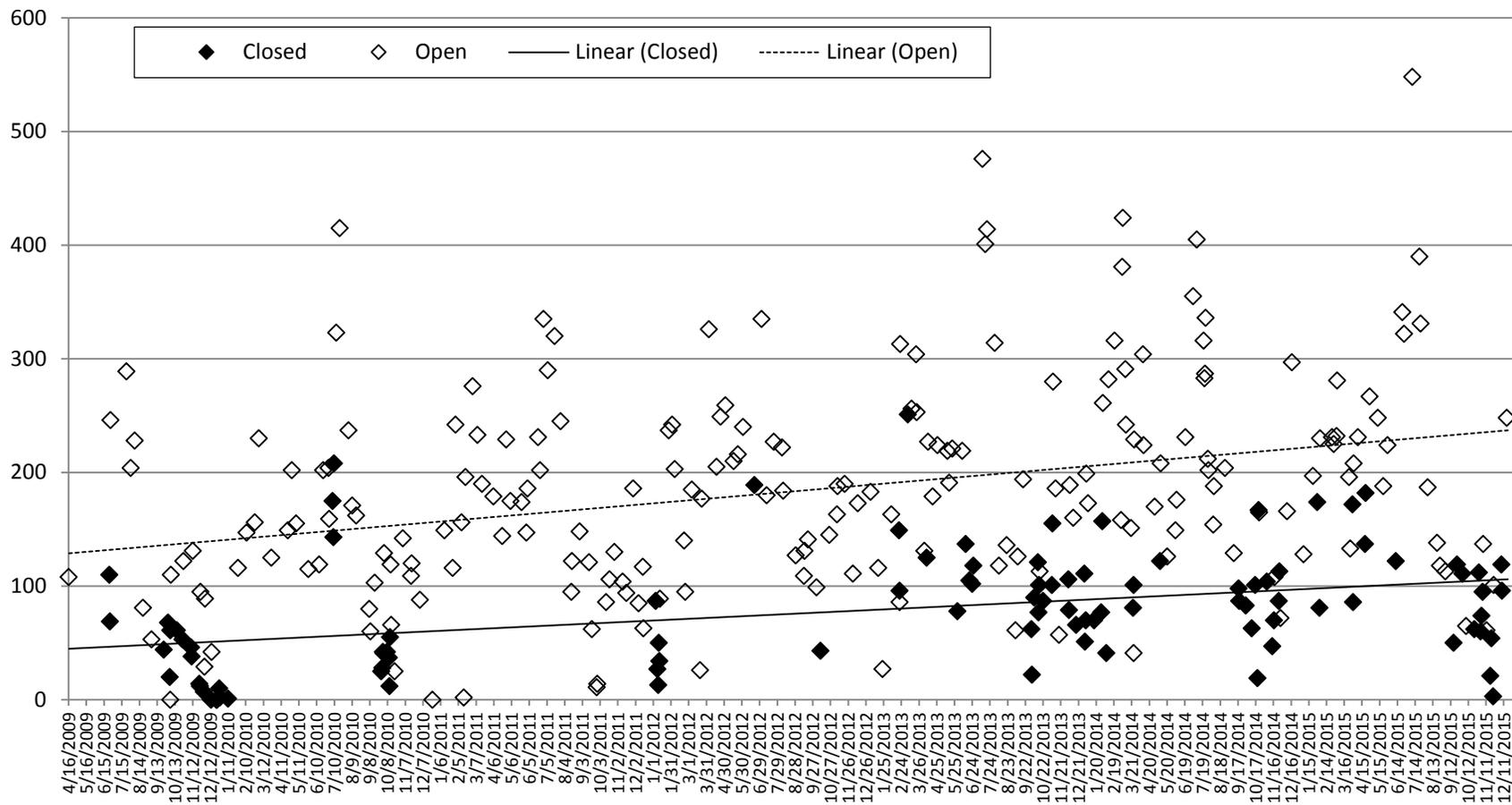


Figure 3. Maximum number of harbor seals counted during all pinniped surveys at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) since 2009. Open diamonds represent counts in mouth open conditions and black filled diamonds represent counts during mouth closed.

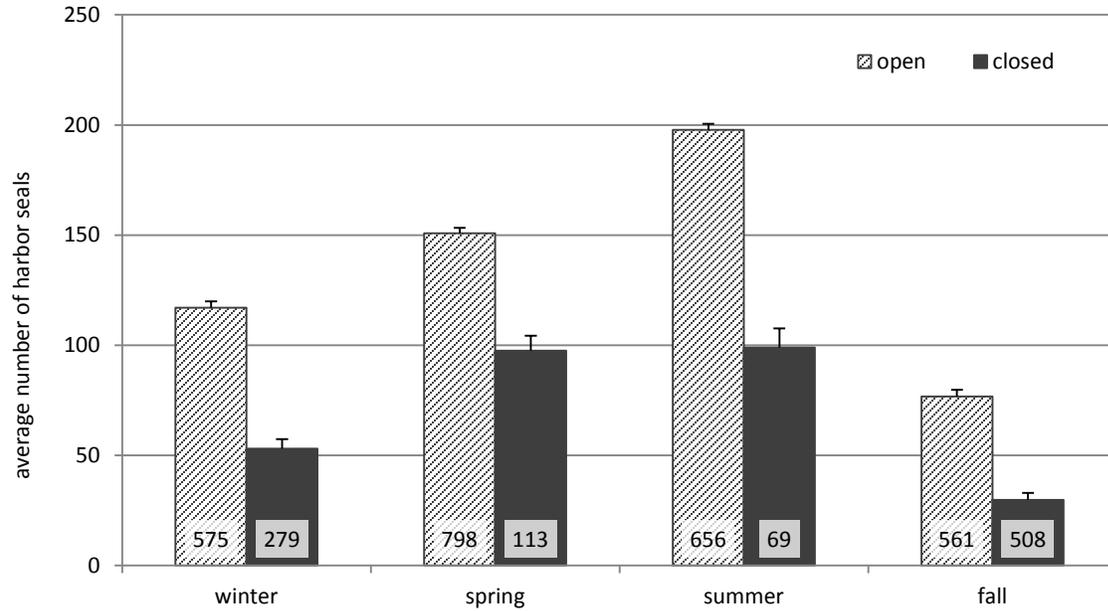


Figure 4. Average number of harbor seals at the Jenner haul-out for all surveys since 2009 for mouth open and mouth closed conditions by season. Seasons were defined as: winter = December – February; spring = March – May; summer = June – August; fall = September – November.

Table 2. The average number of harbor seals by month hauled out at peripheral sites during baseline surveys conducted in 2015. Monthly averages in bold represent seasonal peaks in seal abundance.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North Jenner	0.5	1.7	2.5	1.1	0.8	0.9	2.5	2.8	0.3	0.0	2.3	0.8
Odin Cove	5.0	3.6	0.0	8.5	14.3	12.5	6.0	7.5	9.9	8.3	4.7	1.2
Penny Logs	0.0	0.0	0.0	0.0	0.4	2.7	0.0	0.0	0.1	0.8	0.0	0.0
Paddy's Rock	1.6	2.3	0.5	2.1	2.8	3.8	1.4	1.4	4.4	7.0	6.0	0.3
Chalanchawi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pocked Rock	0.0	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.6	0.0	0.0
Kabemali	0.6	1.1	0.7	3.8	6.0	8.3	5.2	4.4	1.6	5.0	3.2	1.4
Rock Point	11.3	2.0	2.0	4.7	2.3	19.3	11.0	12.6	6.6	15.3	19.7	0.0

Disturbance of Seals

An effort was made to compare the level of disturbance between baseline surveys and surveys when Water Agency personnel are working in the vicinity of the Jenner haul-out. Disturbance sources were separated into ten categories: aircraft, bird, dog, kayak, multiple, other boat, people, unknown, vehicle, and Water Agency. Seals were considered to be disturbed if they moved on or flushed from the haul-out.

Figure 5 illustrates the proportion of surveys when harbor seals were disturbed at the Jenner haul-out, categorized by disturbance source. Harbor seals were most frequently disturbed by people on foot (59% of surveys), with a similar frequency during non-baseline surveys (62% of surveys). Water Agency personnel disturbed seals on 51% of non-baseline surveys. People in kayaks were the next most frequent source of disturbance (28% of baseline surveys) (Figure 5).

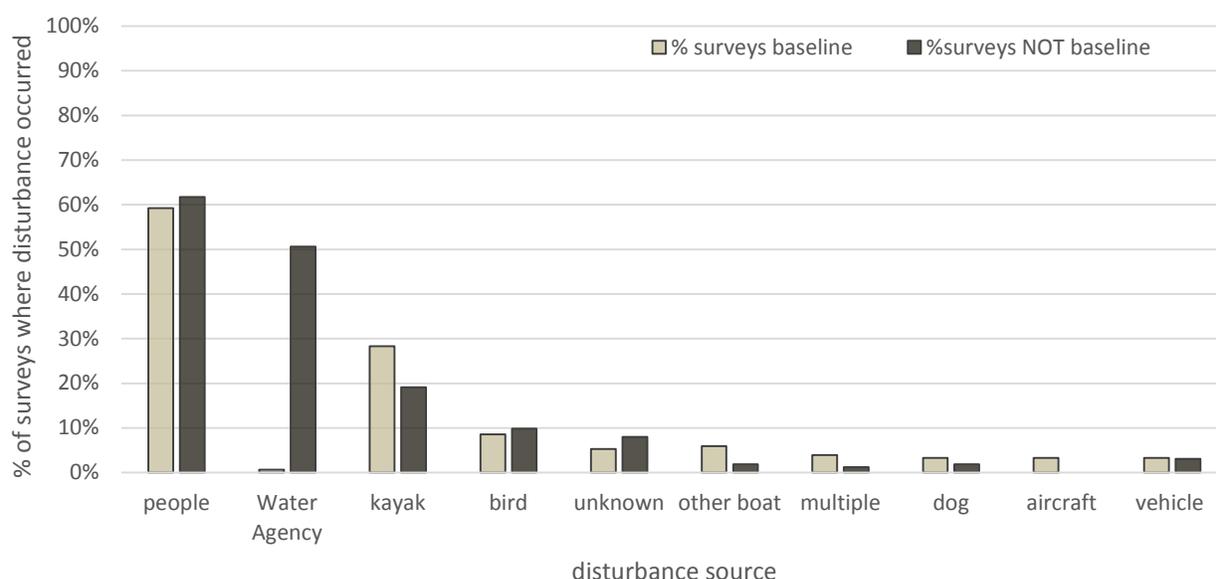


Figure 5. The proportion of baseline surveys where harbor seals were disturbed (moved or flushed) at the Jenner haul-out, described for each disturbance source. Data includes all baseline surveys since surveys began in 2009 (n=152) and all other surveys combined (i.e., breaching, pre-breaching, post-breaching, topographic surveys, jetty study, lagoon outlet implementation, pre-lagoon outlet and post-lagoon outlet) (n=162).

Displacement of Seals

In the absence of summer lagoon conditions, harbor seal abundance at all sites during the summer months was compared for mouth open and mouth closed conditions for all surveys since they began in July 2009. At the Jenner haul-out more seals were observed during mouth open conditions (Figure 6) (Unequal N HSD multiple comparisons test, $p < 0.0001$). More than ten times fewer seals were observed at all of the peripheral sites and at most of these peripheral sites mouth condition did not affect seal abundance (Figure 6). At North Jenner there were slightly more seals during closed conditions (Figure 6) (Unequal N HSD multiple comparisons test, $p < 0.05$).

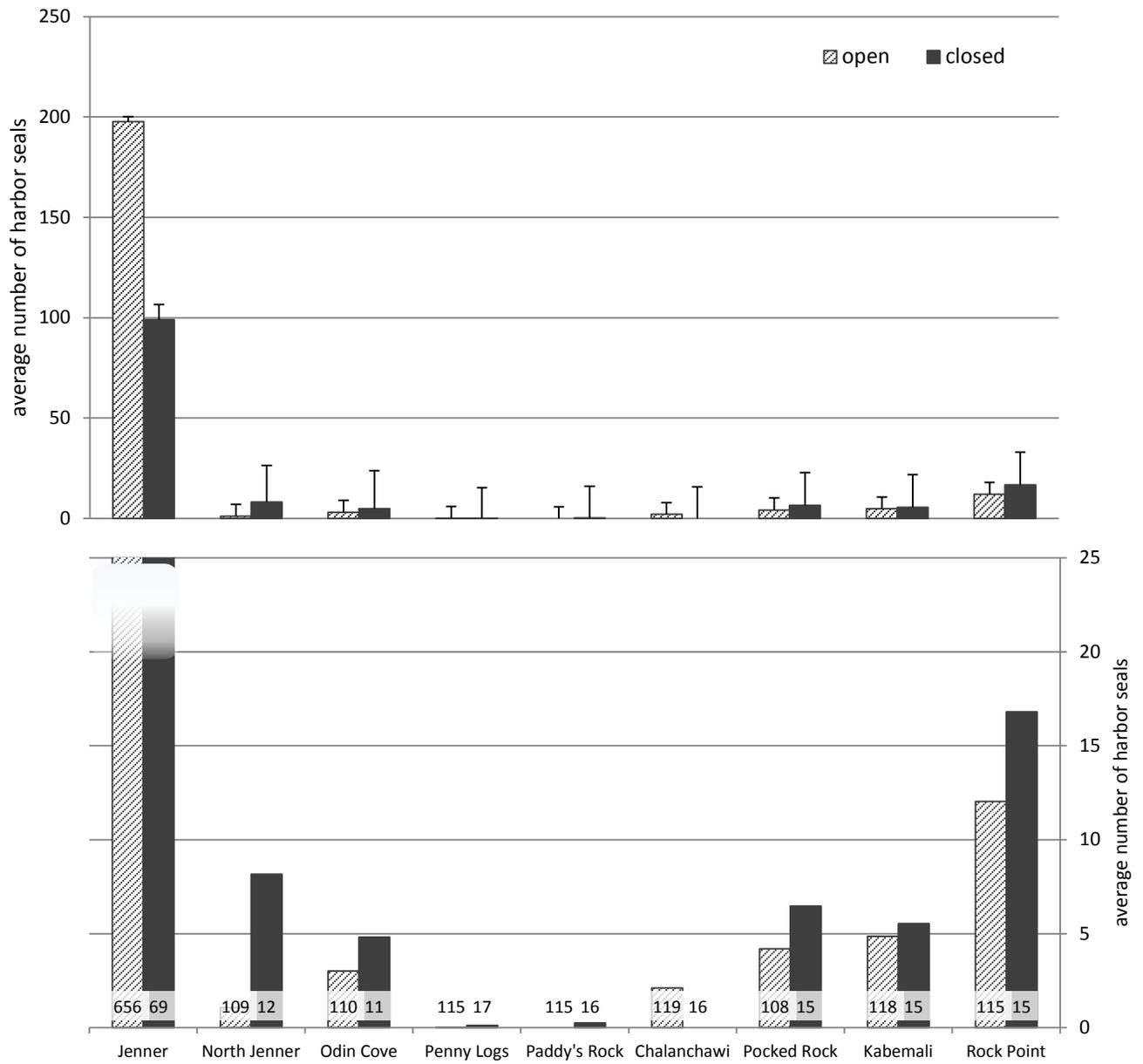


Figure 6. Average number of seals hauled out during summer months (June, July, August) by location for open and closed mouth conditions, for all surveys since they began in 2009. Error bars represent standard error of the mean and number of counts used to calculate the mean are presented inside the bars.

Water Level Management Activities

A barrier beach formed eleven times during 2015 (Table 3), and the Water Agency artificially breached the sand bar during four of these closures. The Russian River outlet was closed to the ocean for a total of 115 days (or 32%) in 2015, with 49 (or 43%) of these days occurring during the Lagoon Management Period. This is similar to the previous year where the outlet was closed for 110 days, however in 2014 only 26% of outlet closures occurred during the Lagoon Management Period.

On March 27, 2015, the river mouth closed and remained closed until it was mechanically breached by the Water Agency on March 31 at 10:39. The peak water level in the estuary was 8.8 ft NGVD as read from the Jenner gauge at 09:30 on March 31. Prior to the start of breaching activities there were 33 harbor seals hauled out on the estuary side of the barrier beach. By 11:30 there were 33 seals hauled out on the estuary side of the beach, south of the pilot channel. Water Agency staff was on the beach for less than one hour during this event.

On October 10 the river mouth closed after a period of southerly ocean swell. The mouth remained closed until November 2nd when the Water Agency excavated a pilot channel. There were 58 harbor seals hauled out in small groups on the estuary and ocean side of the beach prior to the arrival of Water Agency crews. The river level reached 8.7ft NGVD at the time of excavation at 11:10. A few seals remained hauled out north of the excavation site during the activity, and at the end of monitoring there were 3 seals on the beach at 14:56. Continued ocean swells caused the pilot channel to close again on the evening of November 2 and the mouth remained closed until November 5 when the Water Agency excavated a pilot channel in the same location as the previous activity. At this time the river level reached 9.3ft NGVD. Prior to crews entering the beach 95 harbor seals were hauled out on the ocean side of the beach. Sixteen seals remained on the beach during excavation of the pilot channel which occurred between 09:12 and 10:26. Only eight seals remained on the beach at the end of monitoring for the day at 13:20.

The river mouth closed again on November 13 and the Water Agency excavated a pilot channel on November 23, with the river level reaching a peak height of 7.5ft NGVD. On the morning of the breaching activity only a few seals (eight) were hauled out on the ocean side of the beach. Excavation activities began at 09:21 and were complete at 13:03. After activities were complete there were three harbor seals observed hauled out on the estuary side of the beach.

Harbor seal response to excavation activities was similar for all breaching events, and similar to those observed in previous years. Seals that were hauled out first alerted to the sound of the excavator being off-loaded in the Goat Rock State Beach parking lot (greater than 1,500 feet south of the haul-out). Seals then moved on the beach or flushed into the water as the Water Agency safety crew approached on foot. People on foot typically came within 200-100 feet of the haul-out before seals were disturbed. Once on the beach the noise and motion of the excavator disturbed seals at greater distances, between 800 and 200 feet. Seals remained on the beach in small numbers if the excavation activity was far enough away from their initial haul-out location. The estimated take by incidental harassment (Level B), as defined by the Marine Mammal Protection Act, of harbor seals during artificial breaching activities in 2015 was 258 harbor seals (220 flushed and 38 moved). Disturbance information for each event is provided in Table 4.

Table 3. Summary of river mouth closures in 2015 at the Russian River mouth (Goat Rock State Beach). Peak water level during the event was measured at the gauge located at the Sonoma Coast State Park Visitor's Center in Jenner, Ca.

Dates mouth closed	Peak height (ft NGVD)	Date mouth opened	Method of breach
January 29	9.2	February 3	self
February 6	9.4	February 7	self
March 27	8.8	March 31	artificial
April 16	9.7	April 23	self
April 30	6.2	May 3	self
May 28	7.2	June 14	self
September 7	6.7	October 4	self
October 10	8.7	November 2	artificial
November 2	9.3	November 5	artificial
November 13	7.5	November 23	artificial
December 1	8.4	December 8	self

In order to evaluate whether or not beach management activities cause harbor seals to leave the Jenner haul-out for near-by peripheral sites we compared average seal abundance for each peripheral site before, during and after breaching activities for 2015 (Figure 7). Very few seals were observed at the estuary haul-out sites, regardless of timing. All of the coastal haul-outs monitored exhibited an increase in seal abundance during pre-breaching surveys compared with breaching and post-breaching surveys, with the exception of Pocked Rock where post-breaching abundance was greater. However these differences did not reach significance (Unequal N HSD multiple comparisons, $p > 0.05$) (Figure 7).

Due to the small sample sizes used for comparisons of seal abundance during water level management activities for 2015 only, a similar comparison of seal abundance at the peripheral haul-outs was made for 2010-2015 observations combined. Results for the estuarine sites were similar when compared to those for 2015 observations only, with very few seals observed. The only significant differences in the number of seals observed during water level management monitoring were found at North Jenner and Rock Point. At North Jenner more seals were hauled out during pre-breaching surveys (mean = 3.5 ± 0.60 s.e., $n = 72$) compared to post-breaching surveys (mean = 0.2 ± 0.65 s.e., $n = 62$) (Unequal N HSD multiple comparisons test, $p < 0.05$). At Rock Point more seals were observed during breaching surveys (mean = 8.6 ± 0.56 s.e., $n = 82$) compared to pre-breaching surveys (mean = 4.2 ± 0.62 s.e., $n = 67$) (Unequal N HSD multiple comparisons test, $p < 0.001$).

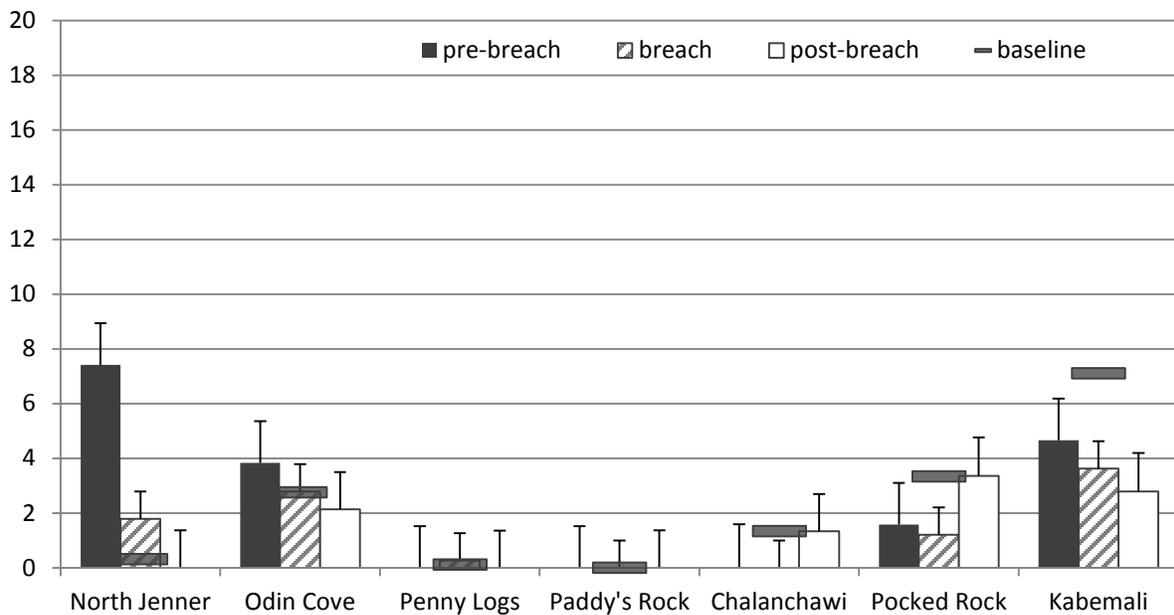


Figure 7. Average seal abundance at peripheral haul-outs as observed during pre-breaching, breaching and post-breaching surveys during 2015. Average seal abundance during 2015 baseline surveys are presented as a solid bar for each site. Error bars represent standard error.

Biological and Physical Monitoring

The NMFS IHA (2015) provides incidental take for Level B harassment of pinnipeds that may result from monitoring of biological resources and physical processes in the Russian River estuary. The number of incidental takes in 2015 was calculated based on the number of animals that responded to activities by either moving on their haul-out or flushing from their haul-out. Alerts were also recorded by monitors, but are not included in the number of incidental takes reported. Most often at haul-out sites within the estuary (excluding the Jenner haul-out on Goat Rock State Beach, Figure 1) harbor seals either had no reaction or raised their heads in alert as a boat passed. The most seals hauled out in the estuary as observed by Water Agency field staff were five at Chalanchawi. On six occasions the acoustic telemetry of steelhead in the estuary resulted in disturbance of harbor seals off their resting areas on partially submerged logs at Chalanchawi and near Duncans Mills (Table 4). No California sea lions were encountered in the estuary during monitoring of biological resources and physical processes.

The Russian River Biological Opinion requires monthly topographic surveys of the barrier beach at the mouth of the Russian River. A Water Agency biologist was present during topographic surveys to monitor the seal response to the survey crew. With the exception of the harbor seal pupping season, when survey personnel will avoid the haul-out when neonates are present, between 15% and 100% of seals were flushed from their haul-out during the monthly mapping activities (Table 4).

Table 4. Number of pinnipeds disturbed as a result of Russian River Estuary Management and Monitoring Activities for 2015, resulting in incidental take by harassment. Disturbances reported are pinnipeds moving on or flushing from their haul-out, number of disturbed seals that flushed from their haul-out is denoted by (#).

Date	Event Type	Estimated Disturbance			
		Species	Age Class	Number	Max % total seals flushed ^a
1/29/2015	topo survey	harbor seal	adult	256(226)	99%
2/2/2015	pre-breaching ^b	harbor seal	adult	38(38)	70%
		Ca. sea lion	juvenile	1(0)	
2/26/2015	topo survey	harbor seal	adult	201(180)	87%
3/26/2015	topo survey	harbor seal	adult	201(126)	47%
3/31/2015	breaching	harbor seal	adult	58(58)	100%
4/20/2015	pre-breaching ^b	harbor seal	adult	64(63)	27%
			neonate	1(1)	
5/27/2015	fisheries studies	harbor seal	adult	2(2)	100%
5/28/2015	fisheries studies	harbor seal	adult	1(1)	100%
5/28/2015	topo survey	harbor seal	adult	279(248)	58%
			pup	2(2)	
6/25/2015	fisheries studies	harbor seal	adult	2(2)	100%
6/25/2015	topo survey	harbor seal	adult	124(82)	15%
7/3/2015	fisheries studies	harbor seal	adult	1(1)	100%
7/22/2015	fisheries studies	harbor seal	adult	2(2)	100%
7/23/2015	topo survey	harbor seal	adult	642(274)	100%
7/30/2015	fisheries studies	harbor seal	adult	1(1)	100%
8/20/2015	topo survey	harbor seal	adult	74(57)	100%
9/17/2015	topo survey	harbor seal	adult	22(22)	100%
10/8/2015	topo survey	harbor seal	adult	77(59)	100%
11/2/2015	breaching	harbor seal	adult	75(57)	100%
11/5/2015	breaching	harbor seal	adult	100(80)	70%
11/12/2015	topo survey	harbor seal	adult	135(71)	100%
11/23/2015	breaching	harbor seal	adult	25(25)	100%
2015 total		harbor seal	adult	2,380(1,675)	
			pup	3(3)	
		Ca. sea lion	juvenile	1(0)	

^a Due to the fact that multiple disturbance episodes are represented by the total number of seals disturbed for a given day, the number reported for the percent of seals on the haul out that were flushed is the maximum value recorded for that day.

^b Disturbance was caused by Water Agency personnel posting warning signs on beach, prior to breaching activities.

CONCLUSIONS

The water level management activities and biological and physical monitoring activities conducted by the Water Agency resulted in incidental harassment (Level B harassment) of 2,384 harbor seals and 1 juvenile California sea lion in 2015, well under the total allowed by NMFS IHA.

The purpose of the Russian River Estuary Management Project Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2011) is to detect the response of pinnipeds to estuary management activities at the Russian River estuary. Specifically, the following questions are of interest:

1. Under what conditions do pinnipeds haul out at the Russian River estuary mouth at Jenner?
2. How do seals at the Jenner haul-out respond to activities associated with the construction and maintenance of the lagoon outlet channel and artificial breaching activities?
3. Does the number of seals at the Jenner haul-out significantly differ from historic averages with formation of a summer (May 15th to October 15th) lagoon in the Russian River estuary?
4. Are seals at the Jenner haul-out displaced to nearby river and coastal haul-outs when the mouth remains closed in the summer?

Harbor seals are found at the mouth of the Russian River (Jenner haul-out) throughout the year. They are observed on the beach throughout the tidal cycle and at any time of day. Our baseline pinniped monitoring concluded that tidal state and time of day influenced harbor seal abundance at the Jenner haul-out, with seals less abundant in the early morning and at high tide (SCWA 2012). Harbor seals were most abundant on the Jenner haul-out in July during their annual molt (SCWA 2012), with these same trends being observed in subsequent years (SCWA 2013, 2014). Seasonal variation in the abundance of harbor seals at their haul-out locations is commonly observed throughout their range (Allen et al. 1989, Stewart and Yochem 1994, Gemmer 2002). The variation in their abundance can mostly be explained by changes in their biological and physiological requirements throughout the year. Peak seal abundance occurring in July during their molting season is likely a result of seals spending more time on land in order to help facilitate the molting process. This annual peak is typically followed by a decline in seal abundance which is likely a result of individual seals decreasing the amount of time on the haul-out post-molt to spend more time foraging and also coincides with the time that young seals may temporarily disperse from their natal haul-out (Stewart and Yochem, 1994, Thompson et al. 1994, Small et al. 2005).

The Jenner haul-out is a harbor seal rookery and we have attempted to standardize a measure of pup counts so that comparisons can be made across years. However, our ability to accurately measure natality (*i.e.*, proportion of births to the number of mature females) is limited by the fact that harbor seals are not sexually dimorphic so the number of adult females on the beach cannot be easily determined. Harbor seal pups are very precocial and are able to swim just after birth, so counts of pups on the beach does not accurately reflect the total number of births.

Harbor seals will use the beach when there is an open channel or when a barrier beach has formed, however, the number of seals at Jenner was influenced by river mouth condition. Daily average seal abundance was lower during closed conditions compared to open conditions. This effect is also closely related to time of year, since most closures occur during the fall and winter, when seal abundance is

low. However, when seal counts were grouped by season, the influence of month condition was observed for winter, spring, summer and fall.

The response of harbor seals at the Jenner haul-out to water level management activities in 2015 was similar to the responses observed in previous years of monitoring (Merritt Smith Consulting 1997, 1998, 1999, 2000; Sonoma County Water Agency and Merritt Smith Consulting 2001; SCWA 2011, 2012, 2013, 2014 and 2015). Harbor seals alerted to the sound of equipment on the beach and left the haul-out as the crew and equipment approached closer on the beach. When breaching activities were conducted south of the haul-out, or when seals were hauled out on the ocean side of the beach, seals often remained on the beach during all or some of the breaching activity. This indicates that seals are less disturbed by activities when equipment and crew do not pass directly past their haul-out.

Since the beginning of the modified estuary water level management procedures as a result of the NMFS 2008 Biological Opinion a lagoon outlet channel has only been implemented once (July 2010). While the Water Agency has not had further opportunity to implement and sustain an outlet channel, observations when a barrier beach has formed during the lagoon management period provide information as to how harbor seals respond when aquatic access between the estuary and the ocean is limited. A barrier beach has formed during the lagoon management period sixteen times, the longest incidence lasting 29 days, with an average duration of fourteen days. While seal abundance was lower during closed conditions, overall there continues to be a slight increasing trend in seal abundance. These results indicate that while seal abundance may exhibit a short term decline during closed conditions it has not inhibited seals from using the Jenner haul-out during any period of the year. We conclude that the effect of barrier beach condition on seal abundance represents only a short term response, and is not an indication that seals are less likely to choose Jenner as a haul-out overall. We do not yet know how seals would respond to a maintained lagoon outlet channel.

As stated above we are unable to draw conclusions about the response of harbor seals to the implementation and maintenance of summer lagoon as outlined in the NMFS 2008 Biological Opinion. Results to date indicate that the peripheral haul-outs located in the estuary are little used by seals, and access is limited by rising water level in the estuary. At Chalanchawi seals are more likely to haul out during open conditions, as the logs that compose the site become submerged as water levels rise. Coastal sites are regularly used by harbor seals, albeit in low numbers. We did find that seals were slightly more abundant at North Jenner during mouth closed conditions, however the numbers of seals observed there remains low in either condition.

In an effort to maximize efficiency and focus monitoring efforts in order to gain new insights, the Water Agency is proposing modifications to the 2011 Pinniped Monitoring Plan. Details of the revised monitoring plan are included in the attached document (Sonoma County Water Agency and the Stewards of the Coast and Redwoods 2016) but the main goal of the revision is to focus monitoring efforts on the Jenner haul-out, where the majority of pinnipeds in the Russian River area are found, to continue to develop our understanding of the physical and biological factors that influence seal abundance and behavior. The modifications proposed include increasing the frequency of surveys at the Jenner haul-out from twice a month to four times a month and reducing the duration of each survey from eight to four hours. Visits to the peripheral haul-outs would be eliminated except in the case that a lagoon outlet channel is constructed and maintained for a prolonged period (over 21 days).

Annual reports to the NOAA Fisheries Office of Protected Resources will continue to specifically address the four questions identified in the plan (see above). The following paragraphs describe how the proposed protocol changes will affect our ability to address the questions going forward.

In regard to the first question: “Under what conditions do pinnipeds haul out at the Russian River Estuary mouth at Jenner?”, we have been able to describe some physical and temporal factors that influence seals abundance at Jenner. Proposed changes to the protocol will allow us to continue monitoring these factors and observe if there are changes over time. Furthermore, by increasing the frequency of surveys we would be able to observe the influence of physical changes that do not persist for more than 10 days, like brief periods of barrier beach closures or other environmental changes.

In regard to the second question: “How do seals at the Jenner haul-out respond to activities associated with the construction and maintenance of the lagoon outlet channel and artificial breaching activities?”, we have collected many observations that describe how seals respond directly to breaching activities, and will continue to record and report these responses under the proposed protocol. Because a lagoon outlet channel has not yet been constructed and maintained, we have been unable to describe how seals respond to activities associated with the construction and maintenance of a lagoon outlet channel. Should such an opportunity arise we would be able to monitor any seal response under the proposed protocol.

In regard to the third question: “Does the number of seals at the Jenner haul-out significantly differ from historic averages with formation of a summer (May 15th to October 15th) lagoon in the Russian River estuary?”, Because a lagoon outlet channel has not yet been constructed and maintained, we have been unable to address this question. However, under the proposed changes we will continue to count seals at Jenner and would be able to compare the abundance of seals over time and with historic averages.

In regard to the fourth question: “Are seals at the Jenner haul-out displaced to nearby river and coastal haul-outs when the mouth remains closed in the summer?”, after five years of surveys we have no evidence that seals are displaced to the peripheral sites during periods of mouth closures in the summer. Because a lagoon outlet channel has not yet been constructed and maintained our only evidence comes from data collected during natural barrier beach closures during the May 15th to October 15th period. While there are small and short-term increases in seal abundance at the coastal haul-outs during and immediately after a breaching event, seal abundance at the peripheral sites remain low throughout the year regardless of river mouth condition. Peripheral sites are composed of small near shore rocks and out-crops or exposed logs in the river and are not likely to accommodate the hundreds of seals observed during the summer months at Jenner. Due to this limitation of haul-out size, only a relatively small number of seals could be displaced to any one of the peripheral sites. The most accurate way to determine if small numbers of seals have moved from Jenner to a peripheral site would be to monitor the movement of individual seals. In order to accomplish this, seals would need to be uniquely marked and re-sighted. Natural markings would be a non-invasive method to identify individual seals using photo identification techniques, but this is very labor intensive and therefore too costly for us to consider at this time. Proposed changes to the baseline monitoring would allow us to focus efforts on the Jenner haul-out where the majority of seals along the Sonoma Coast are concentrated.

In addition to maintaining our ability to address the questions outlined in the original Pinniped Monitoring Plan, the proposed changes will improve our ability to describe how seals respond to barrier beach closures and will allow us to more accurately estimate the number of harbor seal pups born at Jenner each year. Under the current protocol we have had two main challenges. First, we have few

observations of the Jenner haul-out under closed mouth conditions compared to open mouth conditions. Increasing the frequency of surveys at Jenner would allow us to collect more baseline counts during closed-mouth conditions and would therefore increase the robustness of our comparisons. Second, our observations of the Jenner haul-out during pupping season does not currently provide an accurate way to estimate the total number of pups born each year. Increasing the frequency of surveys would allow us to more accurately describe the start and end of the pupping season. The proposed changes would also allow us the opportunity to count pups as newborns (within seven days of birth), leading to better estimates of natality that could be compared to other local harbor seal rookeries.

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Appendix A. Summary of pinniped monitoring activities at the Jenner haul-out (Goat Rock State Beach, Sonoma County) conducted by the Sonoma County Water Agency and Stewards of the Coast and Redwoods from January – December 2015 for the Russian River Estuary Management Project, including summary of pinniped abundance and Estuary water level.

date	Activity	Mouth	Estuary water level ^{a,b}	HASE adult			HASE pup			HASE neonate			n	CASL present ^c	NES present
				max	mean	s.e.	max	mean	s.e.	max	mean	s.e.			
1/6/2015	Baseline	Open	1.66	128	55.8	8.40							11		
1/22/2015	Baseline	Open	3.04	197	149.8	11.34							17		
1/29/2015	Topo survey	Closed	4.83	174	116.9	17.83							9		
2/2/2015	Pre-Breach ^d	Closed	8.94	81	57.9	5.64							17	Y	
2/3/2015	Baseline	Open	2.76	230	183.0	11.16							17		
2/23/2015	Baseline	Open	1.83	231	159.2	12.63							17		
2/26/2015	Topo survey	Open	1.58	225	172.2	13.23							10		
3/3/2015	Jetty Study	Open	1.83	232	170.0	19.91							14		
3/4/2015	Baseline	Open	2.08	281	155.4	19.50							18		
3/24/2015	Baseline	Open	2.98	196	134.1	11.29							16		
3/26/2015	Topo survey	Open	2.85	133	115.0	4.66							10		
3/30/2015	Pre-Breach	Closed	--	172	138.0	8.41							15		
3/31/2015	Breach	Closed	8.80 ^e	86	42.6	8.00							10		
4/1/2015	Post-Breach	Open	1.69	208	173.2	7.17							15		
4/8/2015	Baseline	Open	2.46	231	168.2	10.45	2	0.8	0.21	2	0.2	0.14	17	Y	
4/20/2015	Pre-Breach	Closed	8.27	110	88.1	4.94	8	5.5	0.50	23	15.6	1.25	15		
4/21/2015	Breach ^f / Pre-Breach ^d	Closed	8.95	156	116.0	13.69	15	5.2	2.21	28	15.0	4.92	6		
4/28/2015	Baseline	Open	1.28	225	157.5	21.39	31	22.3	1.72	20	10.2	1.91	10		
5/12/2015	Baseline	Open	1.52	219	126.6	14.64	29	14.4	2.08	0	0.0		17		
5/21/2015	Baseline	Open	1.68	161	148.3	4.18	29	22.6	1.47	0	0.0		12		
5/28/2015	Topo survey	Open	1.64	222	142.7	12.70	2	1.5	0.22	0	0.0		13		
6/11/2015	Baseline	Closed	6.77	113	96.7	3.51	12	7.3	1.01	0	0.0		12		

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date	Activity	Mouth	Estuary water level	HASE adult			HASE pup			HASE neonate			n	CASL present	NES present
				max	mean	s.e.	max	mean	s.e.	max	mean	s.e.			
6/22/2015	Baseline	Open	1.42	341	299.5	5.78							17		
6/25/2015	Topo survey	Open	1.32	322	265.7	19.71							11		
7/9/2015	Baseline	Open	1.69	548	414.8	17.65							18		
7/21/2015	Baseline	Open	1.59	390	328.9	11.05							17		
7/23/2015	Topo survey	Open	1.59	331	223.8	36.04							9		
8/4/2015	Baseline	Open	1.68	187	153.0	4.94							18		
8/20/2015	Topo survey	Open	1.44	138	63.0	15.79							11		
8/25/2015	Baseline	Open	1.56	118	85.2	4.29							17		
9/3/2015	Baseline	Open	1.84	113	77.0	13.12							9		
9/17/2015	Topo survey	Closed	4.63	50	13.2	5.10							11		
9/23/2015	Baseline	Closed	5.86	119	34.0	10.95							18		
10/2/2015	Baseline	Closed	6.55	111	74.8	14.49							5		
10/8/2015	Topo survey	Open	1.76	65	28.8	9.68							8		
10/22/2015	Baseline	Closed	5.82	62	20.4	6.33							17		
10/30/2015	Pre-Breach	Closed	7.90	112	65.5	6.28							17		
11/2/2015	Breach	Closed	8.68	60	22.7	6.53							15		
11/3/2015	Post-Breach/ Pre-Breach	Closed	8.92	74	52.6	3.23							17		
11/5/2015	Breach	Closed	9.31	95	37.9	10.33							13		
11/6/2015	Post-Breach/ Baseline	Open	1.36	137	83.5	11.36							18		
11/12/2015	Topo survey	Open	2.33	61	19.9	6.83							11		
11/18/2015	Baseline	Closed	5.95	21	12.8	1.72							17		
11/20/2015	Pre-Breach	Closed	6.67	54	12.9	4.68							17		

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date	Activity	Mouth	Estuary water level	HASE adult			HASE pup			HASE neonate			n	CASL present	NES present
				max	mean	s.e.	max	mean	s.e.	max	mean	s.e.			
11/23/2015	Breach	Closed	7.46	3	1.0	0.27							11		
11/24/2015	Post-Breach	Open	2.42	101	49.1	10.43							16		
12/7/2015	Pre-Breach ^d	Closed	7.77	119	113.9	2.38							7		
12/8/2015	Baseline	Closed	8.42	96	84.7	3.11							7		
12/16/2015	Baseline	Open	--	248	159.6	15.83							17		

^a For breaching events Estuary water level from time of breaching

^b For all other events Estuary water level is average height for the day

^c Only counts for sea lions on land, does not include sea lions observed in the water

^d No water level management occurred during closure, barrier beach breached naturally

^e Remote link to Jenner river gauge not working, data was recorded from gauge at beginning of pinniped monitoring

^f Breach canceled due to presence of neonate harbor seals on the beach

-- missing data, Jenner river gauge offline