Russian River Estuary Management Project

Marine Mammal Protection Act Incidental Harassment Authorization

Summary Report for April 2017 LOA

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

Sonoma Water

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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 Incidental Harassment Authorization under the 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 summary results of pinniped monitoring as described in the terms of the LOA submitted with the request for continued incidental take authorization. All monitoring of baseline conditions and water level management activities since April 2017 through April 2021, and a summary of findings, will provide the background to support of Sonoma Water's request for a new LOA.

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. 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 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. 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 has formed 34 times during since the LOA was issued in April 2017, water level management activities at the sand bar occurred during 12 of these closure events. The Russian River mouth was closed to the ocean for a total of 262 days (or 17%) during this period. The average number times a barrier beach formed per year was 7.

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 resulted in annual incidental harassment (Level B harassment) of harbor seals below the amount allowed by the NMFS LOA. The number of incidental harassment incidence ranged from 947 to 2,502 annually for 2017-2020 and 308 for 2021 up to April 30.

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 Incidental Harassment Authorization (IHA) under the 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 April 2017 through April 30, 2021. The summary information and analysis will provide the background to support of Sonoma Water's request for a new LOA.

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 (SCWA 2020b). 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.

SONOMA COUNTY WATER AGENCY

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. 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).

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 also recorded.

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 of 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

For each water level management activity the monitoring methods 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. Additionally, the Sonoma Water 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 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 (pups less than one week of age) 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 Sonoma Water'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 for the term of the LOA, including baseline, water level management events and estuary management investigations.

Baseline

Monitoring surveys were conducted according to the protocols outlined in the Pinniped Monitoring Plan and are listed in Appendix A. The number of baseline surveys was lower than would be expected given

the monitoring schedule. One reason for the lower number of surveys is that on occasions when a baseline survey was scheduled for the day just before or just after a breaching event those surveys were recorded as either a pre-breach or post-breach survey as appropriate. Additionally, due to the shelter in place order issued in March 2020 for Sonoma County due to the COVID-19 pandemic, surveys were suspended until a protocol was developed to protect the safety of staff and volunteers.

Jenner Haul-out Use

The abundance of seals at the Jenner haul-out declined slightly during the term of the LOA (Figure 2). Depending on the year, seals were most abundant during the spring or summer months (Figure 3). Annual peak seal abundance (since 2017), as measured by the single greatest count of harbor seals at the Jenner haul-out, ranged from 314 to 356 (this excludes data from 2021 since the typical date for peak counts had not yet occurred). We examined the influence of tide height (station 9415020 Point Reyes, CA), hour of the day, river mouth condition (opened or closed), and the presence of people near the haul-out (Figure 4 – Figure 7) on seal abundance. We found that the number of people recorded near the haul-out and hour had little influence on the number of seals while increased tide height and a closed river mouth had a negative effect on seal abundance.

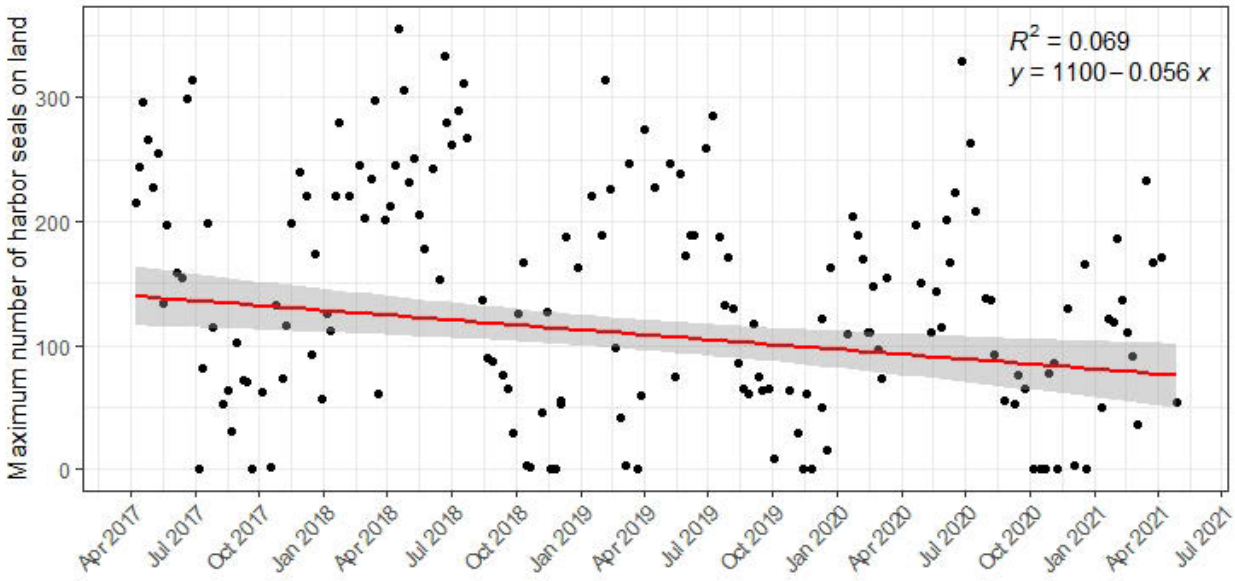


Figure 2. Maximum number of harbor seals counted during baseline surveys for the Jenner haul-out (Goat Rock State Beach) from April 2017 to April 2021. Linear regression line (y ~ x) is plotted in red and the confidence interval is the shaded area.

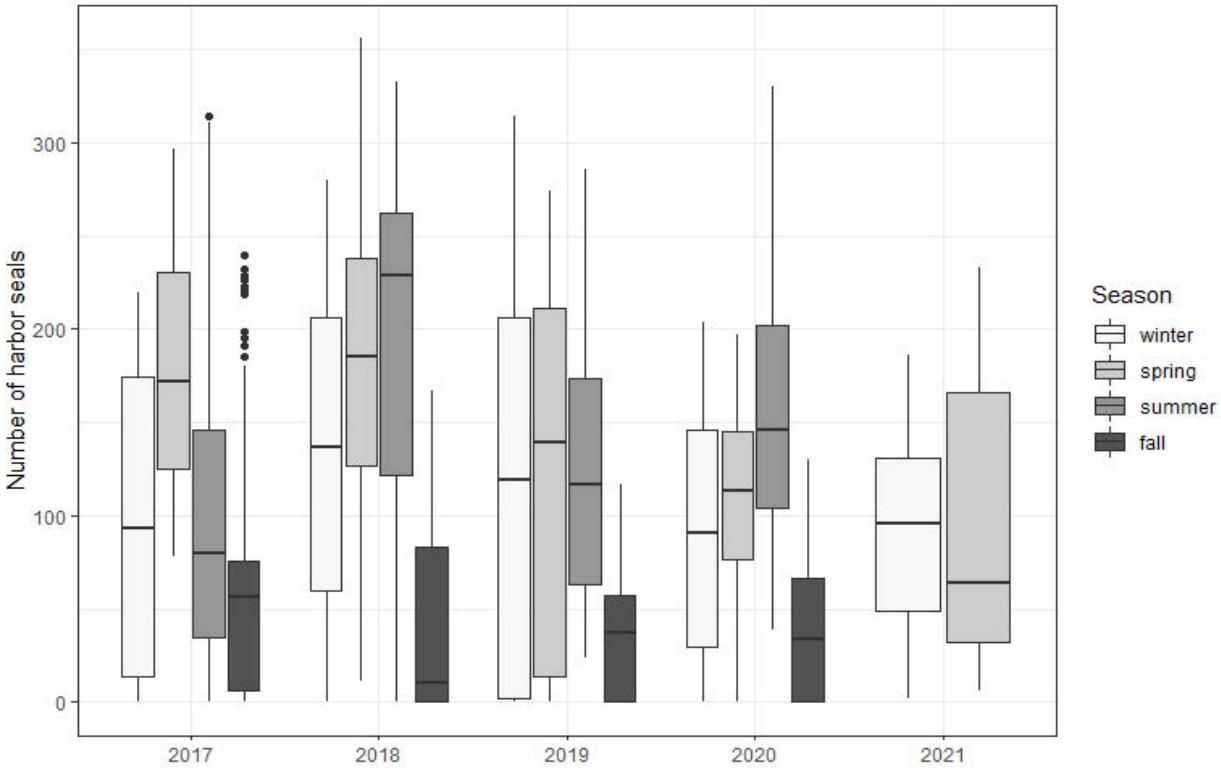


Figure 3. Boxplot showing the median (horizontal line), inter quartile range (area), 95% confidence interval (whisker) and outlying values (point) of harbor seal abundance at the Jenner haul-out (Goat Rock State Beach) by season from 2017 to April 2021 where winter = December-February, spring = March-May, summer = June-August and fall = September-November.

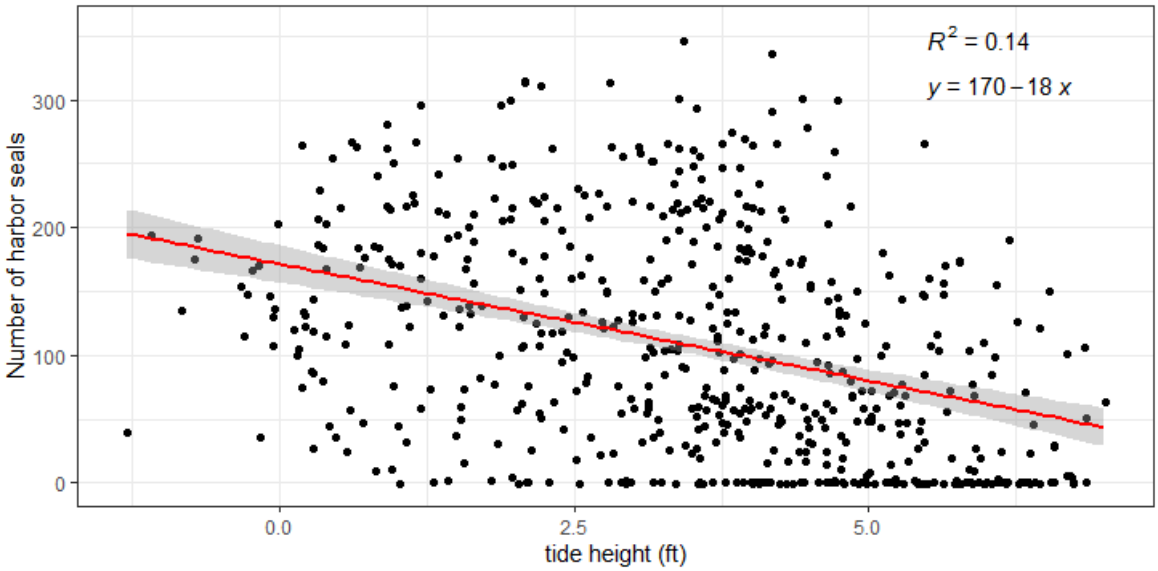


Figure 4. Correlation between seal abundance and tide height in feet as recorded for the Point Reyes, CA tide station from 2017 to April 2021. Linear regression line (y ~ x) is plotted in red and the confidence interval is the shaded area.

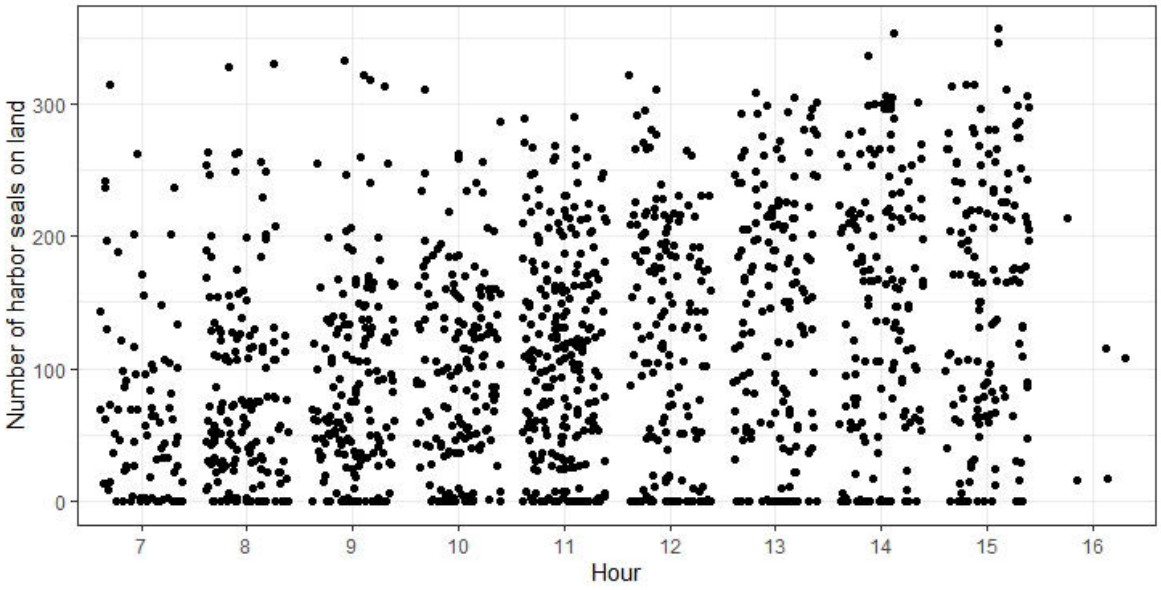
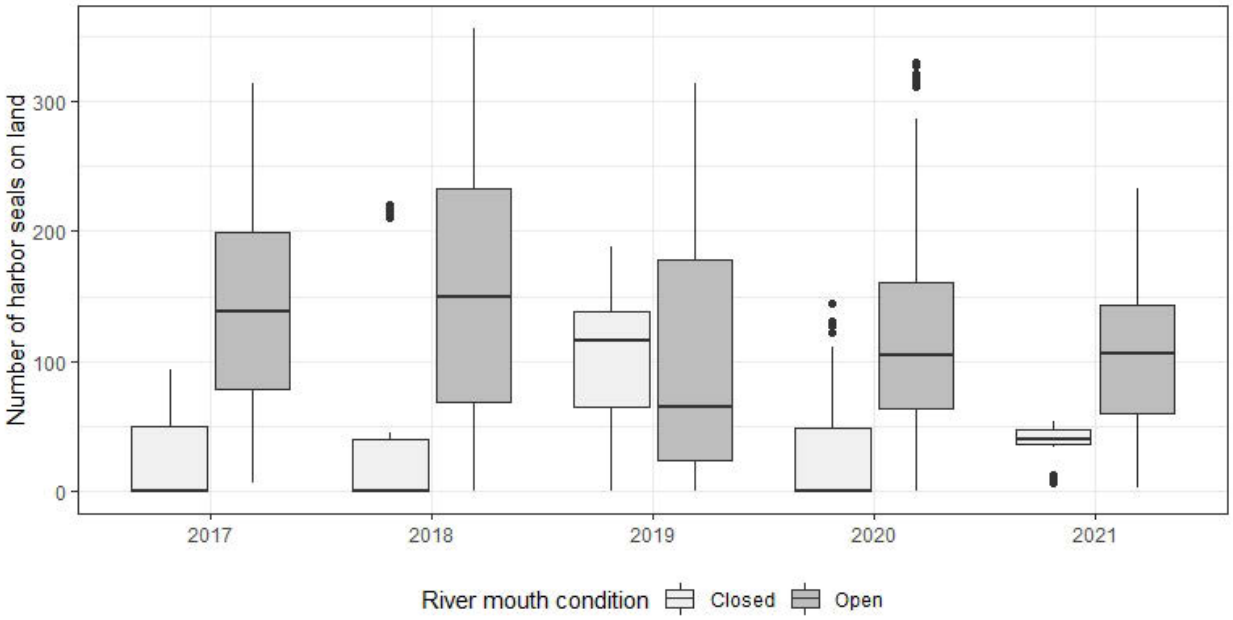


Figure 5. Number of harbor seals hauled out during baseline surveys at the Jenner haul-out (Goat Rock State Beach) by hour of the day from 2017 to April 2021, where hour 0 is midnight and hour 12 in noon.



Year	2017	2018	2019	2020	2021
Closed (n)	90	44	32	64	27
Open (n)	212	355	367	269	107

Figure 6. Boxplot showing the median (horizontal line), inter quartile range (area), 95% confidence interval (whisker) and outlying values (point) of harbor seals hauled out at the Jenner haul-out (Goat Rock State Beach) by river mouth condition for each year from 2017 to April 2021. The number of counts for each group (n) is provide in the table.

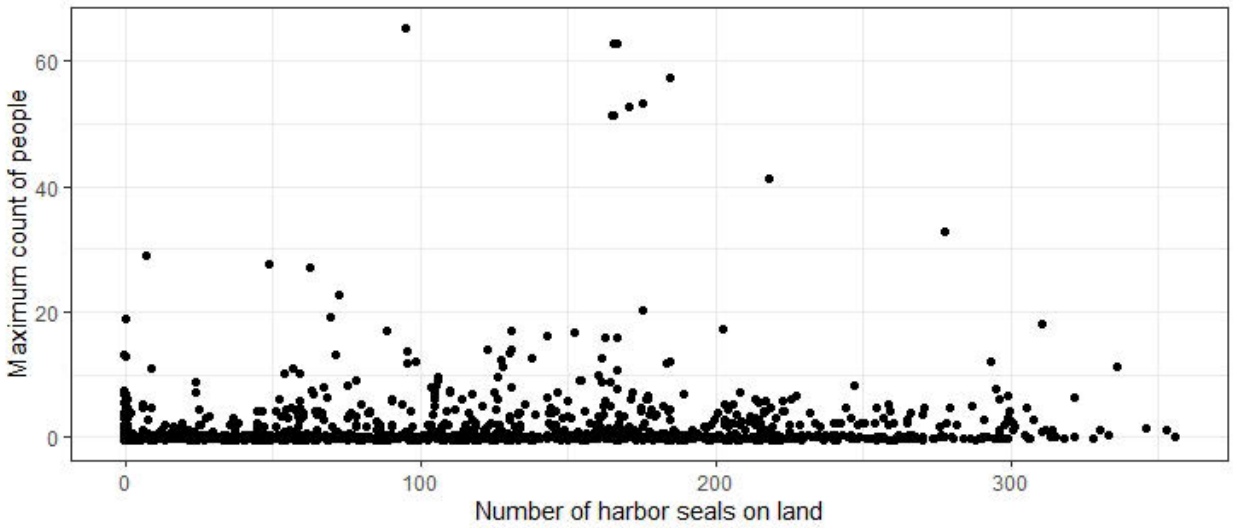


Figure 7. Maximum number of people recorded in a survey day and the number of seals hauled out during baseline surveys at the Jenner haul-out from April 2017 to April 2021 (Goat Rock State Beach).

Pupping Season

During the term of the LOA (April 2017 to April 2021) harbor seal pups were observed between February 28 and June 27, the February observation was unusual and most likely the pup was born prematurely. More typically pups are first observed in April. 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.

The number of pups observed at the Jenner haul-out varied somewhat from year to year during the term of the LOA (Figure 8). The average daily count for each year ranged from 12 to 22 pups observed (when pups were present in April and May) and the daily maximum counts ranged from 35 to 49. As of April 2021 the maximum daily count was 29 pups, but highest pup counts typically occur in May. We use the highest daily pup count as our estimate for pup production each year, however this an underestimate since not all pups born will be present on the beach during the counts.

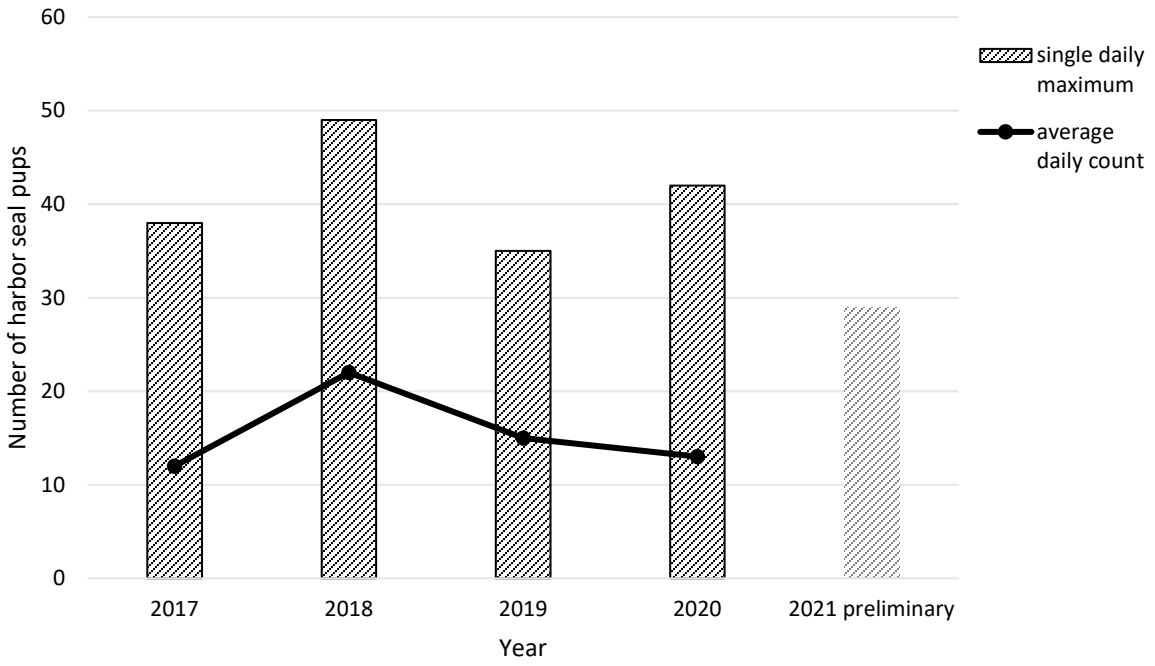


Figure 8. Number of harbor seal pups observed at the Jenner haul-out (Goat Rock State Beach) by year from 2017 to April 2021. Bar height indicates the maximum single day pup count, line indicates the daily average of pups counted throughout the season.

Disturbance of Seals

The behavior of seals was recorded during baseline surveys, with a special emphasis on events when seals are disturbed on their haul-out. Behavior was recorded as a disturbance when seals alerted to a source, moved on, or flushed from their haul-out. Harbor seals were most frequently disturbed by people on foot (62% of surveys), followed by people in kayaks or other boats (36% of surveys). Additional sources of disturbance sources include aircraft, birds, vehicles, dogs, other pinnipeds, waves, floating logs or trash, and unknown sources (Figure 9). The distance between people, either on land or in the water, and seals averaged 114 feet (range 2-1500 ft., s.d. 163 ft.) at the time the seals exhibited an alert response, 109 feet (range 5-300 ft., s.d. 75 ft.) for a move response, and 91 feet (range 5-300 ft., s.d. 63 ft.) for a flush response. The average rate for disturbances (alert, move or flush) per hour during baseline surveys for this period was 1.02 (median = 0.5).

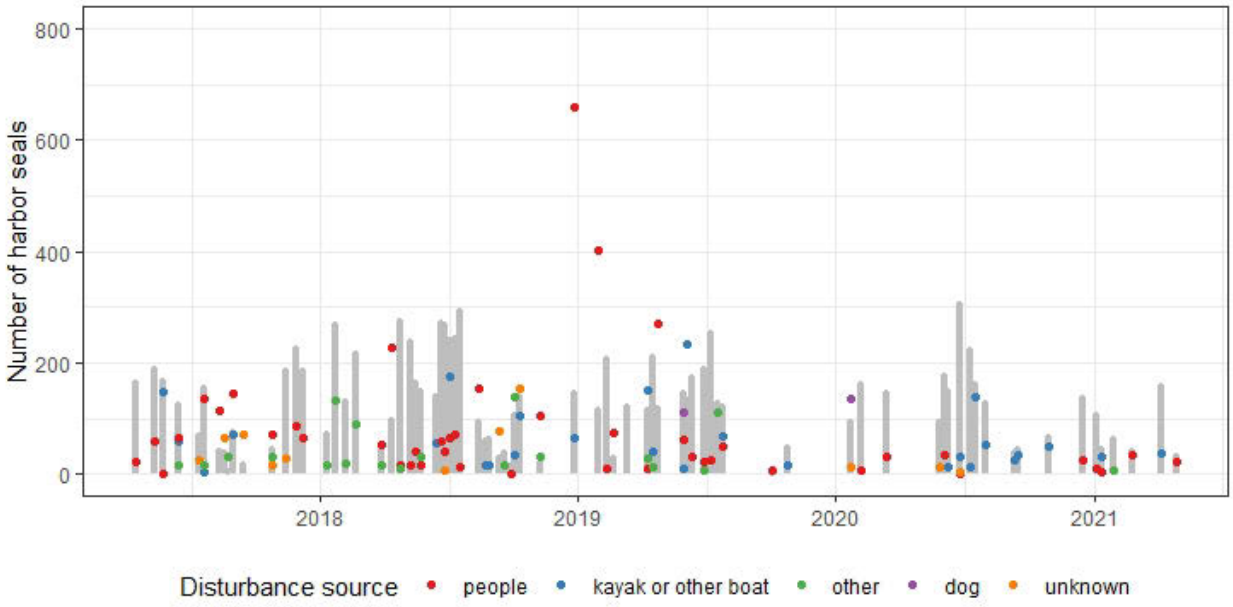


Figure 9. Total number of harbor seals at the Jenner haul-out (Goat Rock State Beach) disturbed during baseline surveys by disturbance source. The average count of harbor seals during each survey is represented by the grey bar. The total number of seals disturbed can be greater than the number of seals on the beach because an individual seal can be recorded as being disturbed multiple times during the course of a survey. One outlying observation where a total of 1,809 seals disturbances was recorded in March 11, 2019, is not represented in the chart.

Water Level Management Activities

A barrier beach formed 34 times since April 2017 (Table 2). Sonoma Water conducted beach management by excavating a pilot channel in the barrier beach on 10 of the closure events and by constructing a lagoon outlet channel during 2 of these events. The Russian River outlet was closed to the ocean for a total of 262 days (or 17%) since April 2017, with 40% of these occurring during the lagoon management period. A barrier beach formed an average of 7 times annually (range 4-10).

Seal behavior associated with water level management activities

On two occasions no seals were on the beach at the start of water level management activities. On all other occasions there were between 17 and 126 seals on the beach prior to the activity. Excavation equipment entered the beach south of the seal haul-out and on most occasions seals alerted to the noise of the excavator as it approached between 300 and 920 feet distant. On other occasions seals were first disturbed by Sonoma Water staff walking ahead of the excavator as they approached between 100 and 700 feet distant. As crews and equipment continued to approach the excavation site seals continued to be disturbed by the noise and the presence of staff and equipment on the beach, moving off the haul-out and into the water until no seals remained on the haul-out. On two occasions at least one seal remained on the beach during the excavation activity. Seals were also observed traveling across the barrier beach north of the excavation activities to get to the ocean from the estuary.

Observations of seal behavior continued at least one hour after all staff and equipment left the beach. On most occasions (6 out of 10) at least some seals were observed hauled out within 1.5 to 2.5 hours after activities began, and seals were always observed hauled out the day after the activity. Overall, seal abundance was greatest the day following the activity compared to the day of and the day before (Figure 10).

Table 2. Summary of river mouth closures 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	Date mouth opened	Peak height (ft NGVD)	Management Activity	Activity start time	Activity end time
Jul 4, 2017	Jul 17, 2017	7.75	Lagoon Outlet Channel	11:20	12:50
Aug 5, 2017	Aug 27, 2017	8.34	None	-	-
Sep 12, 2017	Sep 28, 2017	7.96	Lagoon Outlet Channel	09:40	10:55
Sep 28, 2017	Oct 3, 2017	8.30	None	-	-
Oct 7, 2017	Oct 19, 2017	7.88	Pilot Channel	12:44	13:51
Oct 25, 2017	Nov 2, 2017	7.88	None	-	-
Nov 26, 2017	Nov 28, 2017	6.19	None	-	-
Nov 29, 2017	Dec 1, 2017	8.64	None	-	-
Nov 29, 2017	Dec 2, 2017	10.07	Pilot Channel	14:04	15:18
Dec 13, 2017	Dec 18, 2017	7.42	None	-	-
Jan 15, 2018	Jan 17, 2018	7.88	None	-	-
Oct 15, 2018	Nov 13, 2018	8.51	None	-	-
Nov 20, 2018	Nov 24, 2018	7.92	None	-	-
Nov 29, 2018	Nov 30, 2018	9.48	None	-	-
Dec 6, 2018	Dec 10, 2018	9.44	Pilot Channel	14:32	15:09
Dec 14, 2018	Dec 16, 2018	10.92	None	-	-
May 15, 2019	May 16, 2019	6.24	none	-	-
Jul 18, 2019	Aug 3, 2019	8.56	none	-	-
Oct 18, 2019	Oct 22, 2019	5.23	none	-	-
Nov 21, 2019	Nov 27, 2019	8.26	none	-	-
Jan 5, 2020	Jan 7, 2020	10.03	Pilot Channel	08:52	10:18
Apr 29, 2020	May 14, 2020	9.31	none	-	-
May 18, 2020	May 21, 2020	7.42	none	-	-
Sep 28, 2020	Oct 25, 2020	7.25	none	-	-
Nov 7, 2020	Nov 19, 2020	8.40	Pilot Channel	12:50	14:11
Dec 1, 2020	Dec 10, 2020	8.10	Pilot Channel	10:10	10:33
Dec 21, 2020	Dec 25, 2020	5.86	none	-	-
Dec 25, 2020	Dec 30, 2020	8.10	Pilot Channel	12:47	13:47
Jan 2, 2021	Jan 7, 2021	10.40	none	-	-
Jan 9, 2021	Jan 12, 2021	9.17	Pilot Channel	11:36	12:26
Jan 15, 2021	Jan 19, 2021	8.80	Pilot Channel	09:26	12:00
Jan 26, 2021	Jan 28, 2021	10.37	none	-	-
Mar 5, 2021	Mar 10, 2021	8.80	Pilot Channel	11:55	13:08
Apr 21, 2021	May 6, 2021	6.20	none	-	-

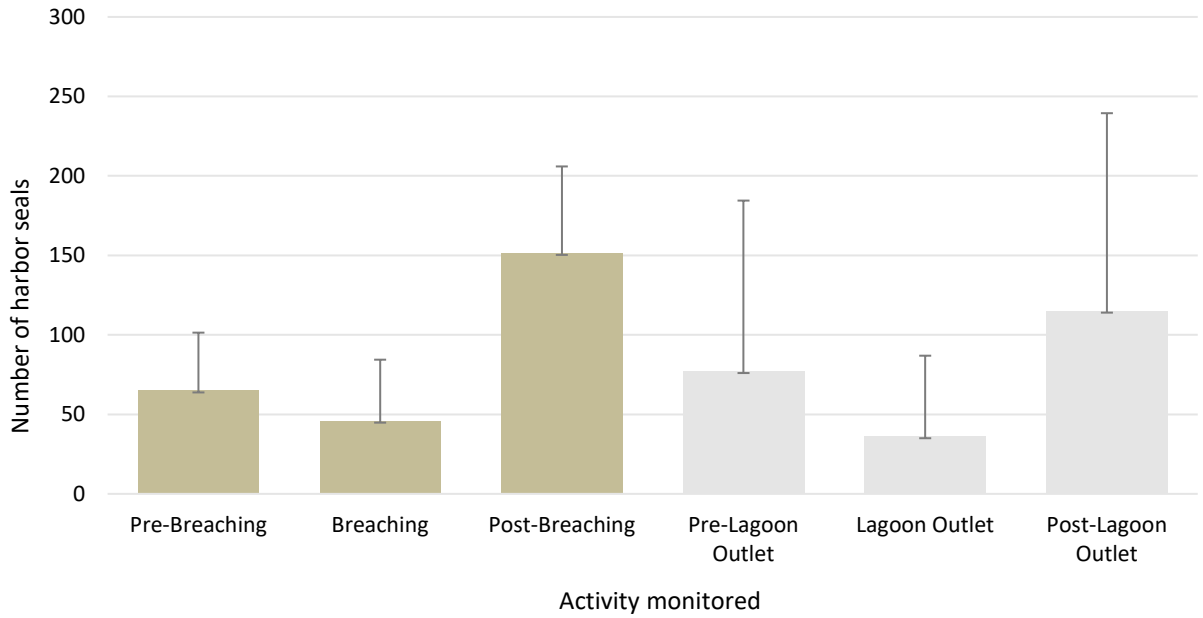


Figure 10. The average abundance of harbor seals hauled out at the Jenner haul-out (Goat Rock State Beach) during breaching (n=10) and lagoon outlet implementation (n=2) activities, including the surveys the day before the event (pre-) and the day following the event (post-) from April 2017 to April 2021. Error bars represent 1+ standard deviation from the mean.

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 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. Monthly topographic surveys did not occur when neonate harbor seals were present on the beach where the survey was to be conducted, or when conditions on the beach were unsafe due to wave overwash, resulting in some months with no topographic survey. On a few occasions topographic surveys were repeated due to equipment issues. With the exception of the harbor seal pupping season, when survey personnel will avoid the haul-out where neonates are present, between 42% 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, 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]
2/15/2017	Monthly beach topo survey	harbor seal	adult	166(166)	100%
3/16/2017	Monthly beach topo survey	harbor seal	adult	222(207)	93%
5/18/2017	Monthly beach topo survey	harbor seal	adult	7(7)	6%
			pup	6(6)	43%
5/24/2017	Monthly beach topo survey	harbor seal	adult	137(137)	100%
			pup	11(11)	100%
6/22/2017	Monthly beach topo survey	harbor seal	adult	35(15)	8%
7/11/2017	Monthly beach topo survey	harbor seal	adult	143(82)	100%
8/3/2017	Monthly beach topo survey	harbor seal	adult	130(127)	43%
8/10/2017	Monthly beach topo survey	harbor seal	adult	35(30)	100%
9/26/2017	Monthly beach topo survey	harbor seal	adult	1(1)	100%
9/28/2017	Lagoon Outlet Implementation	harbor seal	adult	122(72)	100%
10/19/2017	Artificial breaching	harbor seal	adult	42(40)	100%
10/26/2017	Monthly beach topo survey	harbor seal	adult	13(11)	80%
11/22/2017	Monthly beach topo survey	harbor seal	adult	89(89)	99%
12/2/2017	Artificial breaching	harbor seal	adult	4(4)	13%
12/21/2017	Monthly beach topo survey	harbor seal	adult	127(127)	100%
2017 total		**harbor seal**	**adult**	**1,273(1,115)**	
			pup	**17(17)**	
1/29/2018	Monthly beach topo survey	harbor seal	adult	108(96)	100%
2/22/2018	Monthly beach topo survey	harbor seal	adult	141(141)	100%
5/17/2018	Monthly beach topo survey	harbor seal	adult	75(69)	42%
5/22/2018	Estuary seining	harbor seal	adult	1(1)	100%
6/20/2018	Monthly beach topo survey	harbor seal	adult	219(219)	56%
7/19/2018	Monthly beach topo survey	harbor seal	adult	351(300)	98%
		northern elephant seal	juvenile	1(1)	100%
8/16/2018	Monthly beach topo survey	harbor seal	adult	154(154)	100%
10/18/2018	Monthly beach topo survey	harbor seal	adult	52(37)	100%
10/29/2018	Monthly beach topo survey	harbor seal	adult	31(31)	80%

Date	Event Type	Estimated Disturbance			
		Species	Age Class	Number	Max % total seals flushed[a]
11/15/2018	Monthly beach topo survey	harbor seal	adult	183(183)	100%
12/10/2018	Breaching	harbor seal	adult	113(113)	100%
12/13/2018	Monthly beach topo survey	harbor seal	adult	13(13)	100%
2018 total		**harbor seal**	**adult**	**1,441(1,357)**	
		northern elephant seal	**juvenile**	**1(1)**	
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)**	
1/7/2020	Breaching	harbor seal	adult	3(3)	100%
1/16/2020	Monthly beach topo survey	harbor seal	adult	22(17)	100%
1/22/2020	Baseline	harbor seal	adult	19(19)	12%
2/27/2020	Monthly beach topo survey	harbor seal	adult	120(120)	98%
3/16/2020	Monthly beach topo survey	harbor seal	adult	181(181)	100%
5/14/2020	Monthly beach topo survey	harbor seal	adult	168(80)	100%
			pup	3(3)	100%
5/21/2020	Extra Survey	harbor seal	adult	111(59)	100%
			pup	2(2)	100%
6/11/2020	Monthly beach topo survey	harbor seal	adult	80(80)	100%
7/29/2020	Monthly beach topo survey	harbor seal	adult	114(114)	100%
8/13/2020	Monthly beach topo survey	harbor seal	adult	53(53)	100%
12/10/2020	Breaching	harbor seal	adult	20(20)	100%
12/30/2020	Breaching	harbor seal	adult	51(39)	75%
2020 total		**harbor seal**	**adult**	**942(785)**	
			pup	**5(5)**	

Date	Event Type	Estimated Disturbance			
		Species	Age Class	Number	Max % total seals flushed[a]
1/12/2021	Breaching	harbor seal	adult	72(36)	100%
1/19/2021	Breaching	harbor seal	adult	25(25)	100%
1/21/2021	Monthly beach topo survey	harbor seal	adult	38(37)	84%
2/24/2021	Monthly beach topo survey	harbor seal	adult	34(33)	100%
3/11/2021	Breaching	harbor seal	adult	50(50)	100%
3/18/2021	Monthly beach topo survey	harbor seal	adult	17(0)	100%
4/22/2021	Monthly beach topo survey	harbor seal	adult	52(40)	52%
			pup	20(16)	36%
2021 as of April		**harbor seal**	**adult**	**288(221)**	
			pup	**20(16)**	

[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.*

Discussion

The water level management activities and biological and physical monitoring activities conducted by Sonoma Water resulted in incidental harassment (Level B harassment) of between 947 and 1,443 harbor seals annually, well under the total allowed by the 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. The following questions of interest were described in Pinniped Monitoring Plan:

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?

Jenner haul-out use

During our long term monitoring of harbor seals at the Jenner haul-out we have collected an abundance of data allowing us to describe trends in seal abundance related to a variety of factors. We have observed a strong seasonal pattern in most years where seals are most abundant during the spring and summer months (Figure 11) (SCWA 2020a). Seasonal variation in the abundance of harbor seals is

commonly observed throughout their range (Allen et al. 1989, Stewart and Yochem 1994, Gemmer 2002). While not as strongly evident in the shorter data set presented for this report, during baseline surveys since 2010 seal abundance is shown to increase throughout the day, but only during the spring and winter months (Figure 12). Seal abundance was weakly effected by tide height with tides over 5 feet shown to reduce seal abundance, based on direct observations, this is likely due to waves washing over the haul-out during these high tides.

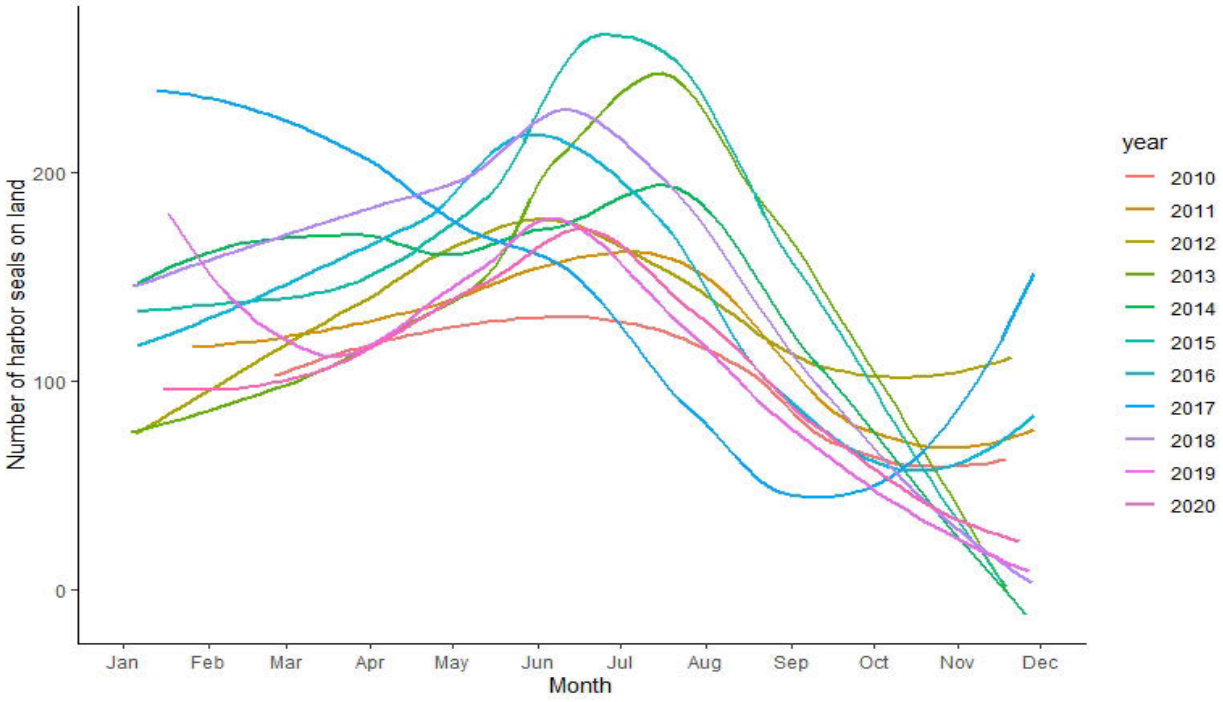


Figure 11. Seasonal trends in harbor seal abundance at the Jenner haul-out (Goat Rock State Beach) during baseline surveys for the years 2010 to 2020.

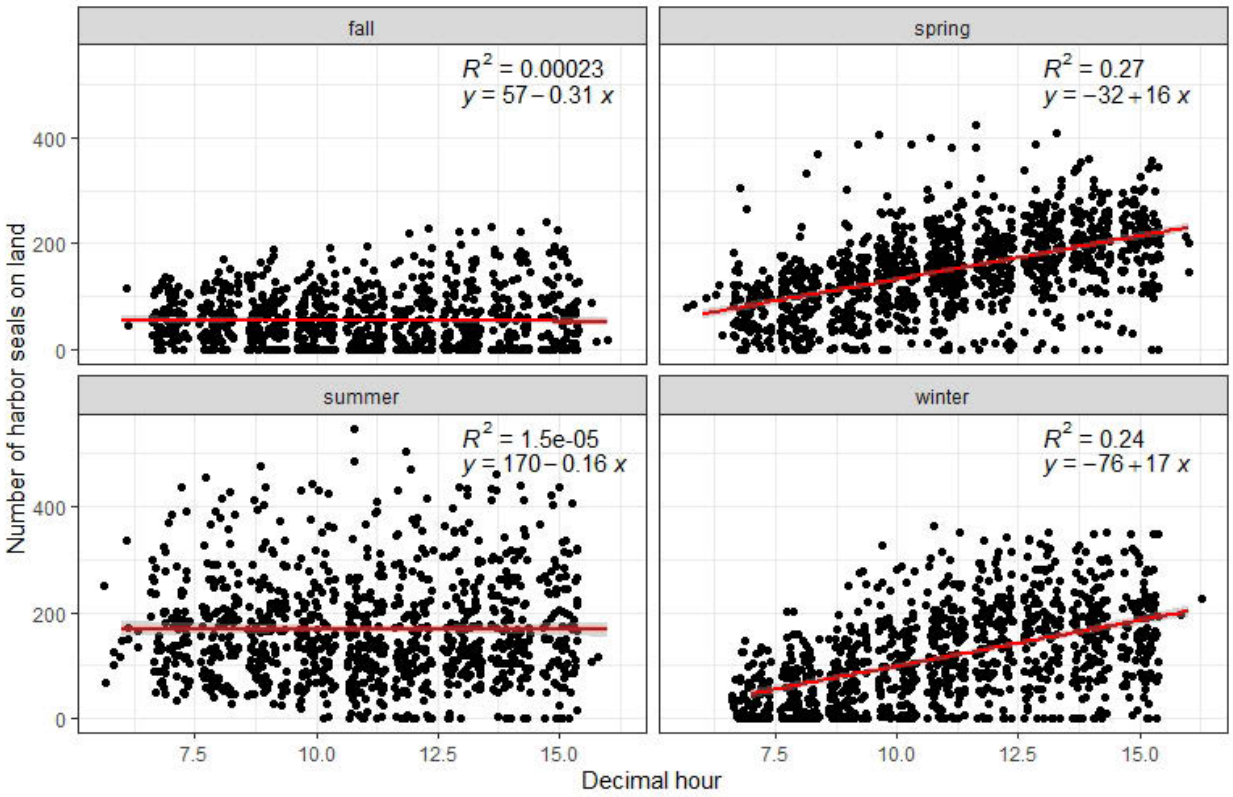


Figure 12. Number of harbor seals counted on the Jenner haul-out, by time of day in decimal hour (where 12.0 is noon) for each season, during baseline surveys between January 2010 and April 2021, Linear regression line (y ~ x) is plotted in red and the confidence interval is the shaded area.

Harbor seals will use the Jenner haul-out when there is an open channel or when a barrier beach has formed, however, the number of seals was influenced by river mouth condition, with seal abundance lower during closed conditions compared to open conditions (Figure 6) (SCWA 2020a). One possible reason for this difference is that a closed river mouth would lead to more human disturbance since people would be able to walk across the beach and get closer to the seal haul-out. Disturbance events do not occur during all baseline surveys, but a comparison of the proportion of baseline surveys when a disturbance event occurred during closed or open river mouth conditions did not indicate that disturbance events are always more frequent during closed conditions (Figure 13).

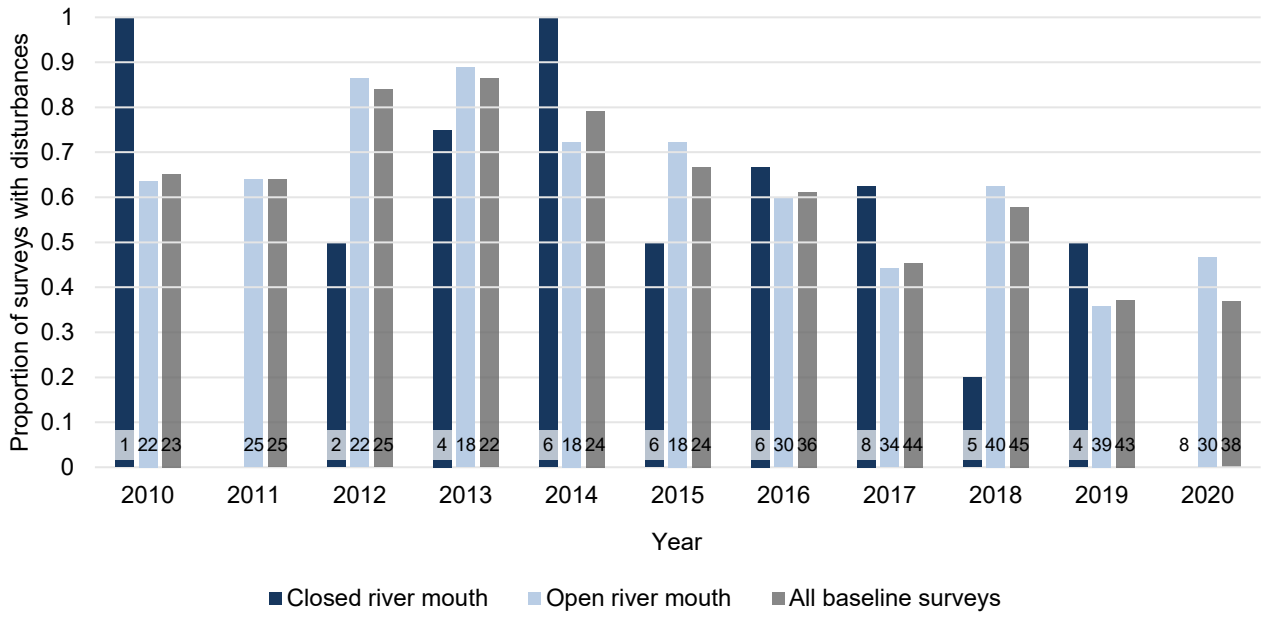


Figure 13. Proportion of baseline surveys where a disturbance event (alert, move, or flush) occurred on the Jenner haul-out by river mouth condition for the years 2010 to 2020. The number of surveys conducted (n) are provided at the base of each bar.

Looking at our long term dataset we observed that seal abundance at Goat Rock State Beach has been declining since 2018 (Figure 14). Similar declines in abundance were observed at harbor seal rookeries in Marin County where the Point Reyes National Seashore reported declining summer abundance since 2016 (Codde 2020). Marin County locations included in the Point Reyes National Seashore surveys are approximately 16 to 55 miles south along the coastline. The most recent statewide census for harbor seals was conducted in 2012, so it is unknown if the decline in seal abundance locally reflects a larger trend for the population of harbor seals in California (Carretta et. al. 2015).

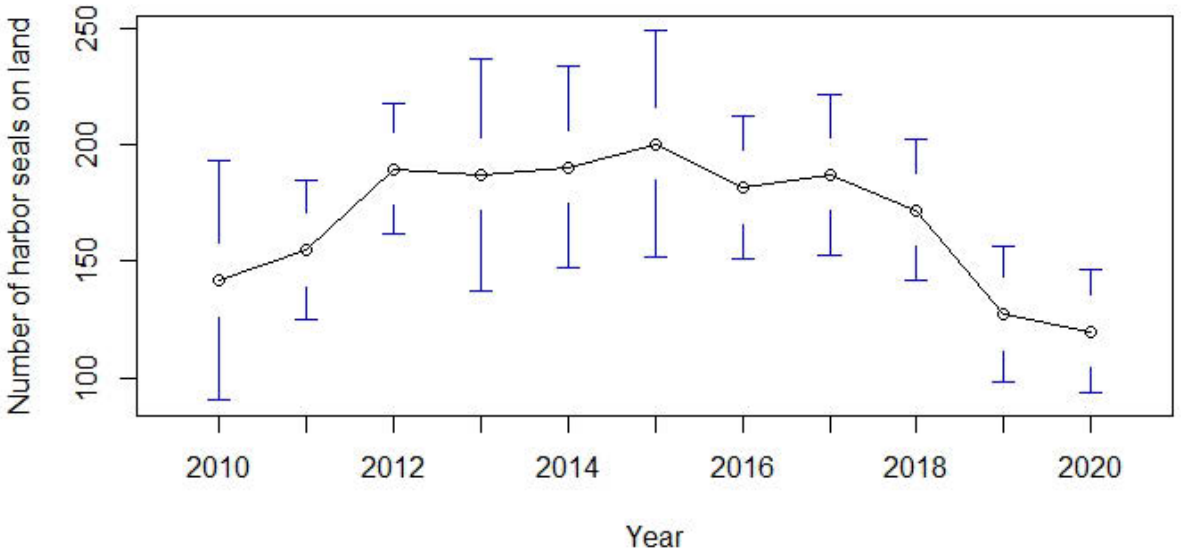


Figure 14. Average maximum count of harbor seals per survey day by year for baseline surveys at the Jenner haul-out (Goat Rock State Beach) from 2010 to 2020. Bars represent 95% confidence intervals around mean.

Seal response to beach management activities

Harbor seal response to artificial breaching and lagoon outlet channel construction has been predictable and consistent since we began our pinniped monitoring program in 2010. The presence and activity of staff and equipment on the beach causes harbors seals to move and flush off the haul-out, unless the activity is occurring at some distance from the haul-out, which is rare. While these activities do have a short term impact on seal behavior, the number of seals on land consistently increases within 24 hours or less after the activity has ceased. The increase in seal abundance after a breaching event can be contributed to the fact that seals haul out in greater numbers during open river mouth conditions (Figure 6). The results of our baseline monitoring suggest that seals using the Jenner haul-out regularly experience disturbance events (Figure 9). The average annual rate of disturbance, where disturbance is defined as seals alerting, moving on or flushing from the haul-out in response to a disturbance, ranged from 0.46 to 1.69 disturbances per hour, with an average of 0.80 disturbances per hour for baseline surveys since 2010. For comparison, the reported rate of disturbances in Tomales Bay (a large haul-out located in Marin County, south of Jenner) for 2019 was 0.51 disturbances per hour (Codde 2020).

Seal abundance during lagoon conditions

During the term of the LOA there have been 2 occasions where a lagoon outlet channel was constructed following a river mouth closure, but no additional maintenance activities of the channel occurred and the activity on the beach was very similar to that of a breaching event. On one occasion the outlet channel scoured open by the following day, reconnecting tidal conditions in the lagoon. On the second occasion the river mouth remained closed after the outlet channel was constructed and water levels in the estuary continued to rise until an unknown party dug a pilot channel within the footprint of the outlet channel, allowing the barrier beach to self-breach. Looking at the influence of the percent of days with a closed river mouth on seal abundance we found that seal abundance was lower in months with 81%-100% days closed compared to months with 0%-20% days closed (Tukey HSD, df = 131, p = 0.011)

(Figure 15). This result is likely confounded by the fact that closure events occur more frequently in the fall, a time when seals are least abundant on the haul-out.

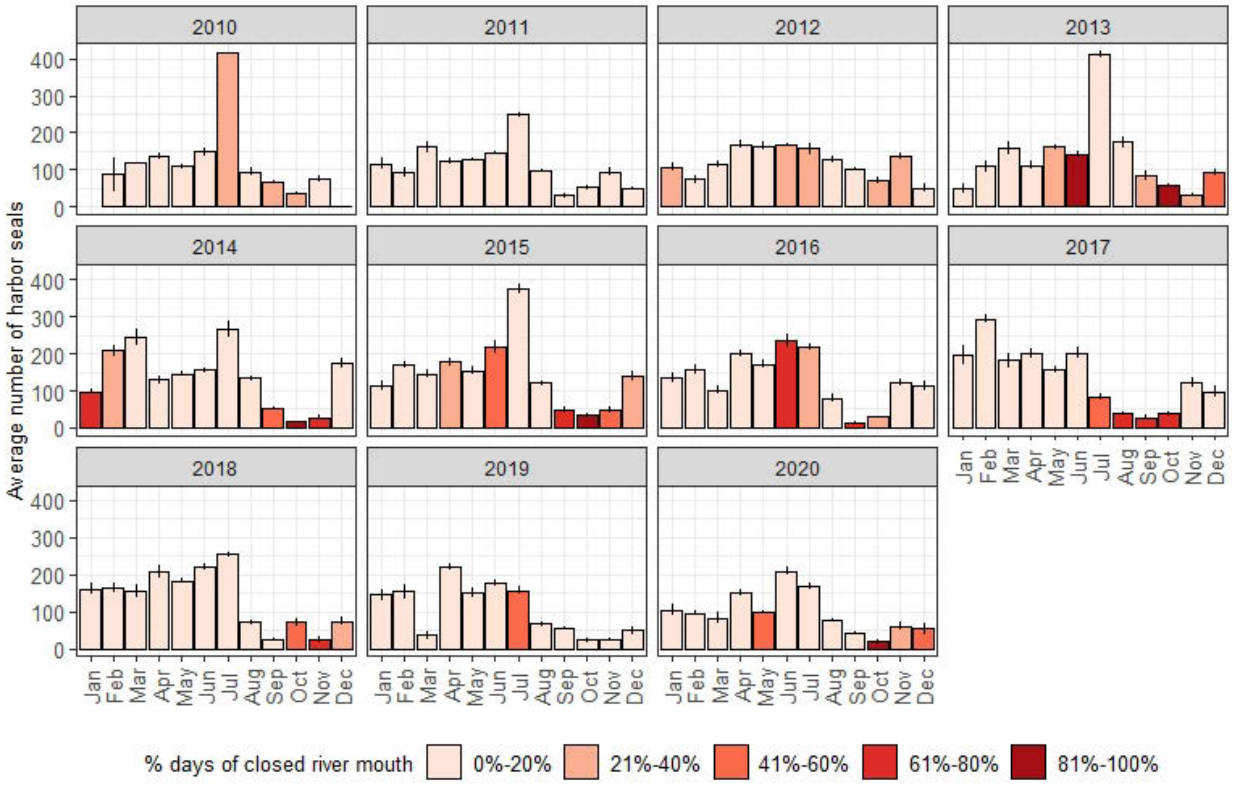


Figure 15. Monthly average number of harbor seals at the Jenner haul-out (Goat Rock State Beach) compared to the number of days each month where the river mouth was closed from 2010 to 2020.

We are unable to directly determine if seals are leaving the Jenner haul-out for other locations during closed river mouth conditions. However, results from earlier monitoring efforts that included monitoring of peripheral haul-outs did not show a relationship between mouth closures and seal abundance at nearby riverine and coastal locations (SCWA 2014). The lack of correlation between the number of people on the beach or number of disturbance events, and seal abundance suggests that the potential for increased interactions due to a closed river mouth (and barrier beach formation) would not be the cause for declines in seal abundance. It is possible that seals are changing their haul-out location, hauling out less frequently, hauling out for shorter duration, or choosing to haul out at night during periods where abundance at the Jenner haul-out is low.

Recommendations

With over 10 years of data collected on the harbor seals at Goat Rock State Beach we have been able to describe temporal patterns in seal abundance. We have also been able to describe the factors that may influence the abundance of seals on the haul-out. Sonoma Water will continue to implement the Russian River Estuary Management Plan (SCWA 2020b) throughout the term of the RRBIOP (NMFS 2008) and possibly longer. Water level management actions and biological and physical monitoring activities will continue, therefore, Sonoma Water is requesting a new LOA when the current LOA expires.
Based on results presented in this report and previous reports (SCWA 2011 – SCWA 2020a), we propose to continue with baseline monitoring of the Jenner haul-out in a manner that will optimize our ability to

capture trends in seal abundance and pup production while maintaining a focus on monitoring seal behavior and disturbances during water level management activities and biological and physical monitoring of the barrier beach and estuary. We propose to modify the schedule and frequency of baseline surveys. Baseline surveys will be conducted from March 15 – October 15. This schedule would capture the pupping and molting seasons, and extend to the end of the beach management period, when management activities are more likely to occur. Surveys would be conducted twice monthly, except for the pupping season (April-May) when surveys would be conducted weekly in order to record the presence of neonate harbor seals. Monitoring surveys for beach management and estuary monitoring activities will continue to occur year round, as needed.

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 and A. Cresswell provided the support that made the monitoring effort possible. Special thanks to all the volunteers that provided their time and keen observations to monitoring pinnipeds.

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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 April 2017 to April 2021 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 condition	estuary water level	max	mean	s.e.	max	mean	s.e.	max	mean	s.e.	n	CASL present	NES present
4/7/2017	Baseline	Open	4.88	215	135.6	17.38	1	0.3	0.17	1	0.6	0.18	9		
4/10/2017	Monthly beach topo survey	Open	1.90	115	70.2	16.49	0	0.0	0.00	7	4.8	1.05	6		
4/13/2017	Baseline	Open	1.60	234	156.4	17.40	9	5.9	0.56	3	1.8	0.22	9		
4/19/2017	Baseline	Open	2.57	275	254.0	6.67	20	19.3	0.29	4	3.2	0.15	9		
4/25/2017	Monthly beach topo survey	Open	2.36	154	153.0	1.00	21	21.0	0.00	11	10.0	1.00	2		
4/26/2017	Baseline	Open	3.07	228	190.8	12.24	35	26.2	1.57	13	7.1	1.84	9		
5/3/2017	Baseline	Open	0.80	227	163.0	15.27	0	0.0	0.00	0	0.0	0.00	9		
5/10/2017	Baseline	Open	2.47	243	177.0	19.81	13	10.7	0.78	1	1.0	0.00	9		
5/16/2017	Baseline	Open	1.19	134	110.2	4.05	3	1.7	0.33	0	0.0	0.00	9		
5/18/2017	Monthly beach topo survey	Open	1.88	160	140.3	10.44	14	11.0	1.29	0	0.0	0.00	4		
5/23/2017	Baseline	Open	1.72	186	155.0	5.26	14	10.4	0.73	0	0.0	0.00	9		
5/24/2017	Monthly beach topo survey	Open	1.94	136	79.8	20.69	11	3.3	1.37	0	0.0	0.00	8		
6/6/2017	Baseline	Open	1.53	159	51.8	25.90	0	0.0	0.00	0	0.0	0.00	9		
6/13/2017	Baseline	Open	1.22	154	124.1	11.47	0	0.0	0.00	0	0.0	0.00	9		
6/20/2017	Baseline	Open	2.00	295	214.4	20.71	6	3.8	0.66	0	0.0	0.00	5		
6/22/2017	Monthly beach topo survey	Open	3.03	263	213.1	19.31	0	0.0	0.00	0	0.0	0.00	8		
6/27/2017	Baseline	Open	3.30	314	295.8	5.48	0	0.0	0.00	0	0.0	0.00	8		
7/7/2017	Baseline	Closed	5.59	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
7/11/2017	Monthly beach topo survey	Closed	6.41	103	46.8	18.37	0	0.0	0.00	0	0.0	0.00	6		
7/12/2017	Baseline	Closed	6.76	83	69.1	5.03	0	0.0	0.00	0	0.0	0.00	9		
7/14/2017	Pre-Lagoon Outlet	Closed	7.15	153	82.0	20.07	0	0.0	0.00	0	0.0	0.00	9		
7/17/2017	Lagoon Outlet Implementation	Closed	7.68	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	12		
7/18/2017	Post-Lagoon Outlet	Perched	3.22	203	148.3	12.03	0	0.0	0.00	0	0.0	0.00	9		
7/20/2017	Baseline	Open	1.77	199	153.7	19.69	0	0.0	0.00	0	0.0	0.00	9		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
7/26/2017	Baseline	Open	1.87	115	102.2	1.83	0	0.0	0.00	0	0.0	0.00	11		
8/3/2017	Monthly beach topo survey	Open	2.54	180	132.4	14.89	0	0.0	0.00	0	0.0	0.00	8		
8/10/2017	Monthly beach topo survey	Closed	5.43	31	15.3	4.87	0	0.0	0.00	0	0.0	0.00	9		
8/11/2017	Baseline	Closed	5.66	53	39.6	5.35	0	0.0	0.00	0	0.0	0.00	9		
8/17/2017	Baseline	Closed	6.91	64	39.0	7.68	0	0.0	0.00	0	0.0	0.00	11		
8/23/2017	Baseline	Closed	7.98	30	3.3	3.33	0	0.0	0.00	0	0.0	0.00	9		
8/29/2017	Baseline	Open	1.32	102	75.1	9.84	0	0.0	0.00	0	0.0	0.00	8	Y	
9/8/2017	Baseline	Open	2.51	72	65.1	2.36	0	0.0	0.00	0	0.0	0.00	9		
9/14/2017	Baseline	Closed	4.27	70	15.4	10.22	0	0.0	0.00	0	0.0	0.00	9		
9/19/2017	Baseline	Closed	5.97	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
9/26/2017	Monthly beach topo survey	Closed	7.71	1	0.3	0.15	0	0.0	0.00	0	0.0	0.00	10		
9/28/2017	Lagoon Outlet Implementation	Closed	7.98	72	7.2	7.20	0	0.0	0.00	0	0.0	0.00	10		
9/29/2017	Post-Lagoon Outlet	Closed	8.09	27	15.7	4.52	0	0.0	0.00	0	0.0	0.00	9		
10/4/2017	Baseline	Open	2.69	62	48.7	4.79	0	0.0	0.00	0	0.0	0.00	9		
10/17/2017	Baseline	Closed	7.19	2	0.3	0.29	0	0.0	0.00	0	0.0	0.00	7		
10/19/2017	Breaching	Closed	7.83	50	25.9	6.71	0	0.0	0.00	0	0.0	0.00	12		
10/20/2017	Post-Breaching	Open	2.74	112	78.0	17.11	0	0.0	0.00	0	0.0	0.00	9		
10/24/2017	Baseline	Open	2.99	132	43.3	12.44	0	0.0	0.00	0	0.0	0.00	11		
10/26/2017	Monthly beach topo survey	Closed	4.55	20	4.5	1.90	0	0.0	0.00	0	0.0	0.00	10		
11/1/2017	Pre-Breaching	Closed	7.65	57	44.4	2.55	0	0.0	0.00	0	0.0	0.00	9		
11/3/2017	Baseline	Open	2.33	73	30.1	9.89	0	0.0	0.00	0	0.0	0.00	9		
11/7/2017	Baseline	Open	1.92	116	63.2	10.71	0	0.0	0.00	0	0.0	0.00	9		
11/14/2017	Baseline	Open	2.90	199	183.6	3.28	0	0.0	0.00	0	0.0	0.00	7		
11/22/2017	Monthly beach topo survey	Open	2.95	125	44.9	12.34	0	0.0	0.00	0	0.0	0.00	14		
11/28/2017	Baseline	Open	2.62	240	223.1	4.11	0	0.0	0.00	0	0.0	0.00	9		
12/1/2017	Pre-Breaching	Closed	8.73	112	67.3	13.68	0	0.0	0.00	0	0.0	0.00	9		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
12/2/2017	Breaching	Closed	10.02	39	20.7	3.94	0	0.0	0.00	0	0.0	0.00	9		
12/4/2017	Post-Breaching	Open	3.60	130	32.8	16.63	0	0.0	0.00	0	0.0	0.00	8		
12/6/2017	Baseline	Open	3.49	220	185.4	9.78	0	0.0	0.00	0	0.0	0.00	9		
12/14/2017	Baseline	Perched	4.12	93	21.3	10.94	0	0.0	0.00	0	0.0	0.00	9		
12/20/2017	Baseline	Open	2.30	174	93.0	19.72	0	0.0	0.00	0	0.0	0.00	9		
12/21/2017	Monthly beach topo survey	Open	2.40	125	44.0	21.38	0	0.0	0.00	0	0.0	0.00	6		
12/28/2017	Baseline	Perched	2.74	57	16.4	8.48	0	0.0	0.00	0	0.0	0.00	9		
1/4/2018	Baseline	Open	2.77	126	98.6	7.51	0	0.0	0.00	0	0.0	0.00	9		Y
1/10/2018	Baseline	Open	3.21	112	70.3	11.37	0	0.0	0.00	0	0.0	0.00	9	Y	
1/16/2018	Baseline	Closed	6.58	221	215.4	1.13	0	0.0	0.00	0	0.0	0.00	8		
1/22/2018	Baseline	Open	5.07	280	267.6	2.79	0	0.0	0.00	0	0.0	0.00	9		
1/29/2018	Monthly beach topo survey	Open	3.51	98	63.0	15.28	0	0.0	0.00	0	0.0	0.00	6		
2/6/2018	Baseline	Open	1.26	221	129.1	22.62	0	0.0	0.00	0	0.0	0.00	9		
2/21/2018	Baseline	Open	1.06	246	213.8	5.22	0	0.0	0.00	0	0.0	0.00	9		
2/22/2018	Monthly beach topo survey	Open	1.47	141	75.6	15.13	0	0.0	0.00	0	0.0	0.00	8		
2/27/2018	Baseline	Open	2.57	203	154.9	22.67	0	0.0	0.00	0	0.0	0.00	11	Y	
3/8/2018	Baseline	Open	1.34	235	153.4	17.23	0	0.0	0.00	0	0.0	0.00	9		
3/14/2018	Baseline	Open	3.70	298	232.8	17.83	0	0.0	0.00	0	0.0	0.00	9	Y	
3/20/2018	Baseline	Open	2.17	61	36.9	8.42	0	0.0	0.00	0	0.0	0.00	7		
3/28/2018	Baseline	Open	2.81	202	51.9	22.77	0	0.0	0.00	0	0.0	0.00	9		
3/30/2018	Monthly beach topo survey	Open	2.37	98	58.3	18.39	0	0.0	0.00	1	0.8	0.25	4		
4/4/2018	Baseline	Open	0.60	211	145.3	16.73	1	0.2	0.15	3	2.2	0.22	9		
4/11/2018	Baseline	Open	2.26	205	77.9	23.18	37	15.6	4.11	4	3.3	0.17	9		
4/17/2018	Baseline	Open	2.06	332	300.2	9.80	25	18.6	1.28	1	0.1	0.11	9		
4/24/2018	Baseline	Open	0.97	262	233.3	11.05	43	36.0	2.43	8	5.3	0.75	8		
5/2/2018	Baseline	Open	0.68	185	154.7	10.31	46	33.6	3.74	0	0.0	0.00	9	Y	
5/9/2018	Baseline	Open	0.72	220	205.0	2.77	33	28.0	0.85	4	3.3	0.17	9		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
5/10/2018	Monthly beach topo survey	Open	1.85	169	105.5	29.65	49	36.0	6.65	0	0.0	0.00	4		
5/16/2018	Baseline	Open	1.69	182	145.1	5.21	24	16.7	1.37	0	0.0	0.00	9		
5/17/2018	Monthly beach topo survey	Open	0.68	169	126.0	15.61	36	24.1	3.97	0	0.0	0.00	7		
5/23/2018	Baseline	Open	2.04	162	135.9	7.45	16	11.1	1.37	0	0.0	0.00	9		
6/5/2018	Baseline	Open	0.50	243	203.2	9.53	0	0.0	0.00	0	0.0	0.00	9		
6/14/2018	Baseline	Open	1.04	153	139.3	4.04	0	0.0	0.00	0	0.0	0.00	9		
6/20/2018	Monthly beach topo survey	Open	0.80	304	236.1	19.97	0	0.0	0.00	0	0.0	0.00	8		
6/21/2018	Baseline	Open	1.05	333	270.9	10.47	0	0.0	0.00	0	0.0	0.00	9		
6/25/2018	Baseline	Open	1.27	280	267.2	2.41	0	0.0	0.00	0	0.0	0.00	9		
7/2/2018	Baseline	Open	0.66	262	239.2	6.64	0	0.0	0.00	0	0.0	0.00	9		
7/10/2018	Baseline	Open	0.91	290	243.2	8.69	0	0.0	0.00	0	0.0	0.00	9		
7/17/2018	Baseline	Open	1.02	311	290.7	4.98	0	0.0	0.00	0	0.0	0.00	9		
7/19/2018	Monthly beach topo survey	Open	0.63	330	218.8	40.57	0	0.0	0.00	0	0.0	0.00	9		Y
7/24/2018	Baseline	Open	1.67	268	241.4	7.45	0	0.0	0.00	0	0.0	0.00	9		Y
8/14/2018	Baseline	Open	0.60	136	92.1	14.78	0	0.0	0.00	0	0.0	0.00	9		
8/16/2018	Monthly beach topo survey	Open	0.54	162	52.0	32.92	0	0.0	0.00	0	0.0	0.00	6		
8/22/2018	Baseline	Open	1.43	90	59.0	11.49	0	0.0	0.00	0	0.0	0.00	9		
8/28/2018	Baseline	Open	2.12	87	62.8	5.52	0	0.0	0.00	0	0.0	0.00	9		
9/11/2018	Baseline	Open	0.79	76	27.6	9.54	0	0.0	0.00	0	0.0	0.00	9		
9/19/2018	Baseline	Open	1.04	65	38.7	7.72	0	0.0	0.00	0	0.0	0.00	9		
9/20/2018	Monthly beach topo survey	Open	1.56	23	3.8	3.83	0	0.0	0.00	0	0.0	0.00	6		
9/27/2018	Baseline	Open	2.53	29	12.1	3.55	0	0.0	0.00	0	0.0	0.00	9	Y	
10/3/2018	Baseline	Open	2.06	125	106.0	3.60	0	0.0	0.00	0	0.0	0.00	9	Y	
10/10/2018	Baseline	Open	2.24	167	138.2	8.60	0	0.0	0.00	0	0.0	0.00	9		
10/16/2018	Baseline	Closed	3.16	3	0.3	0.33	0	0.0	0.00	0	0.0	0.00	9		
10/18/2018	Monthly beach topo survey	Closed	3.99	37	24.5	3.20	0	0.0	0.00	0	0.0	0.00	6		
10/22/2018	Baseline	Closed	5.32	2	0.2	0.22	0	0.0	0.00	0	0.0	0.00	9		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
10/29/2018	Monthly beach topo survey	Closed	7.03	44	33.8	7.64	0	0.0	0.00	0	0.0	0.00	4		
11/7/2018	Baseline	Closed	8.05	45	18.1	7.19	0	0.0	0.00	0	0.0	0.00	9		
11/13/2018	Pre-Breaching	Closed	8.40	42	34.1	2.25	0	0.0	0.00	0	0.0	0.00	9		
11/14/2018	Baseline	Open	1.37	127	120.8	2.31	0	0.0	0.00	0	0.0	0.00	5		
11/15/2018	Monthly beach topo survey	Open	1.95	183	93.9	20.84	0	0.0	0.00	0	0.0	0.00	9		
11/20/2018	Baseline	Closed	4.29	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
11/27/2018	Baseline	Open	4.18	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
12/3/2018	Baseline	Open	3.30	55	9.3	6.22	0	0.0	0.00	0	0.0	0.00	9	Y	
12/4/2018	Baseline	Open	3.64	53	11.2	7.09	0	0.0	0.00	0	0.0	0.00	9		
12/9/2018	Pre-Breaching	Closed	8.61	100	37.6	15.29	0	0.0	0.00	0	0.0	0.00	10		
12/10/2018	Breaching	Closed	9.34	126	81.3	13.52	0	0.0	0.00	0	0.0	0.00	14		
12/11/2018	Post-Breaching	Open	2.84	286	237.4	10.27	0	0.0	0.00	0	0.0	0.00	9		
12/12/2018	Baseline	Open	1.74	187	126.6	15.84	0	0.0	0.00	0	0.0	0.00	9	Y	
12/13/2018	Monthly beach topo survey	Open	2.88	43	15.0	5.57	0	0.0	0.00	0	0.0	0.00	7		
12/27/2018	Baseline	Open	2.44	163	145.0	3.68	0	0.0	0.00	0	0.0	0.00	9		
1/16/2019	Monthly beach topo survey	Open	6.56	31	16.8	4.47	0	0.0	0.00	0	0.0	0.00	5		
1/17/2019	Baseline	Open	5.74	220	209.0	3.65	0	0.0	0.00	0	0.0	0.00	9		
1/24/2019	Monthly beach topo survey	Open	2.18	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	8		
1/30/2019	Baseline	Open	1.65	189	113.0	18.68	1	0.1	0.06	0	0.0	0.00	18		
2/5/2019	Baseline	Open	3.65	314	238.4	22.78	0	0.0	0.00	0	0.0	0.00	18		
2/11/2019	Baseline	Open	2.15	226	204.9	8.02	0	0.0	0.00	0	0.0	0.00	9		
2/19/2019	Baseline	Open	4.06	98	28.7	11.50	0	0.0	0.00	0	0.0	0.00	9		
2/21/2019	Monthly beach topo survey	Open	2.79	81	52.6	10.09	0	0.0	0.00	0	0.0	0.00	7		
2/26/2019	Baseline	Open	5.60	42	15.0	5.41	0	0.0	0.00	0	0.0	0.00	9		
3/5/2019	Baseline	Open	3.32	3	1.2	0.49	0	0.0	0.00	0	0.0	0.00	9		
3/11/2019	Baseline	Open	1.28	247	120.3	27.33	0	0.0	0.00	0	0.0	0.00	9		
3/14/2019	Monthly beach topo survey	Open	0.73	215	145.6	15.43	0	0.0	0.00	0	0.0	0.00	12		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
3/22/2019	Baseline	Open	3.64	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
3/28/2019	Baseline	Open	1.36	59	26.8	6.36	0	0.0	0.00	0	0.0	0.00	9		
4/2/2019	Baseline	Open	1.82	274	232.0	14.89	0	0.0	0.00	0	0.0	0.00	9		
4/10/2019	Baseline	Open	0.66	155	110.6	11.09	1	0.6	0.18	5	2.7	0.37	9		
4/17/2019	Baseline	Open	1.46	202	183.2	4.93	30	25.2	0.80	1	0.2	0.15	9		
4/23/2019	Baseline	Open	0.53	130	100.2	9.16	13	10.4	0.80	9	5.9	1.03	9		
5/8/2019	Baseline	Open	1.62	235	199.6	8.60	35	23.3	3.53	2	0.3	0.25	8		
5/13/2019	Monthly beach topo survey	Open	2.72	173	134.6	13.25	27	21.8	1.93	0	0.0	0.00	5		
5/15/2019	Baseline	Open	3.69	60	35.7	6.25	13	7.4	1.55	1	0.8	0.15	9		
5/22/2019	Baseline	Open	2.00	214	178.4	6.56	25	18.3	1.71	0	0.0	0.00	9		
5/23/2019	Monthly beach topo survey	Open	0.87	173	123.3	14.75	16	8.8	1.94	1	0.1	0.11	9		
5/29/2019	Baseline	Open	1.57	157	132.8	6.03	16	11.4	1.11	0	0.0	0.00	9		
6/5/2019	Baseline	Open	0.86	188	131.3	12.55	1	0.3	0.17	0	0.0	0.00	9		
6/12/2019	Baseline	Open	0.97	189	169.4	3.52	4	1.8	0.57	0	0.0	0.00	9		
6/26/2019	Monthly beach topo survey	Open	2.49	243	168.0	24.14	0	0.0	0.00	0	0.0	0.00	8		
6/27/2019	Baseline	Open	2.49	258	185.7	35.42	3	0.9	0.35	0	0.0	0.00	9		
7/8/2019	Baseline	Open	3.37	286	252.0	9.60	0	0.0	0.00	0	0.0	0.00	9		
7/18/2019	Baseline	Closed	3.98	188	124.9	24.42	0	0.0	0.00	0	0.0	0.00	9		
7/23/2019	Extra Survey	Closed	6.41	170	106.7	53.64	0	0.0	0.00	0	0.0	0.00	3		
7/25/2019	Baseline	Closed	6.95	133	119.1	3.41	0	0.0	0.00	0	0.0	0.00	9		
7/29/2019	Baseline	Closed	7.85	171	96.8	13.77	0	0.0	0.00	0	0.0	0.00	9		
7/30/2019	Monthly beach topo survey	Closed	8.00	133	60.9	22.02	0	0.0	0.00	0	0.0	0.00	7		
8/2/2019	Pre-Breaching	Closed	8.39	132	94.1	9.73	0	0.0	0.00	0	0.0	0.00	9		
8/6/2019	Baseline	Open	1.21	130	107.3	7.22	0	0.0	0.00	0	0.0	0.00	9		
8/13/2019	Baseline	Open	0.92	86	52.6	7.89	0	0.0	0.00	0	0.0	0.00	9		
8/20/2019	Baseline	Open	1.55	65	57.2	1.79	0	0.0	0.00	0	0.0	0.00	9		
8/27/2019	Baseline	Open	1.44	61	47.3	2.32	0	0.0	0.00	0	0.0	0.00	9		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
8/28/2019	Monthly beach topo survey	Open	1.40	59	27.3	12.28	0	0.0	0.00	0	0.0	0.00	6		
9/4/2019	Baseline	Open	2.09	117	71.9	16.04	0	0.0	0.00	0	0.0	0.00	10		
9/10/2019	Baseline	Open	1.35	75	42.4	4.88	0	0.0	0.00	0	0.0	0.00	9		
9/17/2019	Baseline	Open	0.82	64	50.1	4.11	0	0.0	0.00	0	0.0	0.00	9		
9/19/2019	Monthly beach topo survey	Open	1.39	55	11.0	11.00	0	0.0	0.00	0	0.0	0.00	5		
9/26/2019	Baseline	Open	2.07	65	36.7	8.56	0	0.0	0.00	0	0.0	0.00	9		
10/2/2019	Baseline	Open	2.61	8	0.9	0.89	0	0.0	0.00	0	0.0	0.00	9		
10/17/2019	Monthly beach topo survey	Open	1.58	35	8.6	4.60	0	0.0	0.00	0	0.0	0.00	9		
10/24/2019	Baseline	Open	2.41	64	45.4	4.43	0	0.0	0.00	0	0.0	0.00	9		
11/6/2019	Baseline	Open	0.96	29	22.7	1.39	0	0.0	0.00	0	0.0	0.00	7		
11/13/2019	Baseline	Open	2.93	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
11/18/2019	Baseline	Open	1.99	61	55.4	1.44	0	0.0	0.00	0	0.0	0.00	9		
11/25/2019	Monthly beach topo survey	Perched	6.62	7	4.2	1.71	0	0.0	0.00	0	0.0	0.00	5		
11/26/2019	Baseline	Closed	7.21	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	5		
11/27/2019	Pre-Lagoon Outlet	Closed	8.12	20	6.7	2.93	0	0.0	0.00	0	0.0	0.00	9		
12/4/2019	Monthly beach topo survey	Open	2.65	110	57.0	23.82	0	0.0	0.00	0	0.0	0.00	5		
12/10/2019	Baseline	Open	1.68	122	115.1	3.81	0	0.0	0.00	0	0.0	0.00	9		
12/11/2019	Baseline	Open	4.27	50	10.0	5.80	0	0.0	0.00	0	0.0	0.00	9		
12/18/2019	Baseline	Open	3.85	15	4.4	2.13	0	0.0	0.00	0	0.0	0.00	9		
12/19/2019	Monthly beach topo survey	Open	2.68	192	129.9	23.61	0	0.0	0.00	0	0.0	0.00	9		
12/23/2019	Baseline	Open	5.06	163	64.7	23.77	0	0.0	0.00	0	0.0	0.00	9		
1/6/2020	Pre-Breaching	Closed	7.94	47	35.1	4.22	0	0.0	0.00	0	0.0	0.00	9		
1/7/2020	Breaching	Closed	9.87	17	3.5	1.69	0	0.0	0.00	0	0.0	0.00	10		
1/8/2020	Post-Breaching	Open	1.66	170	161.6	3.35	0	0.0	0.00	0	0.0	0.00	9		
1/15/2020	Baseline	Open	2.34	109	43.3	13.55	0	0.0	0.00	0	0.0	0.00	9		
1/16/2020	Monthly beach topo survey	Open	3.43	24	10.8	4.40	0	0.0	0.00	0	0.0	0.00	5		
1/22/2020	Baseline	Open	5.38	204	93.2	25.67	0	0.0	0.00	0	0.0	0.00	9		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
1/30/2020	Baseline	Open	3.36	189	176.8	3.03	0	0.0	0.00	0	0.0	0.00	9		
2/5/2020	Baseline	Open	3.97	170	161.3	3.35	0	0.0	0.00	0	0.0	0.00	9		
2/13/2020	Baseline	Open	0.80	111	88.4	5.57	0	0.0	0.00	0	0.0	0.00	9		
2/17/2020	Baseline	Open	0.74	110	100.4	3.74	0	0.0	0.00	0	0.0	0.00	9		
2/20/2020	Baseline	Open	3.18	147	55.7	18.24	0	0.0	0.00	0	0.0	0.00	9		
2/27/2020	Monthly beach topo survey	Open	1.29	123	70.6	14.02	0	0.0	0.00	0	0.0	0.00	7		
2/28/2020	Baseline	Open	3.48	95	71.2	4.98	0	0.0	0.00	1	1.0	0.00	9		
3/5/2020	Baseline	Open	3.03	73	25.7	10.21	0	0.0	0.00	0	0.0	0.00	9		
3/12/2020	Baseline	Open	2.31	154	144.6	3.19	0	0.0	0.00	0	0.0	0.00	8		
3/16/2020	Monthly beach topo survey	Open	1.41	180	107.4	23.71	0	0.0	0.00	0	0.0	0.00	8		
4/22/2020	Baseline	Open	1.60	167	147.9	4.18	23	20.3	0.94	10	9.0	0.24	9		
4/28/2020	Baseline	Open	2.83	128	107.6	4.51	26	14.2	2.54	5	2.8	0.40	9		
5/6/2020	Pre-Breaching	Closed	6.76	132	118.0	4.08	42	36.0	1.56	0	0.0	0.00	9		
5/11/2020	Extra Survey	Closed	7.92	50	20.7	15.07	3	1.0	1.00	0	0.0	0.00	3		
5/13/2020	Baseline	Closed	8.73	107	70.1	8.90	5	3.3	0.44	0	0.0	0.00	9		
5/14/2020	Monthly beach topo survey	Closed	9.15	83	57.7	9.10	3	1.7	0.56	0	0.0	0.00	6	Y	
5/20/2020	Baseline	Closed	6.07	139	123.0	3.83	5	3.7	0.33	0	0.0	0.00	9		
5/21/2020	Extra Survey	Closed	7.00	59	41.5	9.57	2	0.8	0.48	0	0.0	0.00	4		
5/27/2020	Baseline	Open	0.59	107	87.3	4.81	10	6.2	0.74	0	0.0	0.00	9		
6/4/2020	Baseline	Open	1.03	201	174.0	6.75	0	0.0	0.00	0	0.0	0.00	9		
6/9/2020	Baseline	Open	0.46	166	146.3	5.06	1	1.0	0.00	0	0.0	0.00	9	Y	
6/11/2020	Monthly beach topo survey	Open	0.57	178	136.4	9.48	0	0.0	0.00	0	0.0	0.00	9	Y	
6/17/2020	Baseline	Open	1.03	222	207.7	3.27	2	0.7	0.24	0	0.0	0.00	9		
6/25/2020	Baseline	Open	0.73	330	303.2	9.24	0	0.0	0.00	0	0.0	0.00	9		
7/9/2020	Baseline	Open	0.60	264	220.1	11.83	0	0.0	0.00	0	0.0	0.00	9		
7/16/2020	Baseline	Open	1.06	208	158.9	13.95	0	0.0	0.00	0	0.0	0.00	9		
7/23/2020	Monthly beach topo survey	Open	0.55	242	228.7	4.40	0	0.0	0.00	0	0.0	0.00	7		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
7/29/2020	Monthly beach topo survey	Open	1.35	117	62.2	22.53	0	0.0	0.00	0	0.0	0.00	6		
7/30/2020	Baseline	Open	0.86	138	127.3	2.86	0	0.0	0.00	0	0.0	0.00	9		
8/5/2020	Baseline	Open	1.54	136	107.1	8.76	0	0.0	0.00	0	0.0	0.00	9		
8/12/2020	Baseline	Open	1.41	92	76.0	4.35	0	0.0	0.00	0	0.0	0.00	9		
8/13/2020	Monthly beach topo survey	Open	1.27	69	31.7	14.35	0	0.0	0.00	0	0.0	0.00	6		
8/26/2020	Baseline	Open	1.43	55	48.4	1.53	0	0.0	0.00	0	0.0	0.00	9		
9/10/2020	Baseline	Open	1.28	52	39.0	4.98	0	0.0	0.00	0	0.0	0.00	9		
9/15/2020	Baseline	Open	1.66	76	44.0	10.17	0	0.0	0.00	0	0.0	0.00	9		
9/17/2020	Monthly beach topo survey	Open	2.03	36	10.6	4.26	0	0.0	0.00	0	0.0	0.00	9		
9/24/2020	Baseline	Open	1.71	65	40.7	4.58	0	0.0	0.00	0	0.0	0.00	9		Y
9/29/2020	Extra Survey	Closed	3.54	6	3.5	0.56	0	0.0	0.00	0	0.0	0.00	6		
10/7/2020	Baseline	Closed	5.48	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	6		
10/8/2020	Monthly beach topo survey	Closed	5.61	30	3.0	3.00	0	0.0	0.00	0	0.0	0.00	10		
10/13/2020	Extra Survey	Closed	6.32	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	7		
10/15/2020	Baseline	Closed	6.55	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
10/21/2020	Extra Survey	Closed	6.98	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	8		
10/22/2020	Baseline	Closed	7.07	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
10/28/2020	Baseline	Open	1.80	78	65.6	5.43	0	0.0	0.00	0	0.0	0.00	9		
11/5/2020	Baseline	Open	1.73	86	71.4	3.50	0	0.0	0.00	0	0.0	0.00	9		
11/9/2020	Baseline	Closed	4.52	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	4		
11/10/2020	Extra Survey	Closed	4.82	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	7		
11/16/2020	Extra Survey	Closed	7.08	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	5		
11/18/2020	Pre-Breaching	Closed	7.96	56	45.2	2.74	0	0.0	0.00	0	0.0	0.00	9		
11/19/2020	Breaching	Closed	8.38	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	10		
11/19/2020	Monthly beach topo survey	Closed	8.33	56	13.0	8.35	0	0.0	0.00	0	0.0	0.00	8		
11/20/2020	Post-Breaching	Open	2.38	122	95.1	6.99	0	0.0	0.00	0	0.0	0.00	9		
11/23/2020	Baseline	Open	1.75	130	77.2	17.74	0	0.0	0.00	0	0.0	0.00	9		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
12/3/2020	Baseline	Closed	4.21	3	0.3	0.33	0	0.0	0.00	0	0.0	0.00	9		
12/7/2020	Extra Survey	Closed	6.26	7	1.2	1.17	0	0.0	0.00	0	0.0	0.00	6		
12/9/2020	Pre-Breaching	Closed	7.67	59	40.9	3.37	0	0.0	0.00	0	0.0	0.00	9		
12/10/2020	Breaching	Closed	7.84	20	8.3	2.95	0	0.0	0.00	0	0.0	0.00	10		
12/11/2020	Post-Breaching	Open	3.24	120	116.7	0.47	0	0.0	0.00	0	0.0	0.00	9		
12/17/2020	Baseline	Open	2.68	166	135.6	7.47	0	0.0	0.00	0	0.0	0.00	9		
12/21/2020	Baseline	Closed	3.94	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	9		
12/23/2020	Monthly beach topo survey	Closed	5.31	12	4.0	1.21	0	0.0	0.00	0	0.0	0.00	15		
12/29/2020	Pre-Breaching	Closed	7.39	24	8.1	2.29	0	0.0	0.00	0	0.0	0.00	15		
12/30/2020	Breaching	Closed	8.06	52	21.2	8.38	0	0.0	0.00	0	0.0	0.00	9	Y	
12/31/2020	Post-Breaching	Open	4.01	151	138.0	4.15	0	0.0	0.00	0	0.0	0.00	9		
1/5/2021	Baseline	Closed	7.33	111	104.1	2.81	0	0.0	0.00	0	0.0	0.00	9		
1/11/2021	Baseline	Closed	8.38	50	42.8	1.92	0	0.0	0.00	0	0.0	0.00	9		
1/12/2021	Breaching	Closed	8.39	39	13.0	4.75	0	0.0	0.00	0	0.0	0.00	11		
1/13/2021	Post-Breaching	Open	4.72	107	56.0	14.52	0	0.0	0.00	0	0.0	0.00	8	Y	
1/18/2021	Pre-Breaching	Closed	8.10	98	81.9	2.26	0	0.0	0.00	0	0.0	0.00	9		
1/19/2021	Breaching	Closed	8.82	19	6.9	2.07	0	0.0	0.00	0	0.0	0.00	12		
1/20/2021	Baseline	Open	1.39	122	90.3	8.23	0	0.0	0.00	0	0.0	0.00	9		
1/21/2021	Monthly beach topo survey	Open	2.44	91	46.0	14.53	0	0.0	0.00	0	0.0	0.00	6		
1/28/2021	Baseline	Open	7.27	119	60.7	11.72	0	0.0	0.00	0	0.0	0.00	9		
2/2/2021	Baseline	Open	4.41	186	155.7	6.61	0	0.0	0.00	0	0.0	0.00	9		
2/9/2021	Baseline	Open	1.40	136	131.3	1.88	0	0.0	0.00	0	0.0	0.00	9		
2/17/2021	Baseline	Open	4.27	110	100.4	3.74	0	0.0	0.00	0	0.0	0.00	9		
2/23/2021	Baseline	Open	2.91	91	40.2	11.27	0	0.0	0.00	0	0.0	0.00	9		
2/24/2021	Monthly beach topo survey	Perched	3.32	49	24.9	6.27	0	0.0	0.00	0	0.0	0.00	7		
3/4/2021	Baseline	Open	4.04	36	28.2	2.39	0	0.0	0.00	0	0.0	0.00	9		
3/8/2021	Monthly beach topo survey	Closed	7.07	88	79.7	3.01	0	0.0	0.00	0	0.0	0.00	9		

				HASE adult			HASE pups			HASE neonate					
date	**activity**	**mouth condition**	**estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
3/9/2021	Pre-Breaching	Closed	7.85	100	94.1	1.79	0	0.0	0.00	0	0.0	0.00	9		
3/10/2021	Breaching	Closed	8.68	96	42.2	12.41	0	0.0	0.00	0	0.0	0.00	11		
3/11/2021	Post-Breaching	Open	2.34	193	186.9	1.64	0	0.0	0.00	0	0.0	0.00	9		
3/16/2021	Baseline	Open	1.65	233	211.6	4.30	0	0.0	0.00	0	0.0	0.00	9		
3/18/2021	Monthly beach topo survey	Open	1.01	31	11.7	2.96	0	0.0	0.00	0	0.0	0.00	11		
3/24/2021	Baseline	Open	2.12	167	74.8	21.18	0	0.0	0.00	0	0.0	0.00	9		
4/6/2021	Baseline	Open	0.90	163	148.8	4.93	7	4.7	0.50	5	3.7	0.41	9		
4/13/2021	Baseline	Open	1.07	107	84.1	7.33	0	0.0	0.00	12	9.6	0.44	9		
4/20/2021	Baseline	Open	2.06	125	110.4	2.89	29	24.3	1.29	0	0.0	0.00	8		
4/22/2021	Monthly beach topo survey	Closed	3.00	55	28.0	5.88	19	12.7	1.83	3	2.7	0.24	9		
4/27/2021	Baseline	Closed	4.60	40	23.0	4.39	13	7.6	1.29	1	0.2	0.15	9		