

Russian River Estuary Management Project

Marine Mammal Protection Act Incidental Harassment Authorization

Report of Activities and Monitoring Results – January 1 to December 31, 2016



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

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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 21, 2016, 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 2016 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.

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; and
- geophysical surveys conducted at the barrier beach.

Pinniped monitoring was performed in accordance with the requirements of the NMFS IHA issued April 21, 2016, and the Russian River Estuary Management Activities Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2016).

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). Estuary management monitoring occurred during the Water Agency's monthly topographic surveys of the barrier beach 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 2016, during five of these closure events the Water Agency conducted water level management activities at the sand bar. The Russian River mouth was closed to the ocean for a total of 68 days (or 19%) in 2016, 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. 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 2016 resulted in incidental harassment (Level B harassment) of 1,915 harbor seals, well under the total allowed by NMFS IHA. The Russian River estuary management activities in 2015, 2014, 2013, 2012, 2011 and 2010 resulted in incidental harassment (Level B harassment) of 2,383, 2,121, 1,351, 208, 42 and 290 harbor seals, respectively. Reported take numbers represent an overestimate of the number of individuals harassed because these totals represent smaller numbers of individuals that may be harassed multiple times.

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 21, 2016, 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 and associated activities for the 2016 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.



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.

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; 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 2016) 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 21, 2016, and the Russian River Estuary Management Project Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2016).

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 April 5, 2016. Water Agency biologists participating in the monitoring program were also trained. 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 the haul-out monitoring location.

Baseline monitoring of the Jenner haul-out was shared by Water Agency biologists and trained Stewards volunteers. 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 and lagoon outlet channel implementation activities on the day of the event. Pre and post water level management activity 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, 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 counts were scheduled 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 multiple times each month. Surveys were conducted between 0600 and 1530 with most surveys beginning at 0730. 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. In April and May surveys at Jenner were conducted approximately 1 week apart in order to provide a count the total number of neonates observed throughout the pupping season. 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.

Disturbance of Seals

In addition to the count data, disturbances of seals on the haul-outs were recorded. The methods for recording disturbances are similar 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 or brief movement in response to disturbance, which may include turning head towards the disturbance, craning head and neck while holding the body rigid in a u-shaped position, changing from a lying to a sitting position, or brief movement of less than twice the animal’s body length.
2	Movement	Movements in response to the source of disturbance, ranging from short withdrawals at least twice the animal’s body length to longer retreats over the beach, or if already moving a change of direction of greater than 90 degrees.
3	Flush	All retreats (flushes) to the water.

Water Level Management Activities

Pinniped haul-outs were monitored during Water Agency water level management events (lagoon outlet channel implementation and artificial breaching). 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. 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 21, 2016) 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 2016, including baseline, water level management events and estuary management investigations.

Baseline

In 2016 a total of 36 baseline surveys, 12 beach topographic surveys, 3 breaching surveys, 1 pre-breaching, 3 post-breaching, 2 lagoon outlet implementation, 2 pre-lagoon outlet and 2 post-lagoon outlet surveys were conducted (Appendix A). One baseline survey was scheduled on the same day as a pre-breaching survey and one post-breaching survey also functioned as a pre-breaching survey.

Jenner Haul-out Use

Peak seal abundance in 2016, as measured by the single greatest count of harbor seals at the Jenner haul-out, was on June 14 (341 seals). Using the average number of seals hauled out by month, seal abundance at Jenner was greatest in June (mean = 234 ± 11.9 s.e., $n = 24$) compared to other months except July and April (Unequal N HSD multiple comparisons test, $p < 0.05$) (Figure 2). Seal abundance was lowest in September (mean = 14 ± 11.9 s.e., $n = 24$) compared to all other months except October (Unequal N HSD multiple comparisons test, $p < 0.001$) (Figure 2).

Fewer seals were present during closed conditions (mean = 71.3 ± 12.85 s.e., $n = 50$) compared to open conditions (mean = 146.9 ± 4.55 s.e., $n = 320$; 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, $p < 0.0001$).

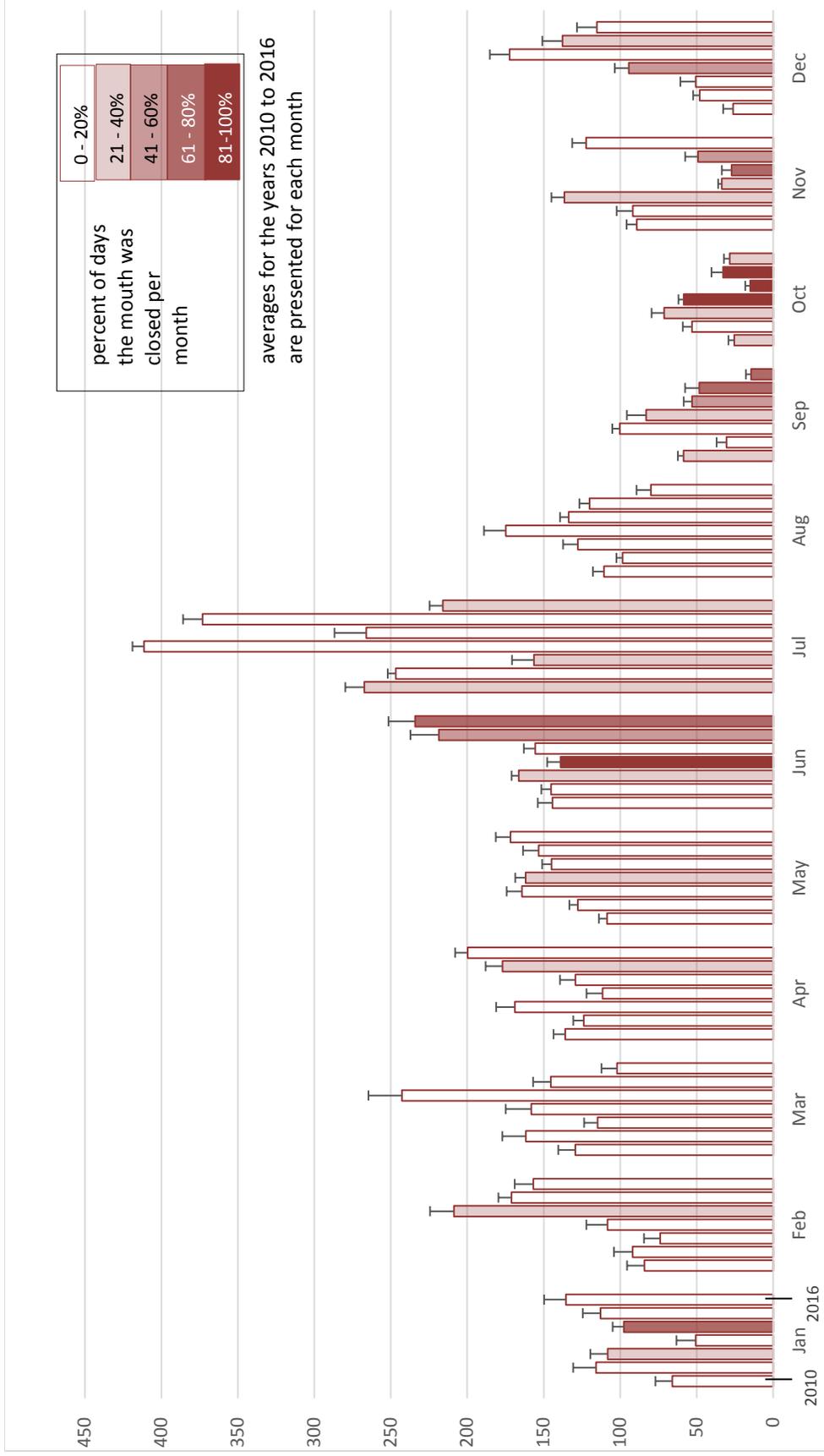


Figure 2. The average number of harbor seals hauled out at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) as counted during baseline surveys for each year (January 2010 – December 2016) categorized by month. Error bars represent standard error.

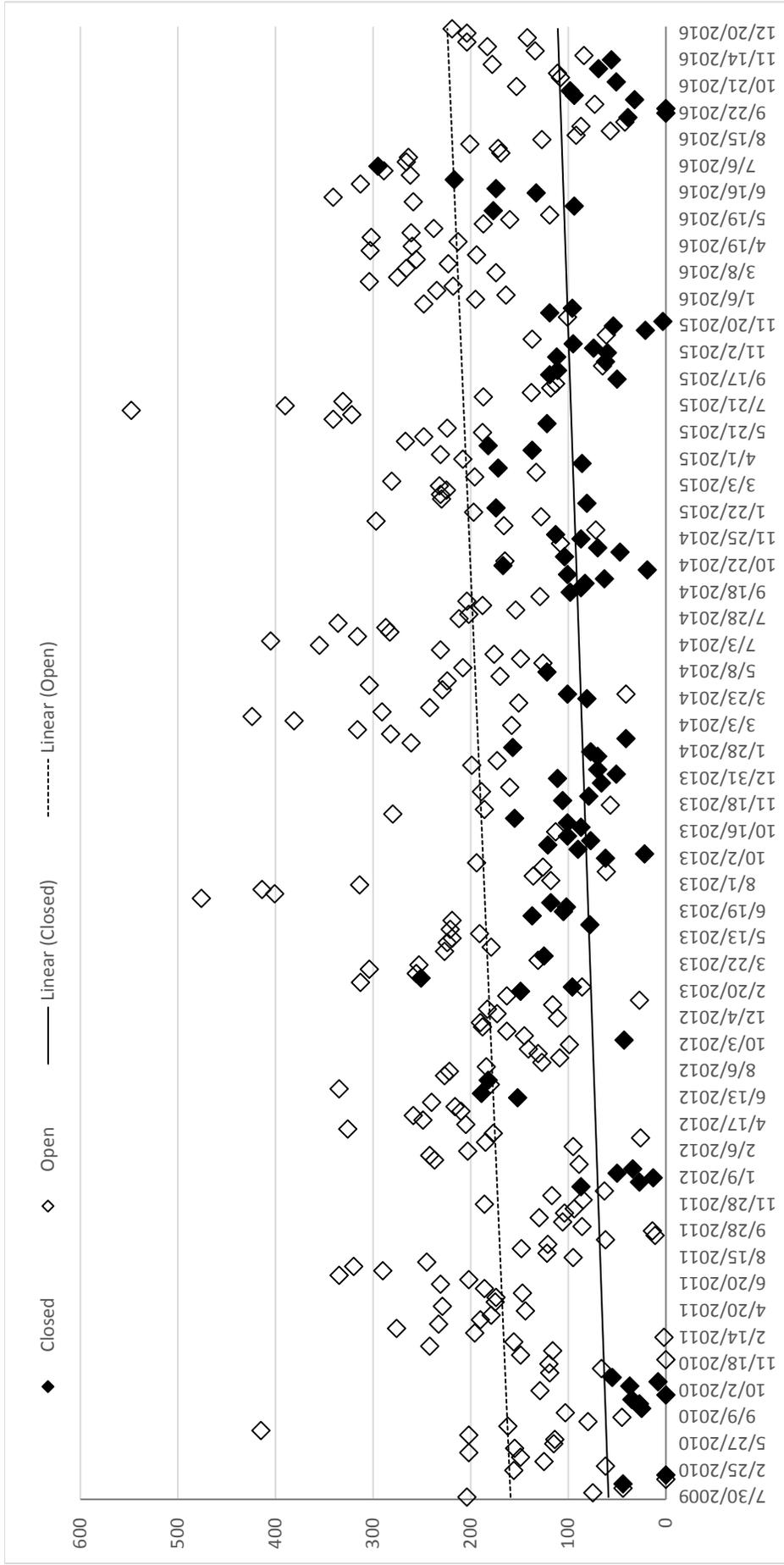


Figure 3. Maximum number of harbor seals counted during all pinniped surveys at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) from July 2009 to December 2016. Open diamonds represent counts in mouth open conditions and black filled diamonds represent counts during mouth closed conditions.

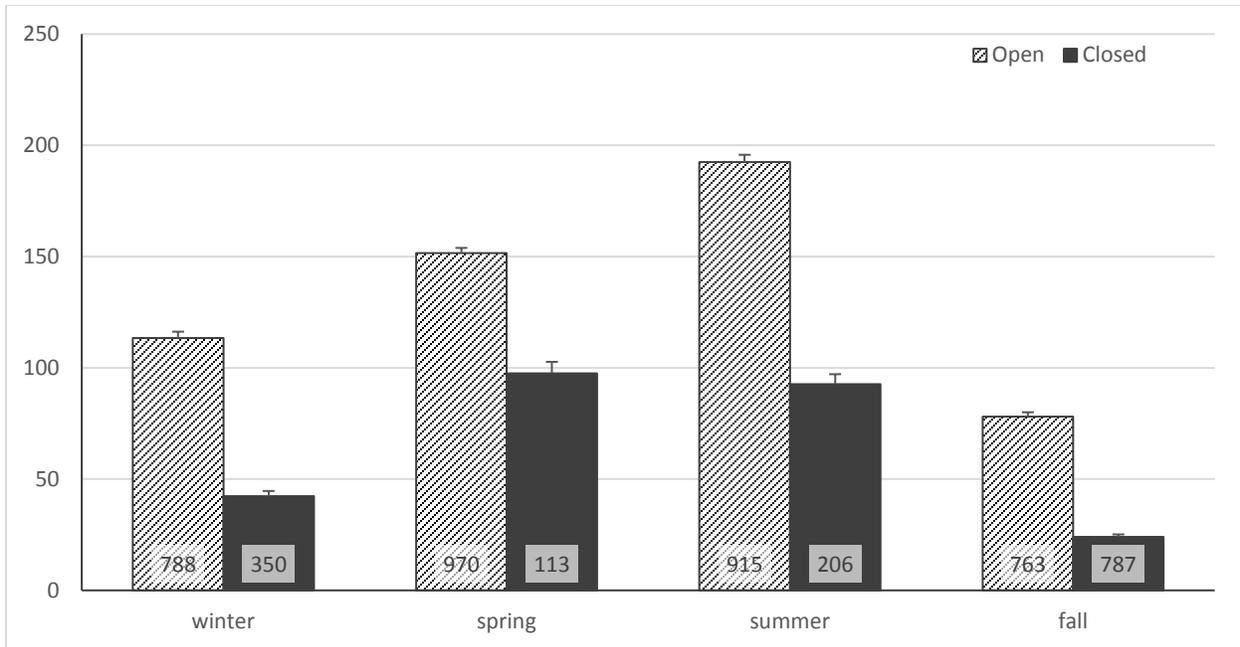


Figure 4. Average number of harbor seals at the Jenner haul-out for all surveys from July 2009 to December 2016 for mouth open and mouth closed conditions by season. Seasons were defined as: winter = December – February; spring = March – May; summer = June – August; fall = September – November.

Pupping Season

Pups have been observed at the Jenner haul-out as early as March (SCWA 2012, 2013). In 2016 the first pups were observed on April 5, with the latest observation of pups occurring on May 24 (the last neonate was observed on May 17). Pups are counted during surveys through June, after which time it becomes difficult to distinguish pups from sub-adult seals. On April 12, 2016, a newborn harbor seal pup was observed on Goat Rock State Beach and reported to the local stranding network (The Marine Mammal Center, Sausalito, CA) and to the regional stranding coordinator and NMFS Office of Protected Resources. The pup had characteristics of premature birth (lanugo) and no contact with any other seals for the duration of our survey.

The number of pups observed at the Jenner haul-out was similar to previous years with an average of 20.2 pups observed (when pups were present) and a single highest maximum count of 40 pups for the season (Figure 5). Using the sum of neonates observed during weekly counts in April and May, we estimate a minimum of 55 harbor seal pups born at Goat Rock State Beach in 2016.

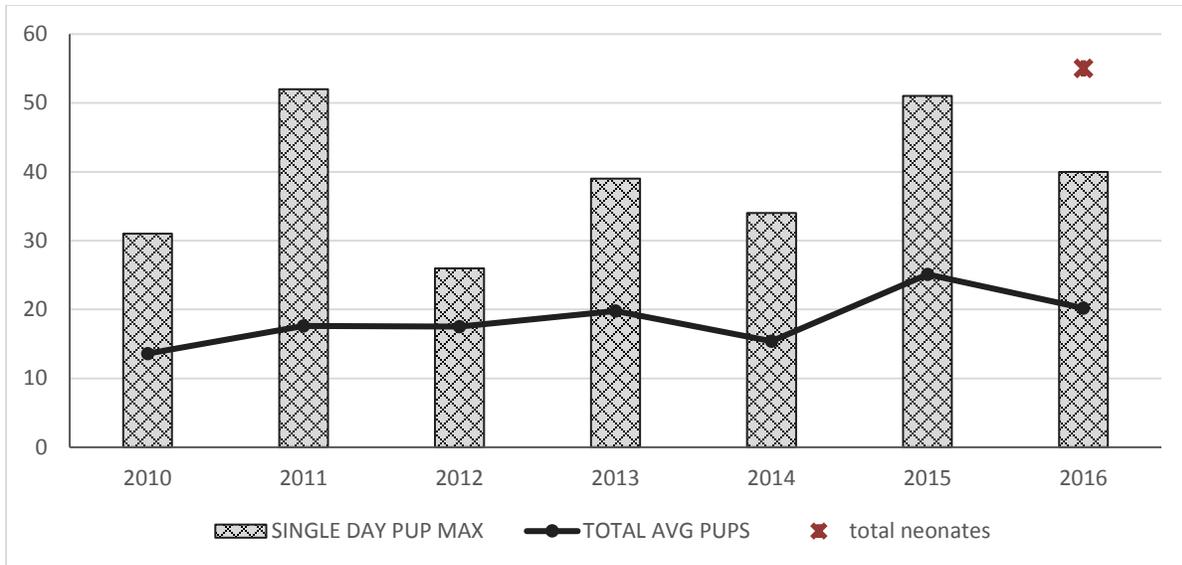


Figure 5. Number of harbor seal pups observed at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) by year. 2016 was the first year births could be estimated using the total number of neonates observed.

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 6 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 (58% of surveys), with a similar frequency during Water Agency activity surveys (55% of surveys). Water Agency personnel disturbed seals on 71% of Water Agency activity surveys. People in kayaks were the next most frequent source of disturbance (24% of baseline surveys) (Figure 6). When people on foot were the source of a disturbance the distance between them and seals averaged 159 feet for an alert response, 113 feet for a move response and 106 feet for a flush response.

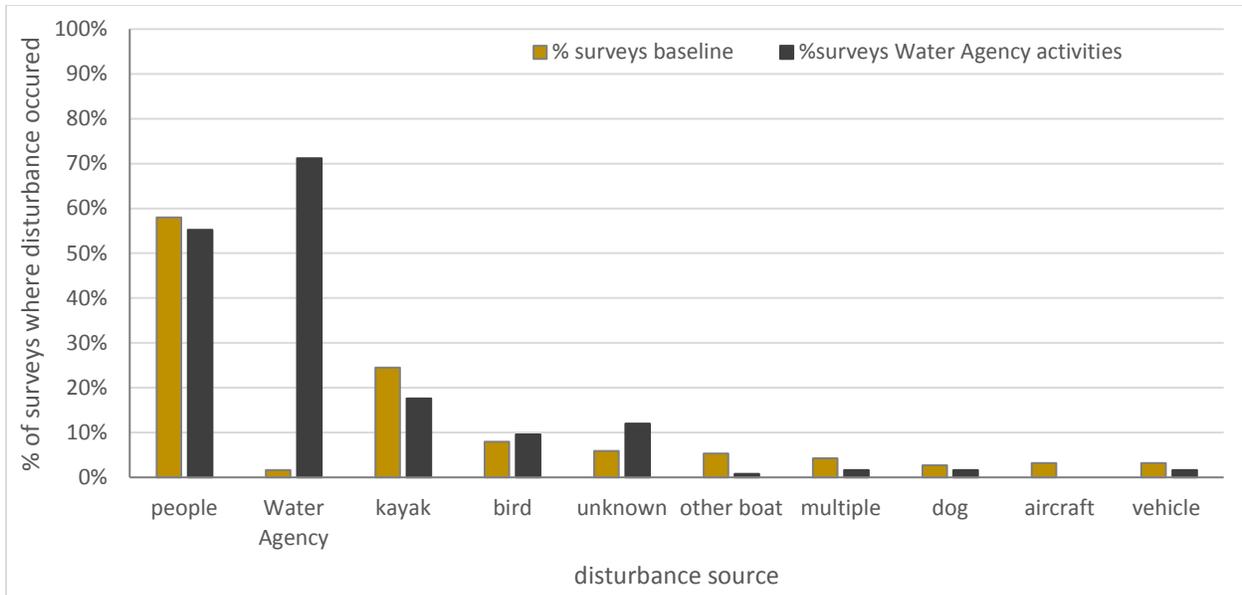


Figure 6. The proportion of surveys where harbor seals were disturbed (moved or flushed) at the Jenner haul-out, described for each disturbance source. Data includes all baseline surveys since surveys began in 2009 (n=188) and Water Agency activity surveys (i.e., breaching, lagoon outlet implementation, topographic surveys, and jetty study) (n=125).

Water Level Management Activities

A barrier beach formed eleven times during 2016 (Table 3), and the Water Agency artificially breached the sand bar during three of these closures and implemented a lagoon outlet channel during two of these closures. The Russian River outlet was closed to the ocean for a total of 68 days (or 19%) in 2016, with 58 (or 85%) of these days occurring during the lagoon management period. While the total number of days where the barrier beach was closed was lower compared to last year (115 days in 2015) most of the closure days occurred during the Lagoon Management Period.

On May 31, 2016, the river mouth closed and on June 7 the Water Agency excavated a lagoon outlet channel. However, the force of the water flowing to the ocean scoured the outlet channel to an open condition by the following day. The peak water level in the estuary was 7.8 ft NGVD as read from the Jenner gauge at 10:42 on June 7. Prior to the start of lagoon outlet channel implementation activities 89 harbor seals hauled out on the ocean side of the barrier beach. A small number of seals remained hauled out on the barrier beach throughout the implementation of the outlet channel (10-14 seals) on both the ocean and estuary side of the barrier beach. The outlet channel was completed at 10:45 and a total of 77 harbor seals were hauled out on the beach by 13:00.

On June 15 the river mouth closed and remained closed until June 27 when the Water Agency excavated a lagoon outlet channel. The river level reached 7.7ft NGVD at 08:09 on June 27. Before the crew arrived there were 212 harbor seals hauled out on both sides of the barrier beach. A few seals (8-34) remained north of the outlet channel site during the excavation activity. At the end of monitoring there were 64 seals on the beach at 11:40. Excavation of the lagoon outlet channel occurred between 08:08 and 09:15. Similar to the previous lagoon outlet channel implementation the outlet channel scoured to an open condition by the following day. On July 1 the barrier beach closed and remained closed for 11 days until it self-breached early in the morning on July 12. Another self-breach occurred on September 30 after the barrier beach was closed for 19 days in September.

The river mouth closed again on October 12 and the Water Agency excavated a pilot channel on October 20, with the river level reaching a peak height of 8.4ft NGVD. On the morning of the breaching activity 95 seals were hauled out on the ocean side of the beach. Excavation activities began at 09:21 and were complete at 10:50. All of the seals on the beach flushed into the ocean by the time the excavator was within 300 feet of the haul-out. At 12:00 12 seals had returned to the beach in the area of the excavated pilot channel. The river mouth remained open for a few days before closing again on October 24, the mouth self-breached on October 26.

The river mouth closed on November 8 and water levels reached a peak height of 7.7ft NGVD until the Water Agency excavated a pilot channel on November 10. Excavation activities lasted from 10:30 to 14:28 as a large amount of sand had been deposited on the beach from ocean swells. Prior to breaching activities there were 69 seals on the estuary side of the beach. At the end of the monitoring there were no seals hauled out. At 07:30 the following morning there were 79 seals hauled out. Continued high ocean swell conditions contributed to a subsequent barrier beach closure on November 12. On November 14, with water levels at 7.8ft NGVD, the Water Agency excavated a pilot channel. Excavation activities lasted from 9:45 to 12:05. Prior to breaching activities there were 56 seals on the ocean side of the beach. All of the seals flushed into the water when the excavator got within 100 feet of the haul-out. Conditions were very foggy and the barrier beach was not visible at the end of the survey at 13:00. At 07:30 the following morning there were 84 seals hauled out.

Harbor seal response to excavation activities was similar for all breaching and lagoon outlet channel implementation 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 300-100 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 lagoon outlet implementation and artificial breaching activities in 2016 was 669 harbor seals (537 flushed and 132 moved). Disturbance information for each event is provided in Table 4.

Table 2. Summary of river mouth closures in 2016 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.

Date mouth closed	Peak height (ft NGVD)	Date mouth opened	Management Activity
March 4	8.0	March 5	none
April 28	7.4	April 29	none
May 31	7.8	June 7	lagoon outlet
June 15	7.7	June 27	lagoon outlet
July 1	6.4	July 11	none
September 10	8.3	September 30	none
October 12	8.4	October 20	breach
October 23	8.1	October 26	none
November 5	7.7	November 7	none
November 8	7.7	November 10	breach
November 12	7.8	November 14	breach

Biological and Physical Monitoring

The NMFS IHA (2016) 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 2016 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 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 6% and 100% of seals were flushed from their haul-out during the monthly mapping activities (Table 3).

Table 3. Number of pinnipeds disturbed as a result of Russian River Estuary Management and Monitoring Activities for 2016, 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
1/21/2016	beach topo survey	harbor seal	adult	201(131)	100%
2/18/2016	beach topo survey	harbor seal	adult	102(13)	6%
3/17/2016	beach topo survey	harbor seal	adult	139(94)	33%
5/19/2016	beach topo survey	harbor seal	adult	129(124)	45%
			pup	5(5)	30%
6/7/2016	lagoon outlet implementation	harbor seal	adult	104(101)	97%
6/16/2016	beach topo survey	harbor seal	adult	117(117)	100%
6/27/2016	lagoon outlet implementation	harbor seal	adult	204(204)	89%
7/21/2016	beach topo survey	harbor seal	adult	259(209)	100%
8/18/2016	beach topo survey	harbor seal	adult	61(56)	100%
10/18/2016	Baseline	harbor seal	adult	9(9)	50%
10/20/2016	Breaching	harbor seal	adult	142(95)	100%
10/25/2016	Baseline	harbor seal	adult	38(38)	88%
10/26/2016	beach topo survey	harbor seal	adult	17(7)	70%
11/10/2016	Breaching	harbor seal	adult	107(81)	100%
11/14/2016	Breaching	harbor seal	adult	112(56)	100%
11/17/2016	beach topo survey	harbor seal	adult	114(94)	100%
12/28/2016	beach topo survey	harbor seal	adult	60(46)	100%
2016 total		harbor seal	adult	1910(1470)	
			pup	5(5)	

^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.

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 1,915 harbor seals in 2016, well under the total allowed by NMFS IHA. The total take numbers represent an overestimate of the number of individuals harassed because it represents smaller numbers of individuals that may be harassed multiple times.

The purpose of the Russian River Estuary Management Project Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2016) 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, 2016). 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).

Two notable deviations from previously observed trends in the abundance of harbor seals at the Jenner haul-out include a peak in haul-out abundance in June rather than in July and a decline in the number of seals in September. Overall seal abundance was still high in June and July compared to other months and this variation may not be significant. Continued monitoring will add to the long-term data set and allow for the detection of any shift in occupancy patterns at the Jenner haul-out. The decline in seal abundance in September compared to previous years was a result of a number of counts with no seals observed on the beach. The river mouth was closed for a total of 20 days in September including during two surveys in late September when no seals were hauled out.

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. Our increased frequency of baseline surveys at Jenner did allow us to count neonates on the beach every seven days during the pupping season and helped provide a more robust method for estimating the number of pups born at Jenner. This method of counting neonates on the beach is still an underestimate of total pups since harbor seal pups are very precocial and able to swim just after birth.

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. The closure of the barrier beach in September likely contributed to the low abundance of seals on the beach for the month. 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 mouth 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 2016 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 been implemented a few times (July 2010, May and June 2016). Each lagoon outlet implementation has failed to create an outlet channel that could be maintained throughout the lagoon management period. In 2016 both attempts to create an outlet channel failed to an open river mouth condition within one day. 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 twenty-one 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.

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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 2016.

date	Activity	Mouth	Estuary water level	HASE adult		HASE pups			HASE neonates			n	CASL present	NES present	
				max	mean	s.e.	max	mean	s.e.	max	mean				s.e.
1/6/2016	Baseline	Open	5.89	195	82.2	20.88	0	0.0	0.00	0	0.0	0.00	10		
1/21/2016	Topo survey	Open	2.45	164	71.3	18.66	0	0.0	0.00	0	0.0	0.00	11		
1/27/2016	Baseline	Open	1.84	235	168.8	14.12	0	0.0	0.00	0	0.0	0.00	16		
2/11/2016	Baseline	Open	3.08	218	166.8	13.30	0	0.0	0.00	0	0.0	0.00	18		
2/18/2016	Topo survey	Open	4.58	304	256.8	11.68	0	0.0	0.00	0	0.0	0.00	10	Y	
2/23/2016	Baseline	Open	2.69	275	146.1	20.94	0	0.0	0.00	0	0.0	0.00	17		
3/8/2016	Baseline	Open	3.19	174	62.0	11.15	0	0.0	0.00	0	0.0	0.00	17		
3/17/2016	Topo survey	Open	2.06	266	179.2	25.13	0	0.0	0.00	0	0.0	0.00	6		
3/24/2016	Baseline	Open	1.48	223	142.1	10.21	0	0.0	0.00	0	0.0	0.00	17		
4/8/2016	Baseline	Open	2.09	189	146.2	6.83	5	2.6	0.36	4	0.8	0.27	17		
4/12/2016	Baseline	Open	2.24	288	232.6	15.77	8	7.3	0.42	7	5.4	0.43	7		
4/19/2016	Baseline	Open	2.69	241	183.2	9.80	12	8.0	0.49	13	6.4	0.90	17		
4/21/2016	Topo survey	Open	2.87	192	180.7	8.95	14	12.3	0.88	10	7.0	1.73	3		
4/26/2016	Baseline	Open	2.66	267	236.4	9.25	21	19.6	0.46	17	14.6	0.56	8		
5/3/2016	Baseline	Open	2.17	245	218.8	6.36	16	10.8	1.56	0	0.0	0.00	9		
5/10/2016	Baseline	Open	1.95	205	188.2	2.50	32	25.2	1.46	2	0.7	0.24	9		
5/17/2016	Baseline	Open	1.70	161	116.2	10.69	39	24.2	4.37	1	0.8	0.15	9		
5/19/2016	Topo survey	Open	2.50	152	120.8	7.70	12	8.8	0.67	0	0.0	0.00	8		
5/24/2016	Baseline	Open	2.64	114	98.6	4.07	7	3.8	0.57	0	0.0	0.00	9		
6/6/2016	Pre-Lagoon Outlet	Closed	7.34	177	159.8	5.60	0	0.0	0.00	0	0.0	0.00	9		
6/7/2016	Lagoon Outlet Implementation	Closed	6.32	94	44.4	9.71	0	0.0	0.00	0	0.0	0.00	14		
6/8/2016	Post-Lagoon Outlet	Open	1.87	259	226.7	9.97	0	0.0	0.00	0	0.0	0.00	10		

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date	Activity	Mouth	Estuary water level	HASE adult			HASE pups			HASE neonates			CASL present	NES present
				max	mean	s.e.	max	mean	s.e.	max	mean	s.e.		
6/14/2016	Baseline	Open	1.62	341	317.2	3.97	0	0.0	0.00	0	0.0	0.00	9	
6/16/2016	Topo survey	Closed	3.05	133	103.9	12.24	0	0.0	0.00	0	0.0	0.00	9	
6/22/2016	Baseline	Closed	6.13	174	135.8	10.73	0	0.0	0.00	0	0.0	0.00	9	
6/24/2016	Pre-Lagoon Outlet	Open	6.87	313	187.3	23.18	0	0.0	0.00	0	0.0	0.00	9	
6/27/2016	Lagoon Outlet Implementation	Closed	6.38	217	78.7	23.48	0	0.0	0.00	0	0.0	0.00	10	
6/28/2016	Post-Lagoon Outlet	Open	2.04	262	245.6	5.13	0	0.0	0.00	0	0.0	0.00	10	
6/29/2016	Baseline	Open	1.91	289	256.8	13.97	0	0.0	0.00	0	0.0	0.00	6	
7/6/2016	Baseline	Closed	5.03	295	239.3	15.38	0	0.0	0.00	0	0.0	0.00	8	
7/13/2016	Baseline	Open	1.41	266	226.0	10.42	0	0.0	0.00	0	0.0	0.00	9	
7/19/2016	Baseline	Open	2.20	264	243.4	6.89	0	0.0	0.00	0	0.0	0.00	9	
7/21/2016	Topo survey	Open	2.07	169	150.2	5.82	0	0.0	0.00	0	0.0	0.00	10	
7/27/2016	Baseline	Open	2.26	172	141.1	9.89	0	0.0	0.00	0	0.0	0.00	7	
8/3/2016	Baseline	Open	2.05	201	168.0	9.73	0	0.0	0.00	0	0.0	0.00	9	
8/15/2016	Baseline	Open	1.79	127	65.9	7.46	0	0.0	0.00	0	0.0	0.00	10	
8/18/2016	Topo survey	Open	2.18	92	37.3	12.54	0	0.0	0.00	0	0.0	0.00	8	
8/23/2016	Baseline	Open	1.68	57	30.4	5.68	0	0.0	0.00	0	0.0	0.00	9	
8/30/2016	Baseline	Open	1.61	87	57.2	7.74	0	0.0	0.00	0	0.0	0.00	9	
9/7/2016	Baseline	Open	1.72	42	32.3	2.71	0	0.0	0.00	0	0.0	0.00	9	
9/13/2016	Baseline	Closed	3.85	39	5.5	3.82	0	0.0	0.00	0	0.0	0.00	10	
9/22/2016	Topo survey	Closed	6.66	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	6	
9/27/2016	Baseline	Closed	7.78	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	5	
10/11/2016	Baseline	Open	2.09	73	43.6	5.99	0	0.0	0.00	0	0.0	0.00	9	
10/18/2016	Baseline	Closed	7.55	32	18.1	2.52	0	0.0	0.00	0	0.0	0.00	9	
10/19/2016	Pre-Breaching	Closed	8.04	94	55.9	12.49	0	0.0	0.00	0	0.0	0.00	8	
10/20/2016	Breaching	Closed	7.80	98	33.7	13.90	0	0.0	0.00	0	0.0	0.00	11	
10/21/2016	Post-Breaching	Open	2.05	153	139.8	6.65	0	0.0	0.00	0	0.0	0.00	6	

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date	Activity	Mouth	Estuary water level	HASE adult			HASE pups			HASE neonates			n	CASL present	NES present
				max	mean	s.e.	max	mean	s.e.	max	mean	s.e.			
10/25/2016	Baseline	Closed	5.67	51	23.7	7.31	0	0.0	0.00	0	0.0	0.00	9		
10/26/2016	Topo survey	Open	6.51	108	59.8	15.81	0	0.0	0.00	0	0.0	0.00	8		
11/3/2016	Baseline	Open	2.65	111	95.0	4.79	0	0.0	0.00	0	0.0	0.00	9		
11/10/2016	Breaching	Closed		69	20.6	0.00	0	0.0	0.00	0	0.0	0.00	10		
11/11/2016	Post-Breaching/ pre-breaching	Open	5.42	178	151.1	7.50	0	0.0	0.00	0	0.0	0.00	17		
11/14/2016	Breaching	Closed		56	26.8	12.01	0	0.0	0.00	0	0.0	0.00	6		
11/15/2016	Post-Breaching	Open	2.01	84	36.8	11.24	0	0.0	0.00	0	0.0	0.00	9		
11/17/2016	Topo survey	Open	2.15	134	82.0	17.88	0	0.0	0.00	0	0.0	0.00	9		
11/28/2016	Baseline	Open	2.48	183	149.6	12.00	0	0.0	0.00	0	0.0	0.00	9		
12/6/2016	Baseline	Open	2.07	204	123.4	19.02	0	0.0	0.00	0	0.0	0.00	9		
12/13/2016	Baseline	Open	2.05	142	50.2	16.33	0	0.0	0.00	0	0.0	0.00	9		
12/20/2016	Baseline	Open	1.44	204	172.0	9.70	0	0.0	0.00	0	0.0	0.00	9		
12/28/2016	Topo survey	Open	2.02	219	58.8	27.90	0	0.0	0.00	0	0.0	0.00	9		