Russian River Estuary Management Project

Marine Mammal Protection Act Incidental Harassment Authorization
Report of Activities and Monitoring Results – January 1 to December 31, 2019

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

March 2020

Table of Contents

EXECUTIVE SUMMARY i

INTRODUCTION 1

BACKGROUND 1

Biological Opinion and the Estuary 3

METHODS 4

Baseline 4

Jenner Haul-out Use 5

Pupping Season 5

Disturbance of Seals 5

Water Level Management Activities 6

Biological and Physical Monitoring 6

RESULTS 6

Baseline 7

Jenner Haul-out Use 7

Pupping Season 11

Disturbance of Seals 11

Water Level Management Activities 12

Biological and Physical Monitoring 13

CONCLUSIONS 15

ACKNOWLEDGEMENTS 16

REFERENCES 16

TABLE OF TABLES

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. 5
Table 2. Summary of river mouth closures in 2019 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. 13
Table 3. Number of pinnipeds disturbed as a result of Russian River Estuary Management Project beach management and monitoring activities for 2019, 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 (#). 14

TABLE OF FIGURES

Figure 1. Pinniped haul-outs at the Russian River Estuary and surrounds. 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 2019) categorized by month. Error bars represent ± 1 standard error. 8
Figure 3. Top panel shows the maximum daily river height in feet as measured at the Jenner river gauge (left axis) and the total daily rainfall in inches as measured at the Bodega Marine Lab (right axis) for 2019. The lower panel shows the maximum daily count of harbor seals at the Jenner haul-out for all surveys in 2019. 9
Figure 4. 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. 10
Figure 5. Number of harbor seal pups observed at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) by year. Bar height indicates the maximum single day pup count, line indicates the daily average of pups counted throughout the season. 11
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=320) and Sonoma Water activity surveys (i.e., breaching, lagoon outlet implementation, topographic surveys, and jetty study) (n=173). 12

TABLE OF APPENDICES

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 to December 2019 for the Russian River Estuary Management Project, including summary of pinniped abundance and Estuary water surface elevation.

EXECUTIVE SUMMARY

The purpose of this report of activities and monitoring results is to comply with the provisions of the Marine Mammal Protection Act (MMPA) and Regulations Governing Taking of Marine Mammals Incidental to Russian River Estuary Management Activities (50 CFR Part 217, Subpart A) under Section 101(a)(5)(A) of the MMPA (16 U.S.C. 1371(a)(5)(A)) to take small numbers of marine mammals incidental to the Sonoma County Water Agency's (Sonoma Water) Russian River Estuary Water Level Management Activities (April 21, 2017, NMFS LOA).

Sonoma Water 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 Sonoma Water on March 30, 2010, and in each subsequent year until a Letter of Authorization (LOA) was issued on April 21, 2017. This report provides the results of all monitoring of baseline conditions and water level management activities for the 2019 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 Sonoma Water's artificial breaching activities are conducted in accordance with the approach 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. Sonoma Water 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 Sonoma Water'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. 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 Sonoma Water 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 haulout 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. Sonoma Water applied for an LOA 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 LOA issued April 21, 2017, 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 Sonoma Water's water level management events (lagoon outlet channel implementation and artificial breaching). Estuary management monitoring occurred during the Sonoma Water'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 four times during 2019, however, none of these closure events resulted in any water level management activities at the sand bar. The Russian River mouth was closed to the ocean for a total of 27 days (or 7%) in 2019.

Sonoma Water's biological and physical monitoring activities of the estuary are included in the NMFS LOA. Sonoma Water 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, Sonoma Water 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 2019 resulted in incidental harassment (Level B harassment) of 1,443 harbor seals, well under the total allowed by the NMFS LOA. The number of incidental harassment incidence in 2019 was very similar to previous years, the average number of incidence per year from 2010 -2019 is 1,248.

INTRODUCTION

The purpose of this report of activities and monitoring results is to comply with the provisions of the Marine Mammal Protection Act (MMPA) and Regulations Governing Taking of Marine Mammals Incidental to Russian River Estuary Management Activities (50 CFR Part 217, Subpart A) under Section 101(a)(5)(A) of the MMPA (16 U.S.C. 1371(a)(5)(A)) to take small numbers of marine mammals incidental to the Sonoma County Water Agency's (Sonoma Water) Russian River Estuary Water Level Management Activities (April 21, 2017, NMFS LOA)

Sonoma Water 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 Sonoma Water on March 30, 2010, and in each subsequent year until a Letter of Authorization (LOA) was issued on April 21, 2017. This report provides the results of all baseline monitoring, water level management and associated activities for the 2019 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 Sonoma Water. Sonoma Water'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.

SPECIAL PROJECTS/RUSSIAN RIVER/7104-ESTUARY/EstuaryManage-PinnipedMonitoring.mxd December 9,2015

Figure 1. Russian River estuary management pinniped monitoring locations.

Biological Opinion and the Estuary

Sonoma Water 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 Sonoma Water'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. 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 Sonoma Water 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). Sonoma Water applied for an LOA 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 LOA issued April 21, 2017, and the Russian River Estuary Management Project Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2016).

Sonoma Water biologists and Stewards of the Coast and Redwoods (Stewards) volunteers and staff monitored pinnipeds at the Jenner haul-out. The Stewards and Sonoma Water provide annual training for all volunteers; the most recent training occurred on March 12, 2019. Sonoma Water biologists participating in the monitoring program were also trained. The training agenda covered:

- the Marine Mammal Protection Act;
- anticipated LOA 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 Sonoma Water biologists and trained Stewards volunteers. Monitoring of water level management activities at the Jenner haul-out was also shared, but Sonoma Water biologists monitored artificial breaching 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 Sonoma Water staff. Sonoma Water 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 0730 and 1630. 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, Sonoma Water 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-out 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 Slavianka and Sonoma Coast State Beaches, Russian River/Mendocino Park District. July 11, 1996.		

Water Level Management Activities

While no water level management activities were conducted in 2019, events were scheduled to occur on two occasions. For these scheduled events pre-activity monitoring of the Jenner haul-out did occur. When water level management activities do occur the monitoring methods follow 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.

When breaching or lagoon outlet channel implementation activities do occur, the Sonoma Water monitor will participate 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 LOA.

Biological and Physical Monitoring

The NMFS LOA also provides incidental take for Level B harassment of pinnipeds that may result from monitoring of biological resources and physical processes in the estuary. Sonoma Water 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 Sonoma Water 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 LOA (April 21, 2017) 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 baseline 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 Sonoma Water), 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 2019, including baseline, water level management events and estuary management investigations.

Baseline

In 2019 a total of 41 baseline surveys, 12 beach topographic surveys, 1 pre-breaching survey, and 1 pre-lagoon outlet survey were conducted (Appendix A).

Jenner Haul-out Use

Peak seal abundance, as measured by the single greatest count of harbor seals at the Jenner haul-out, was on February 5 (314 seals). Using the average number of seals hauled out by month, seal abundance at Jenner was greatest in April compared to other months except January, February, May, June and July (mean = 167.8 ± 10.4 s.e., n = 36; Tukey's HSD multiple comparisons test, $p < 0.001$) (Figure 2). Seal abundance was lowest in November (mean = 21.9 ± 4.4 s.e., n = 30) (Figure 2). More notably the average seal abundance in March was lower in 2019 compared to previous years, reaching statistical significance for all years except 2016 (Tukey's HSD multiple comparisons test, $p < 0.01$). The cumulative (2010-2019) average abundance of seals during March was 138.4 (± 5.4 s.e., n = 350) and in 2019 the average abundance was only 37.1 (± 10.7 s.e., n =36) (Figure 2). Rainfall was above average in late winter of 2019, including the month of March where average daily rainfall was 0.42 inches (range 0.23-0.6 inches) compared to the ten year average of 0.14 inches (range 0.0-0.75 inches). The increase in rainfall and subsequent rise in river flow could have contributed to lower harbor seal abundance in March (Figure 3). Rainfall was found to be negatively correlated to seal abundance in 2019 ($r = -0.19$), a larger effect when compared to the ten year data set ($r = -0.02$).

Unlike in previous years there was no difference in the number of seals present during closed conditions (mean = 95.8 ± 10.8 s.e., n =32) compared to open conditions (mean = 98.4 ± 4.7 s.e., n= 358; ANOVA $p=0.873$). However, when all years are combined (2010-2019) there were significantly more seals hauled out in mouth open conditions (mean = 135.0 ± 1.5 s.e., n =3387) compared to mouth closed conditions (mean = 48.8 ± 4.0 s.e., n =512; Tukey's HSD multiple comparisons test, $p < 0.001$; Figure 4).

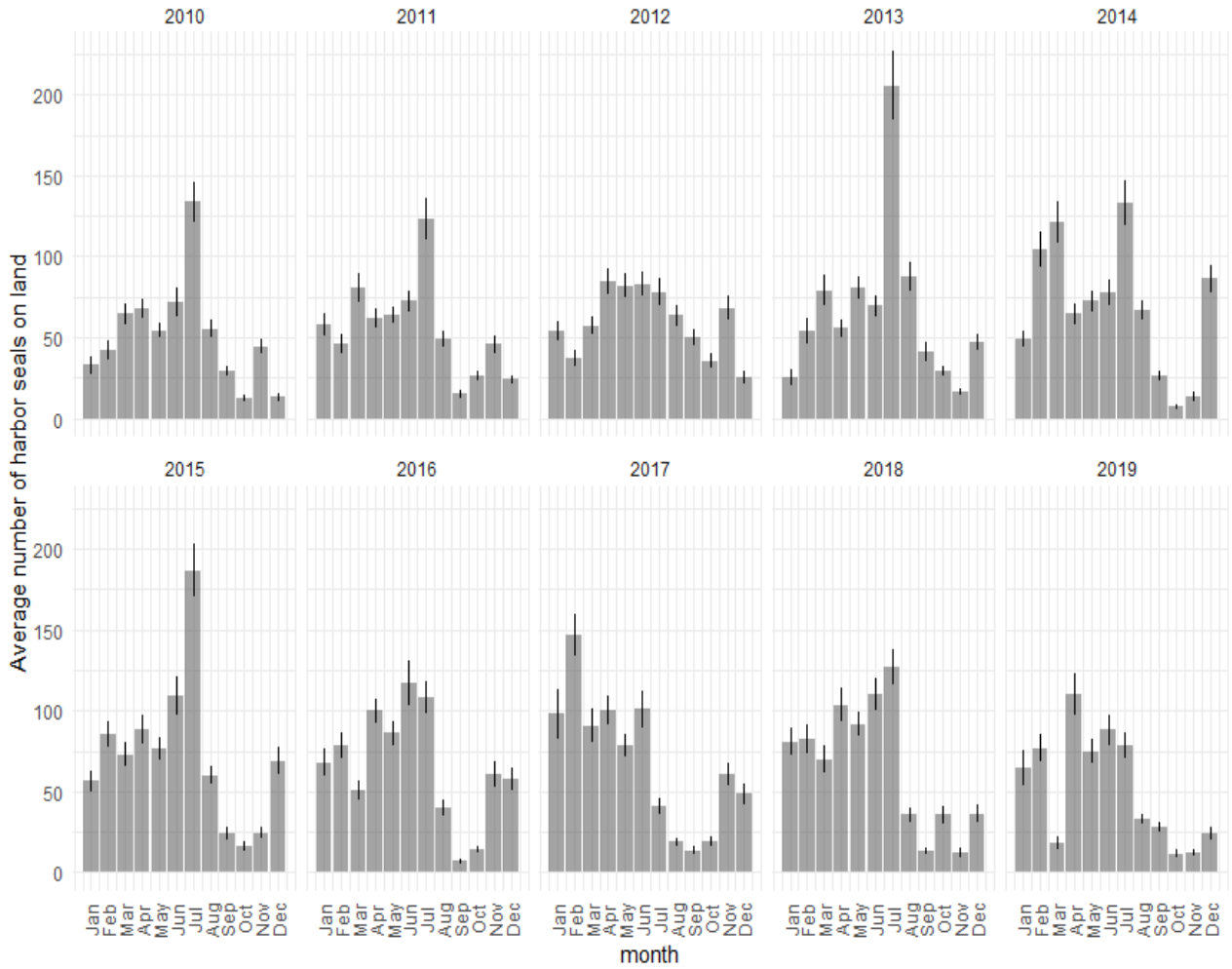

Figure 2. The average number of harbor seals hauled out at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) as counted during baseline surveys for each year (January 2010 – December 2019) categorized by month. Error bars represent ± 1 standard error.

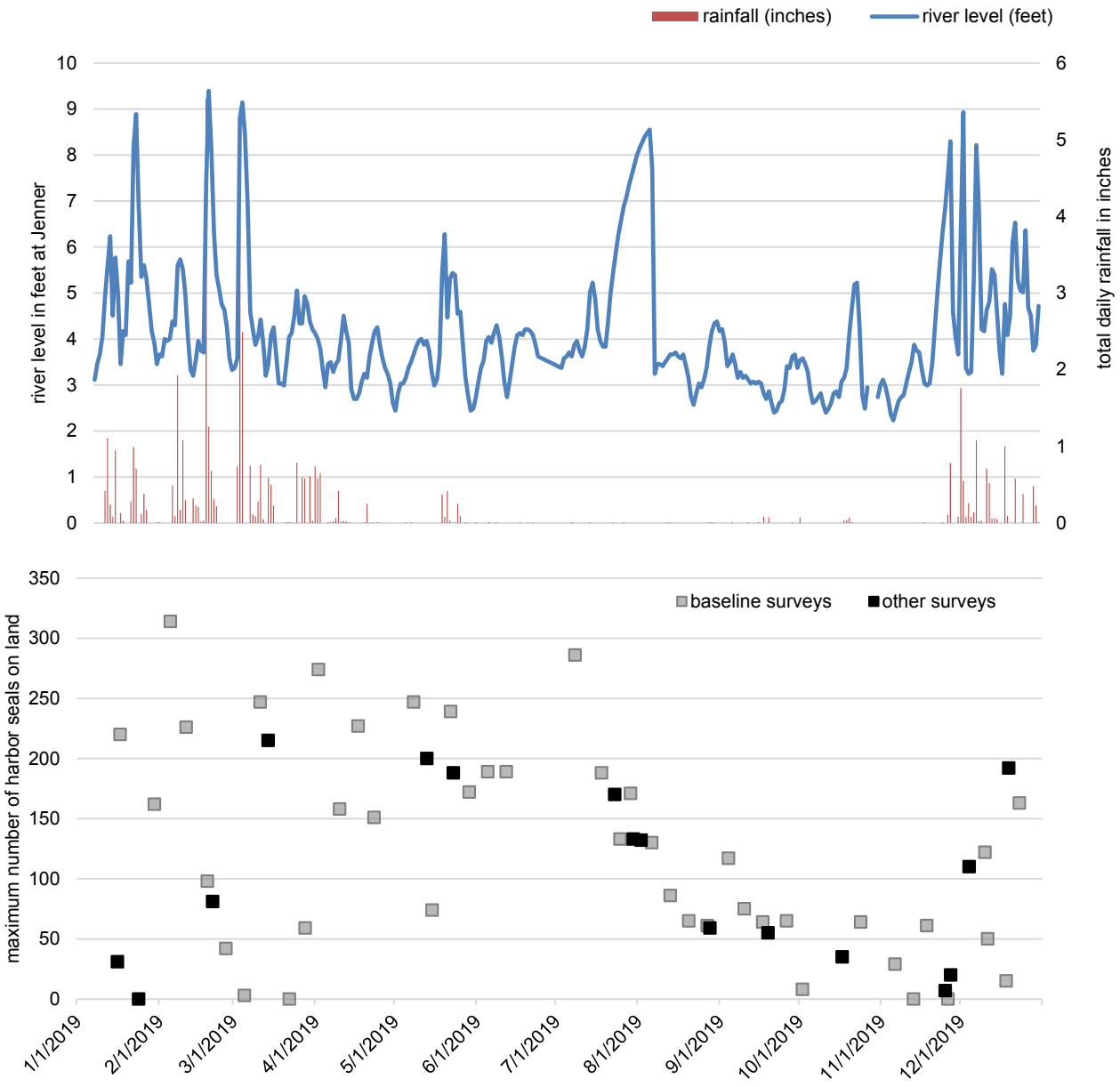

Figure 3. Top panel shows the maximum daily river height in feet as measured at the Jenner river gauge (left axis) and the total daily rainfall in inches as measured at the Bodega Marine Lab (right axis) for 2019. The lower panel shows the maximum daily count of harbor seals at the Jenner haul-out for all surveys in 2019.

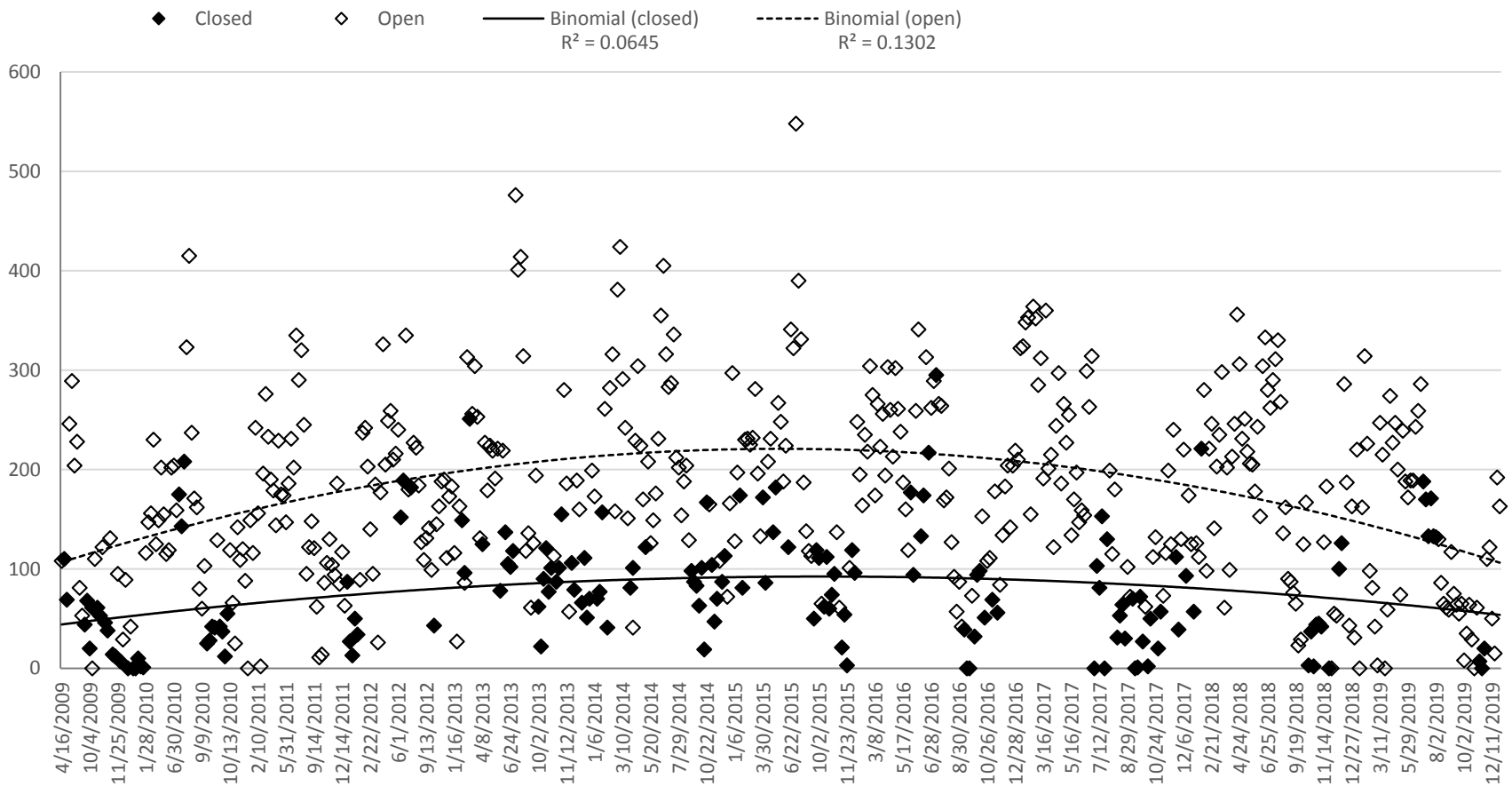

Figure 4. Maximum number of harbor seals counted during all pinniped surveys at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) since 2009. Open diamonds represent counts in mouth open conditions and black filled diamonds represent counts during mouth closed. A binomial curve was fit to counts in open and closed conditions, and their R^2 value is reported in the legend.

Pupping Season

In 2019 the first harbor seal pup was observed on April 10, with the latest observation of pups occurring on June 27 (the last neonate was observed on May 23). Once pups were weaned it became difficult to distinguish pups from sub-adult seals, as a result pups were not identified during surveys beginning in July. On April 23, during a baseline survey, a very skinny harbor seal pup was observed. During the four hour survey the pup did not make contact with any adult female. No further observations of this pup were noted, however the next survey was conducted 2 weeks later.

The number of pups observed at the Jenner haul-out was similar to previous years with an average of 15 pups observed (when pups were present, April - May) and a single highest maximum count of 35 pups for the season (Figure 5). We estimate a minimum of 44 harbor seal pups born at Goat Rock State Beach in 2019. To arrive at this estimate we started with the maximum single daily count of pups (neonates and greater than 1 week of age) on April 17 (31) and added the maximum single daily count of neonates recorded during each of the subsequent surveys where neonates were observed. This is likely an underestimate since there was one week in late April when a survey was not conducted.

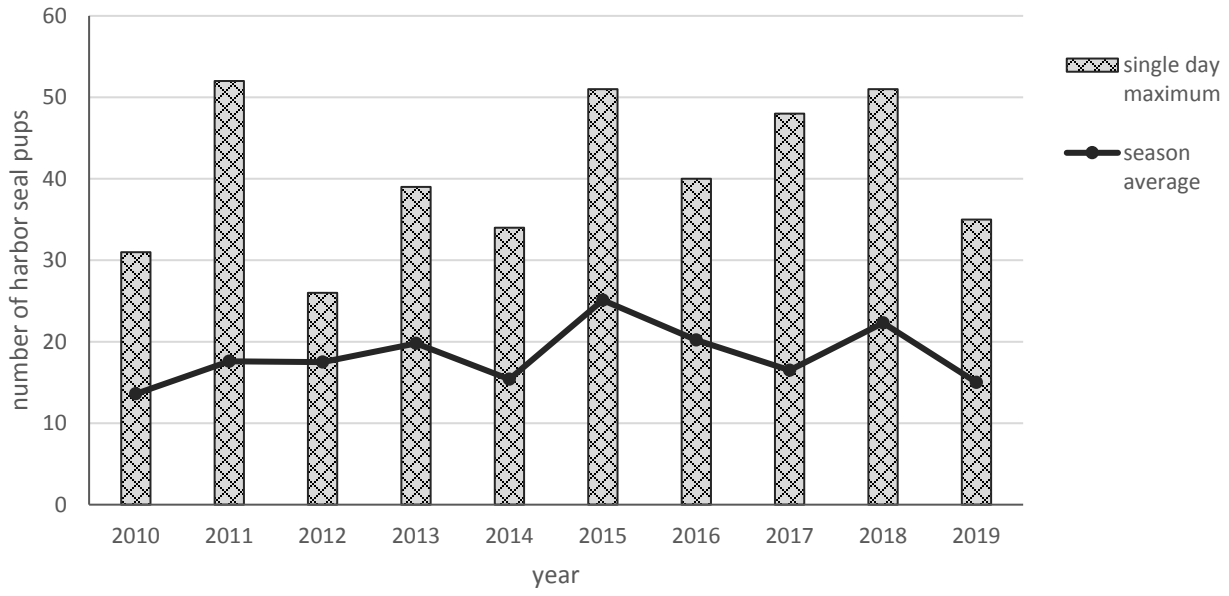

Figure 5. Number of harbor seal pups observed at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) by year. Bar height indicates the maximum single day pup count, line indicates the daily average of pups counted throughout the season.

Disturbance of Seals

An effort was made to compare the level of disturbance between baseline surveys and surveys when Sonoma Water 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 Sonoma Water. Seals were considered to be disturbed if they moved on or flushed from the haul-out.

Harbor seals were most frequently disturbed by people on foot (43% of surveys), with a similar frequency during Sonoma Water activities (42% of surveys) (Figure 6). Sonoma Water personnel disturbed seals on 72% of days with Sonoma Water activity on the beach (Figure 6). People in kayaks were the next most frequent source of disturbance (19% of baseline surveys) (Figure 6). During 2019

baseline surveys, when people on foot were the source of a disturbance the distance between them and seals averaged 118 feet at the time the seals exhibited an alert response, 105 feet for a move response, and 96 feet for a flush response. The rate of disturbance and distances at which a response was elicited were very similar to those observed in previous years (SCWA 2018).

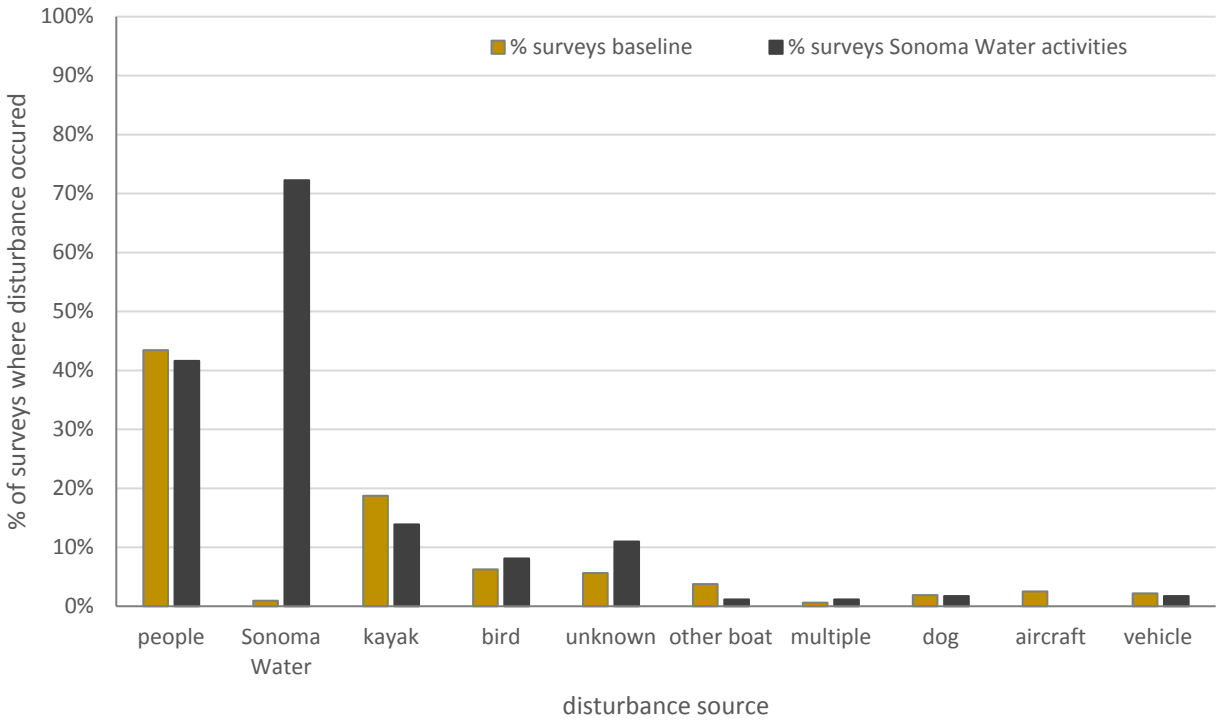

Figure 6. The proportion of surveys where harbor seals were disturbed (moved or flushed) at the Jenner haul-out, described for each disturbance source. Data includes all baseline surveys since surveys began in 2009 (n=320) and Sonoma Water activity surveys (i.e., breaching, lagoon outlet implementation, topographic surveys, and jetty study) (n=173).

Water Level Management Activities

A barrier beach formed four times during 2019 (Table 2). In each of these cases there was no water level management activity performed as the barrier beach self-breached. The Russian River outlet was closed to the ocean for a total of 27 days (or 7%) in 2019, with 60% of these occurring during the lagoon management period.

Table 2. Summary of river mouth closures in 2019 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
July 18	8.6	August 3	none
October 18	5.2	October 22	none
November 21	8.3	November 27	none
December 1	8.9	December 2	none

Biological and Physical Monitoring

The NMFS LOA (2017) 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 2019 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 Sonoma Water 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 92% 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 Project beach management and monitoring activities for 2019, 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]
3/14/2019	Monthly beach topo survey	harbor seal	adult	304(211)	92%
5/23/2019	Monthly beach topo survey	harbor seal	adult	223(173)	99%
			pup	16(16)	99%
6/5/2019	Estuary seining	harbor seal	adult	1(1)	20%
6/26/2019	Monthly beach topo survey	harbor seal	adult	464(382)	93%
7/30/2019	Monthly beach topo survey	harbor seal	adult	126(116)	100%
8/28/2019	Monthly beach topo survey	harbor seal	adult	99(51)	100%
9/19/2019	Monthly beach topo survey	harbor seal	adult	55(55)	100%
11/25/2019	Monthly beach topo survey	harbor seal	adult	10(7)	100%
12/4/2019	Monthly beach topo survey	harbor seal	adult	160(110)	100%
12/19/2019	Monthly beach topo survey	harbor seal	adult	232(192)	100%
	2019 total	**harbor seal**	**adult**	**1,442(1,358)**	
			pup	**1(1)**	

[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 Sonoma Water resulted in incidental harassment (Level B harassment) of 1,443 harbor seals in 2019, well under the total allowed by NMFS LOA.

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 most 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). 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. In most years daily average seal abundance was lower during closed conditions compared to open conditions.

More recently the pattern of harbor seals abundance at the Jenner haul-out have not followed the seasonal pattern described above. While we have consistently observed a decline in abundance following the summer molting period, the peak in abundance has occurred in the winter (February 2017), summer (July 2018) and the spring (April 2019; Figure 2). Another trend that appears to be changing is the overall abundance of harbor seals at Jenner. The abundance of seals overall is no longer increasing as it had been in past years (Figure 4).

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. To obtain a minimum estimate of the number of pups born at Jenner we started with the maximum single daily count of pups (neonates and greater than 1 week of age) on April 17 and added the maximum single daily count of neonates recorded during each of the subsequent surveys where neonates were observed. If we were to have used either the highest single count of pups or the total of neonates, the pup total would have been significantly lower, and not truly represent the number of births (35 and 19 respectively). While we did conduct four baseline surveys each month during the pupping season, we were not able to conduct surveys every week. That combined with the inability of individual observers to consistently assess the age category of pups (neonate or older than 1 week) makes estimating the number of pups by summing the weekly neonate counts impractical and unreliable.

As there were no water level management activities in 2019 we do not have additional information about their response to those activities. The river mouth was closed for a total of 17 days during the lagoon outlet management period (only 11% of days). The question about how seals would respond to the maintenance of a summer lagoon in the Russian River estuary remains unanswered due to the fact that Sonoma Water has not constructed and maintained a summer lagoon for more than a few days (< 1 to 5 days) on only 5 occasions since 2009 (SCWA 2011, 2017, 2018).

ACKNOWLEDGEMENTS

Much appreciation is extended to the Stewards of the Coast and Redwoods staff and volunteers for their hard work and commitment to gathering data on the pinnipeds and haul-outs in and around the Russian River estuary. M. Luna, A. Cresswell, K. Rawhouser provided the training and support that made the monitoring effort possible. Special thanks to all the volunteers that provided their time and keen observations to monitoring pinnipeds.

REFERENCES

Allen, S. G., H. R. Huber, C. A. Ribic and D. G. Ainley. 1989. Population dynamics of harbor seals in the Gulf of the Farallones, California. California Fish and Game 75(4): 224-232.

Gemmer, A. 2002. Ecology of harbor seals, *Phoca vitulina*, in northern California. M.A. Thesis, Humboldt State University: 128pp.

Heckel, M. 1994. Russian River Estuary Study 1992-1993. Prepared for Sonoma County Department of Planning and California State Coastal Conservancy. 186 pp.

Merritt Smith Consulting. 2000. Biological and Water Quality Monitoring in the Russian River Estuary, 1999. Fourth Annual Report. Prepared for the Sonoma County Water Agency. March 24, 2000.

Merritt Smith Consulting. 1999. Biological and Water Quality Monitoring in the Russian River Estuary, 1998. Third Annual Report. Prepared for the Sonoma County Water Agency. March 15, 1999.

Merritt Smith Consulting. 1998. Biological and Water Quality Monitoring in the Russian River Estuary, 1997. Second Annual Report. Prepared for the Sonoma County Water Agency. February 5, 1998.

Merritt Smith Consulting. 1997. Biological and Water Quality Monitoring in the Russian River Estuary, 1996. Prepared for Sonoma County Water Agency. February 21, 1997.

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

NMFS (National Marine Fisheries Service). 2008. Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation Improvement District in the Russian River watershed. September 24, 2008.

Small, R. J., L. F. Lowry, J. M. Ver Hoef, K. J. Frost, R. A. DeLong and M. J. Rehberg. 2005. Differential movements by harbor seal pups in contrasting Alaska environments. Marine Mammal Science 21(4):671-694

Sonoma County Water Agency. 2019. Russian River Estuary Management Project, Marine Mammal Protection Act Incidental Harassment Authorization, Report of Activities and Monitoring Results – January 1 to December 31, 2018. Prepared for Office of Protected Resources and Southwest Regional Administrator, National Marine Fisheries Service, February 2019.

Sonoma County Water Agency. 2018. Russian River Estuary Management Project, Marine Mammal Protection Act Incidental Harassment Authorization, Report of Activities and Monitoring Results – January 1 to December 31, 2017. Prepared for Office of Protected Resources and Southwest Regional Administrator, National Marine Fisheries Service, March 2018.

Sonoma County Water Agency. 2017. 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, February 2017.

Sonoma County Water Agency. 2016. 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, January 2016.

Sonoma County Water Agency. 2015. Russian River Estuary Management Project, Marine Mammal Protection Act Incidental Harassment Authorization, Report of Activities and Monitoring Results – January 1 to December 31, 2014. Prepared for Office of Protected Resources and Southwest Regional Administrator, National Marine Fisheries Service, January 2015.

Sonoma County Water Agency. 2014. Russian River Estuary Management Project, Marine Mammal Protection Act Incidental Harassment Authorization, Report of Activities and Monitoring Results –

January 1 to December 31, 2013. Prepared for Office of Protected Resources and Southwest Regional Administrator, National Marine Fisheries Service, January 2014.

Sonoma County Water Agency. 2013. Russian River Estuary Management Project, Marine Mammal Protection Act Incidental Harassment Authorization, Report of Activities and Monitoring Results – January 1 to December 31, 2012. Prepared for Office of Protected Resources and Southwest Regional Administrator, National Marine Fisheries Service, January 2013.

Sonoma County Water Agency. 2012. Russian River Estuary Management Project, Marine Mammal Protection Act Incidental Harassment Authorization, Report of Activities and Monitoring Results - April 2009 to December 31, 2011. Prepared for Office of Protected Resources and Southwest Regional Administrator, National Marine Fisheries Service, January 2012.

Sonoma County Water Agency. 2011. Russian River Estuary Management Project, Marine Mammal Protection Act Incidental Harassment Authorization (No. 14426), Report of Activities and Monitoring Results - April 1 to December 2010. Prepared for Office of Protected Resources and Southwest Regional Administrator, National Marine Fisheries Service, February 2011.

Sonoma County Water Agency and Merritt Smith Consulting. 2001. Biological and Water Quality Monitoring in the Russian River Estuary, 2000. Fifth Annual Report. June 12, 2001.

Sonoma County Water Agency and Stewards of the Coast and Redwoods. 2016. Russian River Estuary Management Activities Pinniped Monitoring Plan, Revised. January 2016.

Stewart, B. S. and P. K. Yochem. 1994. Ecology of harbor seals in the southern California bight. pp. 123-134 *in* The fourth California islands symposium: update on the status of resources, W. L. Halvorson and G. J. Maender (eds.), Santa Barbara Museum of Natural History, Santa Barbara, California.

Thompson, P. M., K. M. Kovacs and B. J. McConnell. 1994. Natal dispersal of harbor seals (Phoca vitulina) from breeding sites in Orkney, Scotland. Journal of Zoology, London 234:668-673.

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 to December 2019 for the Russian River Estuary Management Project, including summary of pinniped abundance and Estuary water surface elevation.

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
1/16/2019	Topo Survey (canceled)	Open	6.06	31	16.8	4.47	0	0.0	0.00	0	0.0	0.00	5		
1/17/2019	Baseline	Open	6.67	220	209.0	3.65	0	0.0	0.00	0	0.0	0.00	9		
1/24/2019	Topo Survey	Open	1.83	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	8		
1/30/2019	Baseline	Open	1.87	162	49.6	21.62	0	0.0	0.00	0	0.0	0.00	9		
2/5/2019	Baseline	Open	3.08	314	238.4	32.21	0	0.0	0.00	0	0.0	0.00	9		
2/11/2019	Baseline	Open	2.51	226	204.9	8.02	0	0.0	0.00	0	0.0	0.00	9		
2/19/2019	Baseline	Open	2.09	98	28.7	11.50	0	0.0	0.00	0	0.0	0.00	9		
2/21/2019	Topo Survey	Open	1.92	81	52.6	10.09	0	0.0	0.00	0	0.0	0.00	7		
2/26/2019	Baseline	Open	5.82	42	15.0	5.41	0	0.0	0.00	0	0.0	0.00	9		
3/5/2019	Baseline	Open	2.04	3	1.2	0.49	0	0.0	0.00	0	0.0	0.00	9		
3/11/2019	Baseline	Open	2.20	247	120.3	27.33	0	0.0	0.00	0	0.0	0.00	9		
3/14/2019	Topo Survey	Open	1.38	215	145.6	15.43	0	0.0	0.00	0	0.0	0.00	12		
3/22/2019	Baseline	Open	2.19	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
3/28/2019	Baseline	Open	2.64	59	26.8	6.36	0	0.0	0.00	0	0.0	0.00	9		
4/2/2019	Baseline	Open	1.99	274	232.0	14.89	0	0.0	0.00	0	0.0	0.00	9		
4/10/2019	Baseline	Open	1.25	155	110.6	11.09	1	0.6	0.18	5	2.7	0.37	9		
4/17/2019	Baseline	Open	1.57	202	183.2	4.93	30	25.2	0.80	1	0.2	0.15	9		
4/23/2019	Baseline	Open	1.44	130	100.2	9.16	13	10.4	0.80	9	5.9	1.03	9		
5/8/2019	Baseline	Open	2.38	235	199.6	8.60	35	23.3	3.53	2	0.3	0.25	8		
5/13/2019	Topo Survey (canceled)	Open	2.36	173	134.6	13.25	27	21.8	1.93	0	0.0	0.00	5		
5/15/2019	Baseline	Open	3.88	60	35.7	6.25	13	7.4	1.55	1	0.8	0.15	9		
5/22/2019	Baseline	Open	2.32	214	178.4	6.56	25	18.3	1.71	0	0.0	0.00	9		
5/23/2019	Topo Survey	Open	2.03	173	123.3	14.75	16	8.8	1.94	1	0.1	0.11	9		
5/29/2019	Baseline	Open	1.48	157	132.8	6.03	16	11.4	1.11	0	0.0	0.00	9		

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 to December 2019 for the Russian River Estuary Management Project, including summary of pinniped abundance and Estuary water surface elevation.

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
6/5/2019	Baseline	Open	2.08	188	131.3	12.55	1	0.3	0.17	0	0.0	0.00	9		
6/12/2019	Baseline	Open	1.80	189	169.4	3.52	4	1.8	0.57	0	0.0	0.00	9		
6/26/2019	Topo Survey	Open	#N/A	243	168.0	24.14	0	0.0	0.00	0	0.0	0.00	8		
6/27/2019	Baseline	Open	#N/A	258	185.7	35.42	3	0.9	0.35	0	0.0	0.00	9		
7/8/2019	Baseline	Open	3.49	286	252.0	9.60	0	0.0	0.00	0	0.0	0.00	9		
7/18/2019	Baseline	Closed	4.05	188	124.9	24.42	0	0.0	0.00	0	0.0	0.00	9		
7/23/2019	Beach Elevation Survey	Closed	6.42	170	106.7	53.64	0	0.0	0.00	0	0.0	0.00	3		
7/25/2019	Baseline	Closed	6.97	133	119.1	3.41	0	0.0	0.00	0	0.0	0.00	9		
7/29/2019	Baseline	Closed	7.84	171	96.8	13.77	0	0.0	0.00	0	0.0	0.00	9		
7/30/2019	Topo Survey	Closed	8.02	133	60.9	22.02	0	0.0	0.00	0	0.0	0.00	7		
8/2/2019	Pre-Breaching	Closed	8.40	132	94.1	9.73	0	0.0	0.00	0	0.0	0.00	9		
8/6/2019	Baseline	Open	1.54	130	107.3	7.22	0	0.0	0.00	0	0.0	0.00	9		
8/13/2019	Baseline	Open	1.43	86	52.6	7.89	0	0.0	0.00	0	0.0	0.00	9		
8/20/2019	Baseline	Open	1.33	65	57.2	1.79	0	0.0	0.00	0	0.0	0.00	9		
8/27/2019	Baseline	Open	1.78	61	47.3	2.32	0	0.0	0.00	0	0.0	0.00	9		
8/28/2019	Topo Survey	Open	1.75	59	27.3	12.28	0	0.0	0.00	0	0.0	0.00	6		
9/4/2019	Baseline	Open	1.67	117	71.9	16.04	0	0.0	0.00	0	0.0	0.00	10		
9/10/2019	Baseline	Open	1.46	75	42.4	4.88	0	0.0	0.00	0	0.0	0.00	9		
9/17/2019	Baseline	Open	1.49	64	50.1	4.11	0	0.0	0.00	0	0.0	0.00	9		
9/19/2019	Topo Survey	Open	1.89	55	11.0	11.00	0	0.0	0.00	0	0.0	0.00	5		
9/26/2019	Baseline	Open	1.94	65	36.7	8.56	0	0.0	0.00	0	0.0	0.00	9		
10/2/2019	Baseline	Open	1.45	8	0.9	0.89	0	0.0	0.00	0	0.0	0.00	9		

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 to December 2019 for the Russian River Estuary Management Project, including summary of pinniped abundance and Estuary water surface elevation.

				HASE adult			HASE pup			HASE neonate					
date	**activity**	**mouth**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
10/17/2019	Topo Survey	Open	1.89	35	8.6	4.60	0	0.0	0.00	0	0.0	0.00	9		
10/24/2019	Baseline	Open	2.28	64	45.4	4.43	0	0.0	0.00	0	0.0	0.00	9		
11/6/2019	Baseline	Open	1.36	29	22.7	1.39	0	0.0	0.00	0	0.0	0.00	7		
11/13/2019	Baseline	Open	1.89	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
11/18/2019	Baseline	Open	2.20	61	55.4	1.44	0	0.0	0.00	0	0.0	0.00	9		
11/25/2019	Topo Survey	Perched	6.60	7	4.2	1.71	0	0.0	0.00	0	0.0	0.00	5		
11/27/2019	Pre-Lagoon Outlet	Closed	7.44	20	6.7	2.93	0	0.0	0.00	0	0.0	0.00	9		
12/4/2019	Topo Survey	Open	2.09	110	57.0	23.82	0	0.0	0.00	0	0.0	0.00	5		
12/11/2019	Baseline	Open	2.22	50	10.0	5.80	0	0.0	0.00	0	0.0	0.00	9		
12/18/2019	Baseline	Open	3.38	15	4.4	2.13	0	0.0	0.00	0	0.0	0.00	9		
12/19/2019	Topo Survey	Open	2.66	192	129.9	23.61	0	0.0	0.00	0	0.0	0.00	9		
12/23/2019	Baseline	Open	3.16	163	64.7	23.77	0	0.0	0.00	0	0.0	0.00	9		