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

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EXECUTIVE SUMMARY

The purpose of this report of activities and monitoring results is to comply with the requirements of the Incidental Harassment Authorization (IHA) issued pursuant to Section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C 1361 et seq.) to take small numbers of marine mammals, by Level B harassment, incidental to the Sonoma County Water Agency's (Water Agency) Russian River Estuary Water Level Management Activities (April 21, 2014, NMFS IHA).

The Water Agency applied in 2009 to the National Marine Fisheries Service (NMFS) Office of Protected Resources for an IHA under the Marine Mammal Protection Act (MMPA) for activities associated with water level management activities in the Russian River Estuary (Estuary). NMFS issued an original IHA to the Water Agency on March 30, 2010 and subsequently on April 20, 2011, April 17, 2012, April 16, 2013, and April 21, 2014. This report provides the results of all monitoring of baseline conditions, water level management activities, and activities related to the Jetty Study Plan (ESA PWA 2011) for the 2014 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 formation of a lagoon behind the barrier beach and, as water surface levels rise in the Estuary, flooding may occur. The Water Agency's artificial breaching activities are conducted in accordance with the Russian River Estuary Management Plan recommended in the Heckel (1994) study. The purpose of artificially breaching the barrier beach is to alleviate potential flooding of low-lying properties along the Estuary. The Water Agency and the U.S. Army Corps of Engineers (Corps) consulted with the NMFS under Section 7 of the Endangered Species Act (ESA) regarding the potential effects of their operations and maintenance activities, including the Water Agency's estuary management program, on federally-listed steelhead (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*). As a result of this consultation, the 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 primarily 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 the Water Agency to collaborate with NMFS and to modify estuary water level management in order to reduce marine influence (high salinity and tidal inflow) and promote a higher water surface elevation in the estuary (formation of a fresh or brackish lagoon) for purposes of enhancing the quality of rearing habitat for juvenile (age 0+ and 1+) steelhead from May 15 to October 15 (the lagoon management period). A program of potential, incremental steps are prescribed to accomplish this, including adaptive management of a lagoon outlet channel on the barrier beach.

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

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

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

Pinniped monitoring was performed in accordance with the requirements of the NMFS IHA issued April 21, 2014, and the Russian River Estuary Management Activities Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2011).

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

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

A barrier beach was formed eleven times during 2014, but only during six of these closure events did the Water Agency artificially breach the sand bar. The Russian River mouth was closed to the ocean for a

total of 110 days (or 30%) in 2014, mostly during the fall months. Pinniped monitoring occurred no more than 3 days before, the day of, and the day after each water level management activity.

The Water Agency's Estuary biological and physical monitoring activities are included in the NMFS IHA. The Water Agency surveys the sandbar (or barrier beach) monthly to collect a topographic map of the beach, as required by the Russian River Biological Opinion. A monitor is present during these surveys to record any disturbances of the Jenner haul-out during the survey. In 2014 the Water Agency implemented the Jetty Study Plan (ESA PWA 2011) and a pinniped monitor was present to record any disturbances of the Jenner haul-out, similar to the monthly topographic surveys. Additionally, Water Agency field staff conducting biological and physical monitoring in the Estuary recorded any pinnipeds they encountered hauled out and any disturbance to pinnipeds associated with their activities.

The Russian River Estuary Management and Monitoring Activities in 2014 resulted in incidental harassment (Level B harassment) of 2,121 harbor seals and two northern elephant seals, well under the total allowed by NMFS IHA. The Russian River Estuary Management activities in 2013, 2012, 2011 and 2010 resulted in incidental harassment (Level B harassment) of 1,351, 208, 42 and 290 harbor seals, respectively.

INTRODUCTION

The purpose of this report of activities and monitoring results is to comply with the requirements of the Incidental Harassment Authorization (IHA) issued pursuant to Section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C 1361 et seq.) to take small numbers of marine mammals, by Level B harassment, incidental to the Sonoma County Water Agency's (Water Agency) Russian River Estuary Water Level Management Activities (April 21, 2014, NMFS IHA).

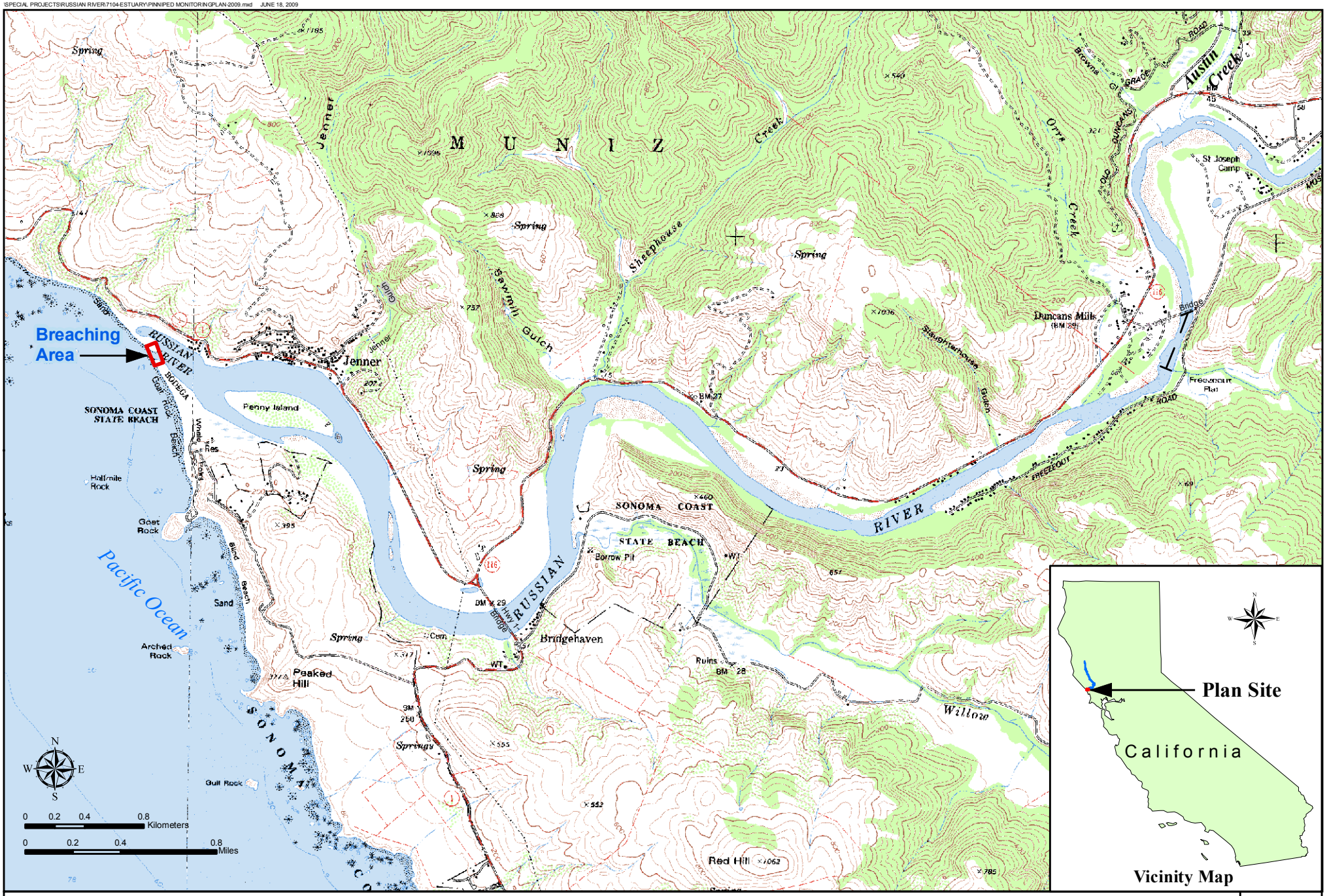
The Water Agency applied in 2009 to the National Marine Fisheries Service (NMFS) Office of Protected Resources for an IHA under the Marine Mammal Protection Act (MMPA) for activities associated with water level management activities in the Russian River Estuary (Estuary). NMFS issued an original IHA to the Water Agency on March 30, 2010 and subsequently on April 20, 2011, April 17, 2012, April 16, 2013, and April 21, 2014. This report provides the results of all baseline monitoring, water level management activities, and activities related to the Jetty Study Plan (ESA PWA 2011) for the 2014 calendar year, and additional summary information for all related activities.

BACKGROUND

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

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

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



RRIFR
Russian River Instream Flow and Restoration

Russian River Estuary

This Map is for general reference only.

Figure 1

Biological Opinion and the Estuary

The Water Agency and the U.S. Army Corps of Engineers (Corps) consulted with the NMFS under Section 7 of the Endangered Species Act (ESA) regarding the potential effects of their operations and maintenance activities, including the Water Agency's Estuary Management Program, on federally-listed steelhead (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*). As a result of this consultation, the 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 the Water Agency to collaborate with NMFS to modify Estuary water level management to reduce marine influence on the Estuary (tidal inflow and high salinity) and to promote a higher water surface elevation in the Estuary to form a fresh or brackish lagoon to enhance rearing habitat for juvenile (age 0+ and 1+) steelhead from May 15 to October 15 (the lagoon management period). The Biological Opinion outlines a program of potential, incremental steps to accomplish this, including adaptive management of a lagoon outlet channel on the barrier beach.

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

Harbor seals (*Phoca vitulina richardsi*) regularly haul out at the mouth of the Russian River (Jenner haul-out) (Figure 2). California sea lions (*Zalophus californianus*) and northern elephant seals (*Mirounga angustirostris*) are occasionally observed at the haul-out. There are also several known river haul-outs at logs and rock piles in the Russian River Estuary (Figure 2). The Water Agency applied for an IHA under the MMPA for activities associated with Russian River estuary management activities, including:

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

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

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

1. Under what conditions do pinnipeds haul out at the Russian River Estuary mouth at Jenner?

2. How do seals at the Jenner haul-out respond to activities associated with the construction and maintenance of the lagoon outlet channel and artificial breaching activities?

3. Does the number of seals at the Jenner haul-out significantly differ from historic averages with formation of a summer (May 15th to October 15th) lagoon in the Russian River Estuary?

4. Are seals at the Jenner haul-out displaced to nearby river and coastal haul-outs when the mouth remains closed in the summer?

METHODS

Monitoring was performed in accordance with the requirements of NMFS IHA issued April 21, 2014, and the Russian River Estuary Management Project Pinniped Monitoring Plan (Sonoma County Water Agency and Stewards of the Coast and Redwoods 2011).

Water Agency biologists and Stewards of the Coast and Redwoods (Stewards) volunteers and staff monitored pinnipeds at the Jenner and peripheral haul-outs. The Stewards and Water Agency provide annual training for all volunteers; trainings occurred on March 10, 2010, January 10, 2011, February 14, 2012, February 14, 2013 and February 11, 2014. Water Agency biologists participating in the monitoring program also attended the training session. The training agenda covered:

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

SPECIAL PROJECTS/RUSSIAN RIVER/7104-ESTUARY/HARBOR SEAL-2009-JENNER FEBRUARY 10,2011

Pinniped Haulouts at the Russian River Estuary and Surrounds

Figure 2

Twice monthly baseline monitoring of the Jenner haul-out was shared by Water Agency biologists and trained Stewards volunteers (each group monitored once a month), with volunteers monitoring the peripheral haul-outs for all baseline monitoring. Monitoring of water level management activities (lagoon outlet channel and artificial breaching) at the Jenner haul-out was also shared, but Water Agency biologists monitored artificial breaching activities on the day of the event (no lagoon outlet channel activities occurred in 2014). Pre- breaching and post-breaching monitoring was shared by the organizations depending on the availability of volunteers and Water Agency staff. Water Agency biologists also monitored pinnipeds during monthly topographic surveys of the beach, Jetty Study investigations, and biological and physical monitoring of the Estuary.

Baseline

Baseline monitoring was performed to gather information about the population of harbor seals utilizing the Jenner haul-out including population trends, patterns in seasonal abundance and the influence of barrier beach condition on harbor seal abundance. Baseline monitoring of the peripheral haul-outs was completed concurrently with the monitoring of the Jenner haul-out. Baseline counts were scheduled for two days out of each month with the intention of capturing a low and high tide each in the morning and afternoon. Weather conditions were recorded at the beginning of each census. 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 and peripheral haul-outs were surveyed twice monthly. This census began at local dawn and continued for 8 hours. At Jenner, 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 the Jenner haul-out. 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 were also recorded and were identified using one or more of the following characteristics: less than 1 week old, less than 15 kg, thin for their body length, an umbilicus or natal pelage present, wrinkled skin, or awkward or “jerky” movement. If any potentially abandoned pup was observed during monitoring, the Water Agency would contact the NMFS stranding response network (Marine Mammal Center in Sausalito, CA) immediately and report the incident to NMFS’ Southwest Regional Office and NMFS Headquarters within 48 hours. Monitors were instructed not to approach or move the pup. Monitors used the following potential indications that a pup may be abandoned: no observed contacts with adult seals, no movement of the pup, and the pup’s attempts to nurse were rebuffed.

Peripheral Haul-out Use

To understand possible relationships between use of the Jenner haul-out and nearby coastal and river (peripheral) haul-outs, monitoring occurred at several other haul-outs on the coast and in the Russian River Estuary (Figure 2). These haul-outs include North Jenner and Odin Cove to the north; Pocked Rock, Kabemali, and Rock Point to the south; Penny Logs, Paddy’s Rock, and Chalanchawi in the Russian River Estuary. These are known harbor seal haul-outs that have been monitored by Joe Mortenson for over 25

years. The peripheral haul-outs were visited for 10 minute counts four times during each baseline monitoring day. All pinnipeds hauled out during the 10 minutes were counted from the same vantage points at each haul-out using a high-powered spotting scope or binoculars.

Disturbance of Seals

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

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

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

Prior to each breaching or lagoon outlet channel implementation, the Water Agency monitor participated in the onsite tailgate safety meeting to discuss the location(s) of pinnipeds at the Jenner haul-out that day and methods of avoiding and minimizing disturbances to the haul-out as outlined in NMFS IHA.

Biological and Physical Monitoring

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

RESULTS AND DISCUSSION

The NMFS IHA (April 21, 2014) requires the following information be provided in this report:

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

Estuary water surface elevations are recorded at the Jenner gauge (operated by the Water Agency), located at the State Parks visitor center in the town of Jenner. Appendix A includes the Estuary water surface elevations associated with pinniped monitoring in 2014, including baseline, water level management events and Estuary management investigations.

Baseline

In 2014 a total of 23 baseline surveys, 11 monthly beach topographic surveys, 6 breaching surveys, 6 pre-breaching, 6 post-breaching and 10 jetty study surveys were conducted (Appendix A). Three of the total baseline surveys also functioned as pre-breaching surveys and one baseline survey also functioned as a post-breaching survey. Additionally one of the topographic surveys was conducted during a breaching event. December's beach topographic survey was cancelled due to dangerous, high wave conditions.

Jenner Haul-out Use

Peak seal abundance, as measured by the single greatest count of harbor seals at the Jenner haul-out, was on March 6 (424 seals). However, using the average number of seals hauled out as a measure of abundance, seal abundance at Jenner was greatest in July (mean = 266 ± 2.1 s.e., n = 33) (Figure 3). Seal

abundance was significantly greater in July and March compared to all other months except February (Unequal N HSD multiple comparisons test, $p < 0.001$). The July peak in abundance occurred during the summer molting period, while the March peak in abundance occurred prior to the start of pupping. Similar to previous years, seal abundance declined in the fall, and was particularly low in October and November (significantly lower than all other months except September; Unequal N HSD multiple comparisons test, $p < 0.001$) (Figure 3). The reduction in seal abundance during the fall months, while not atypical, may have been more severe for 2014 due to the long periods of barrier beach closures during those months. The barrier beach was closed 36 consecutive days beginning on September 17th and another 24 consecutive days beginning October 24th. When compared to previous years combined, there were significantly more seals at the Jenner haul-out in February, March and December, and significantly fewer seals in November of 2014 (Unequal N HSD multiple comparisons test, $p < 0.05$) (Figure 3).

While it is not possible to separate the effect of river mouth condition (closed versus open) from time of year, fewer seals are present during closed conditions (mean = 46.9 ± 1.74 s.e., n =713) compared to open conditions (mean = 134.6 ± 1.89 s.e., n=2,179; ANOVA $p<0.001$) (Figure 4). However, the overall trend was an increase in seal abundance compared to earlier years.

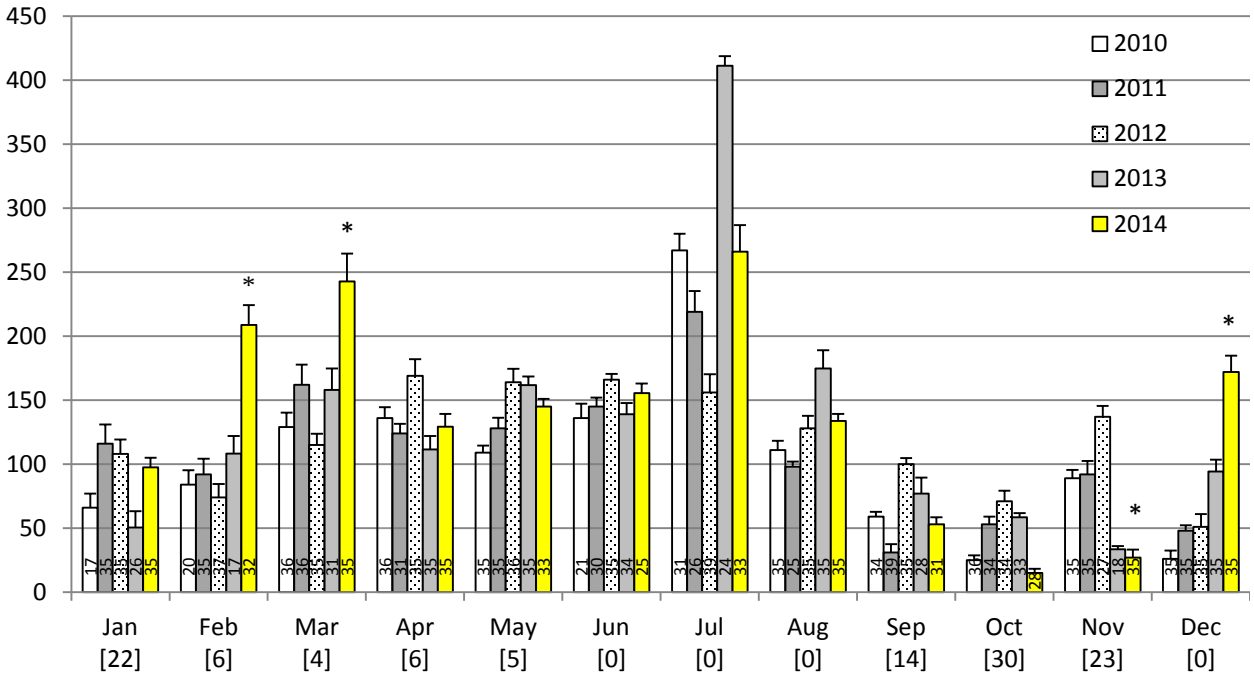


Figure 3. The average number of harbor seals hauled out at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) as counted during baseline surveys for each year (January 2010 – December 2014) categorized by month. Error bars represent standard error and sample size used to calculate means are presented inside the bars. Numbers in brackets indicate the number of days the river mouth was closed in 2014. Asterisk above indicate 2014 monthly average seals counts that varied significantly from the previous years combined monthly average (Unequal N HSD multiple comparisons test, $p < 0.05$).

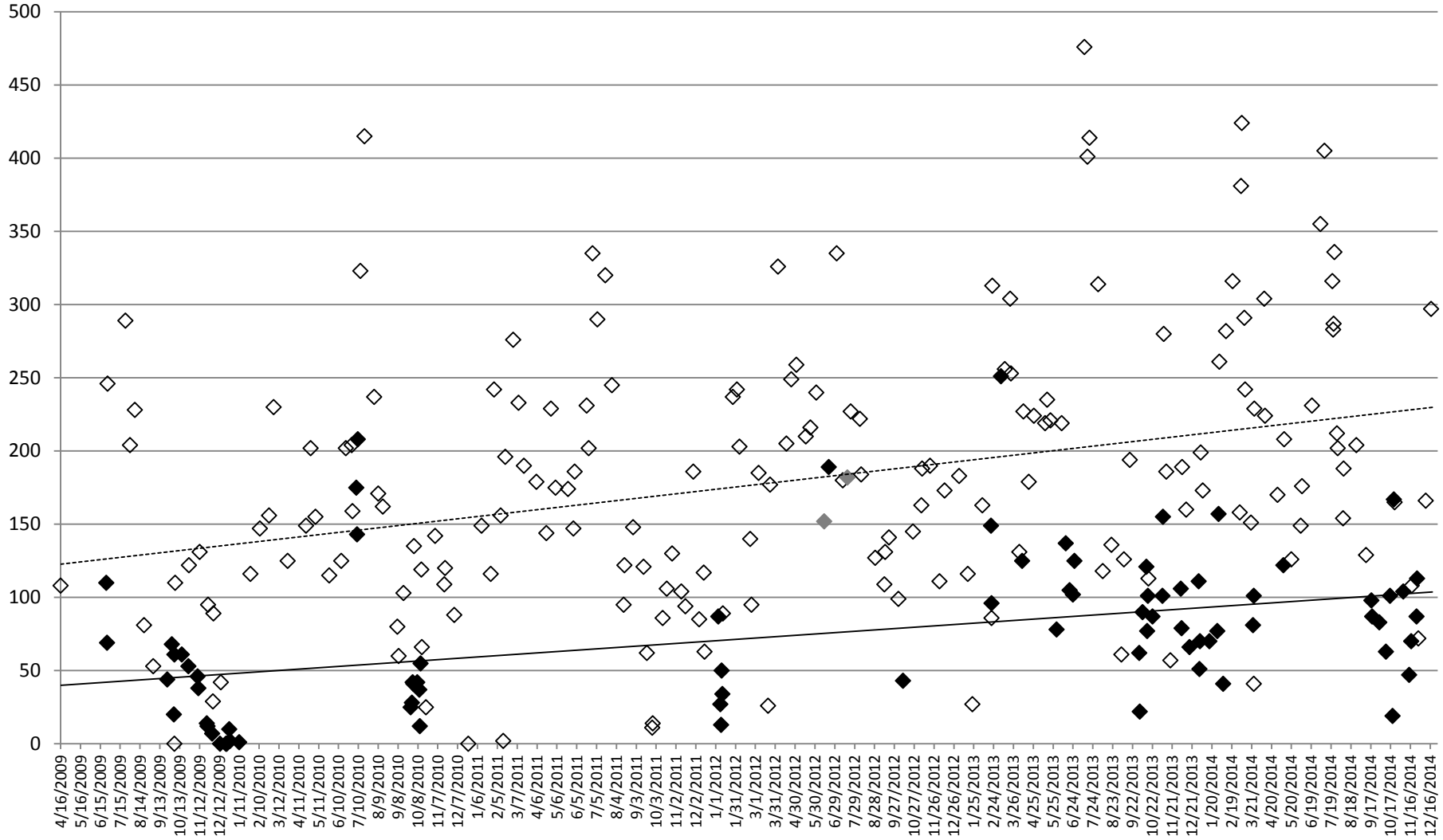


Figure 4. Maximum number of harbor seals counted during all pinniped surveys at the Jenner haul-out (Russian River mouth at Goat Rock State Beach) since surveys began in 2009. Open diamonds represent counts in mouth open conditions, black filled diamonds represent counts during mouth closed conditions and grey diamonds represent counts during naturally perched conditions. Dashed line represents linear trend for harbor seal counts in mouth open conditions and solid line represents linear trend for harbor seal counts in mouth closed conditions.

Pupping Season

Pups have been observed at the Jenner haul-out as early as March (SCWA 2012, 2013). In 2014 the first pups were observed on April 9, with the latest observation of pups occurring on June 5 (the last neonate was observed on May 9). In 2013 the first pups were observed on April 18, with the latest observation of pups occurring on May 30, 2013 (SCWA 2014). Pups are counted during surveys through June, after which time it becomes difficult to distinguish pups from sub-adult seals. No distressed or abandoned pups were reported by Water Agency or Stewards monitors in 2014.

Pup production at the Jenner haul-out was 23.2% of adult seals as calculated from the peak pup count recorded on April 29 and the number of adult harbor seals present at the same time. Pup production decreased slightly since last year when 28.8% of adult seals was reported. However, the average number of pups observed (when pups were present) during April and May was up slightly for 2014: 13.9 pups compared to 12.9 pups in 2013.

Peripheral Haul-out Use

In addition to monitoring harbor seal abundance at the Jenner haul-out, eight coastal and Estuary haul-outs were monitored. Similar to previous years, most of these peripheral haul-outs had very low seal abundance with three sites averaging less than one seal (North Jenner = 0.3, Penny Logs = 0.1, Paddy's Rock = 0) and three sites averaging less than 4 seals (Odin Cove = 3.3, Chalanchawi = 1.2 and Pocked Rock = 3.7), as observed during baseline surveys. The two southernmost coastal haul-outs included in our monitoring surveys, Kabemali and Rock Point, had the highest abundance of seals with a baseline average of 6.0 and 7.6 respectively. Seasonal increases in seal abundance were most apparent at the Pocked Rock, Kabemali, and Rock Point haul-outs, where seal abundance peaked during June and July for Rock Point and Pocked Rock; May and June for Kabemali) (Table 2).

Table 2. The average number of harbor seals by month hauled out at peripheral sites as observed during all monitoring surveys conducted in 2014.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North Jenner	0.1	0.0	3.1	0.0	4.0	0.0	0.0	0.4	0.0	0.0	1.8	0.0
Odin Cove	3.0	4.3	5.9	0.0	6.0	3.0	7.3	6.3	4.6	1.5	4.5	0.0
Penny Logs	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.5	0.1	0
Paddy's Rock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chalanchawi	0.7	2.0	0.5	0.9	2.5	2.5	1.9	2.6	0.0	0.1	0.6	0.7
Pocked Rock	1.3	4.3	3.4	2.8	4.3	**7.8**	**7.8**	2.4	2.3	2.4	2.3	2.7
Kabemali	5.8	2.0	4.6	6.1	**16.2**	**22.5**	3.3	5.6	2.1	1.4	6.8	0.0
Rock Point	8.3	1.6	3.7	8.0	8.5	**13.8**	**25.1**	6.4	8.9	3.4	8.4	0.0

Disturbance of Seals

An effort was made to compare the level of disturbance between baseline surveys and surveys when Water Agency personnel are working in the vicinity of the Jenner haul-out. Disturbance sources were separated into 9 categories: aircraft, bird, dog, kayak, multiple, other boat, people, unknown and vehicle. Seals were considered to be disturbed if they moved on or flushed from the haul-out. Given that seal abundance on the haul-out is lower during closed (including naturally perched) conditions we also compare level of disturbance by river mouth condition.

Figure 5 illustrates the proportion of baseline surveys when harbor seals were disturbed at the Jenner haul-out, categorized by disturbance source. Harbor seals were most frequently disturbed by people on foot (54% of surveys), with an increase in disturbances during mouth closed conditions (69% of surveys). People in kayaks were the next most frequent source of disturbance (29% of surveys). The proportion of baseline surveys when seals were disturbed by people, on foot or in kayaks, was greater for days when the river mouth was closed (Figure 5).

To compare the relative level of disturbance associated with Water Agency personnel working near the Jenner haul-out to days when no Water Agency activities are conducted (*i.e.,* baseline surveys) Figure 6 illustrates disturbances observed during beach topographic surveys, jetty study activities, breaching, and lagoon outlet channel implementation. As expected the proportion of surveys where seals were disturbed by people increased for days when Water Agency personnel were working in the area of the Jenner haul-out (an increase of 30%).

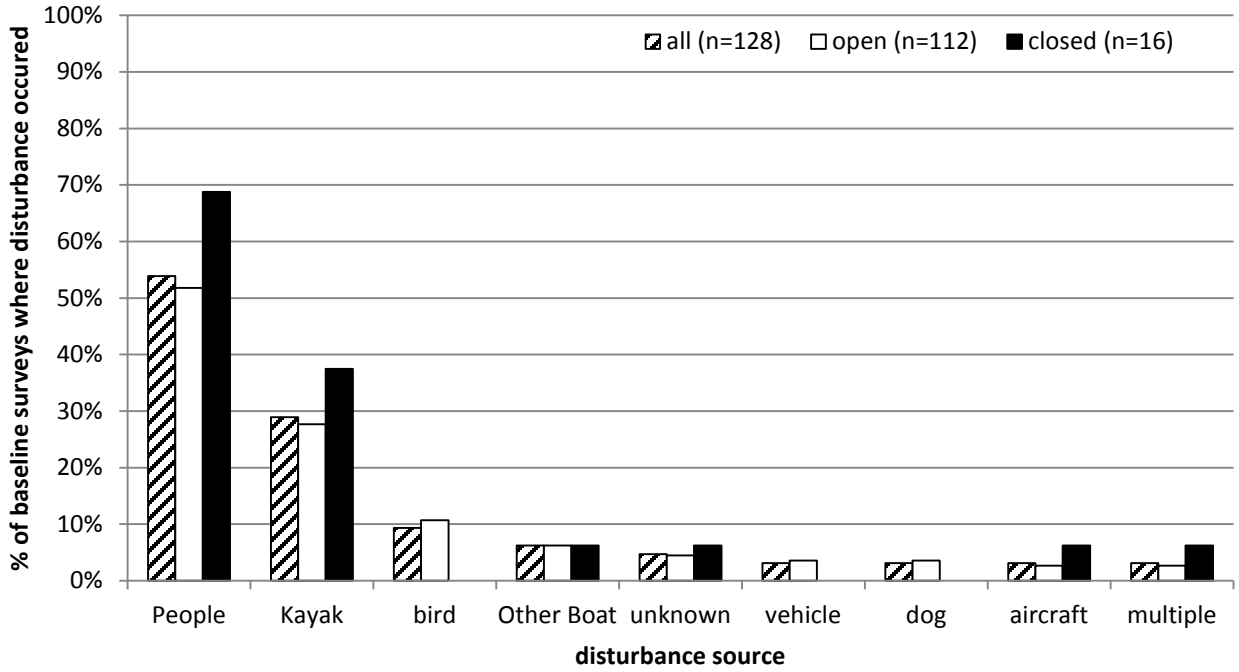


Figure 5. The proportion of baseline surveys where harbor seals were disturbed (moved or flushed) at the Jenner haul-out, described for each disturbance source. Data includes all baseline surveys since surveys began in 2009. Data is presented for baseline surveys during mouth open (n=112) and mouth closed (n=16) conditions, where closed includes naturally perched conditions.

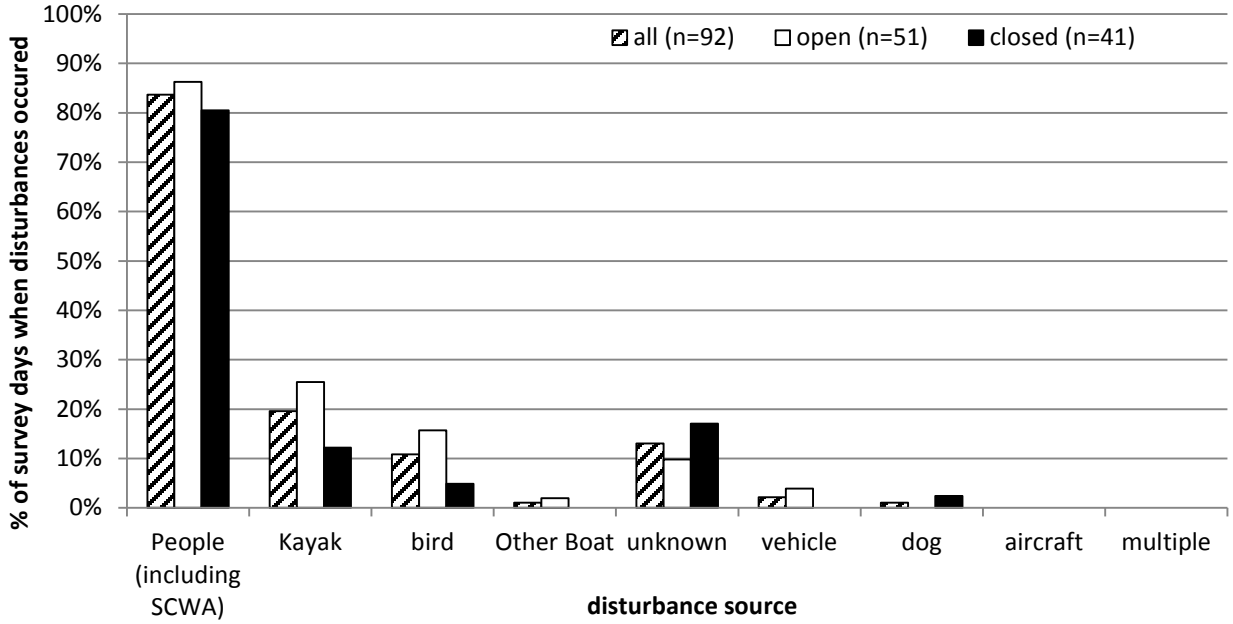


Figure 6. The proportion of surveys during Water Agency activities where harbor seals were disturbed (moved or flushed) at the Jenner haul-out, described for each disturbance source. Data includes all breaching, lagoon outlet channel implementation, beach topographic and jetty study surveys since surveys began in 2009. Data is presented for surveys during mouth open (n=51) and mouth closed (n=41) conditions, where mouth closed conditions include a period of time in 2012 when the barrier beach had formed, but water outflow occurred at the jetty structure. Disturbance source "people" includes Water Agency personnel and/or equipment in the vicinity of the Jenner haul-out.

Water Level Management Activities

A barrier beach formed eleven times during 2014 (Table 3), and the Water Agency artificially breached the sand bar during six of these closures. The Russian River outlet was closed to the ocean for a total of 110 days (or 30%) in 2014, with 29 (or 26%) of these days occurring during the Lagoon Management Period. This is similar to the previous year where the outlet was closed for 104 days, however in 2013 54% of outlet closures occurred during the Lagoon Management Period.

On December 16, 2013, the barrier beach formed, closing the river mouth until December 21st when the water impounded behind the barrier beach and wave over wash at the jetty eroded away enough sand for an outlet channel to form. By the December 23, a barrier beach again closed the river mouth until it was mechanically breached by the Water Agency on January 2, 2014. Breaching activities began at 10:11 and were completed at 11:52. The water level in the Estuary reached 7.7 ft NGVD on the day of breaching. Just prior to breaching harbor seals were hauled out on the ocean side of the barrier beach north of the jetty structure. The maximum number of seals observed hauled out on January 2nd was 62 at 09:25. On January 3rd there were 111 harbor seals hauled out at 07:00.

On January 11, 2014, the river mouth closed and remained closed until it was mechanically breached by the Water Agency on January 30th at 15:14. The peak water level in the Estuary was 8.03 ft NGVD as read from the Jenner gauge at 14:22 on January 30th. Prior to the start of breaching activities there were 157 harbor seals hauled out on the estuary side of the barrier beach. At the end of the day 30 seals remained on the estuary side of the beach. Water Agency staff was on the beach for a total of four hours during this event.

On February 3rd the river mouth closed again. After a period of rain, with a three-day total of 4.49 inches from February 6 – 8 [1], the barrier beach was overtopped from the Estuary and self-breached on February 8th. The river mouth remained open until March 20th. During this period the river mouth migrated north along the beach away from the jetty structure. By the time the mouth closed in March the river mouth was a narrow and shallow channel opening at the north end of Goat Rock State Beach. Again the river mouth closed and the barrier beach remained until it was mechanically breached by the Water Agency on March 24th at 09:14, after only 40 minutes of breaching activity. The peak water level during this closure reached 9.42 ft NGVD at the Jenner gauge. Just before breaching activities began there were 101 harbor seals hauled out on the estuary side of the barrier beach. Following the breaching there were 40 seals hauled out on the beach at 13:30.

During April and May the river mouth closed and opened due to the natural combined actions of ocean waves and river flow a total of four times. The length of time the barrier beach remained was short, from 1 to 4 days (Table 3).

On September 17th the river mouth closed and remained closed for 36 consecutive days until the Water Agency breached the barrier beach on October 22nd at 14:24. Breaching activities began at 11:11 and Water Agency staff was on the beach for three hours and 45 minutes during this event. Water levels in the Estuary reached 8.68 ft NGVD on the morning of October 22nd. Prior to breaching activities there was a large group of harbor seals (137) hauled out on the ocean side and a smaller group (30) hauled out on the estuary side of the barrier beach. By the end of the day there were no seals on the beach, but by 07:30 the following day there were 109 seals on the beach in the area of the new cut.

Due to continued large swells the barrier beach formed again on October 24th. The barrier beach remained closed for another 23 days until it was breached by the Water Agency on November 17th at 12:51. Breaching activities began at 09:30 and Water Agency staff was on the beach for four hours during this event. Water levels in the Estuary reached 7.92 ft NGVD on the morning of November 17th. Prior to breaching activities there were 69 seals hauled out on the ocean side of the barrier beach. No seals were on the beach at the end of the day, but by 07:44 the following day there were 72 seals hauled out just south of the new cut on the estuary side of the beach.

Again, the river mouth closed shortly after breaching and remained closed for 8 days until it was breached by the Water Agency on November 26th at 12:00. Breaching activities began at 09:24 and Water Agency staff was on the beach for three hours and ten minutes during this event. Peak water level in the Estuary was 7.16 ft NGVD recorded on the morning of November 26th. Prior to breaching activities there were 113 seals hauled out on the ocean side of the barrier beach. A small group of seals remained on the ocean side of the beach throughout excavation activities and 15 seals remained at the end of the day (15:07). A maximum count of 72 seals was recorded on November 28; post-breaching monitoring was delayed by one day due to the Thanksgiving Day holiday.

Harbor seal response to excavation activities was similar for all breaching events, and similar to those observed in previous years. Seals that are hauled out first alert to the sound of the excavator being off-loaded in the Goat Rock State Beach parking lot (greater than 1,500 feet south of the haul-out). Seals will then move on the beach or flush into the water as the Water Agency safety crew approaches on

[1] Data provided by the University of California, Davis, Bodega Marine Laboratory. Rain total data retrieved from the BML data set at http://bml.ucdavis.edu/boon/data_rain_fall.html.

foot. People on foot typically come within 200-100 feet of the haul-out before seals are disturbed. Once on the beach the noise and motion of the excavator will disturb seals at greater distances, between 800 and 200 feet. Seals will remain on the beach in small numbers if the excavation activity is far enough away from their initial haul-out location. The estimated take by incidental harassment (Level B), as defined by the Marine Mammal Protection Act, of harbor seals during artificial breaching activities in 2014 was 665 harbor seals (497 flushed and 168 moved). Disturbance information for each event is provided in Table 4.

Table 3. Summary of conditions during river mouth closures occurring in 2014 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 Visitors Center in Jenner, Ca.

Dates barrier beach closed	Peak Jenner gauge height (ft NGVD)	Date mouth opened	Method of breaching
December 23 – January 2	7.70[a]	January 2	Artificial
January 11 – 30	8.03	January 30	Artificial
February 3-8	9.68	February 8	Self
March 20 – 24	9.42	March 24	Artificial
April 22	5.20	April 23	Self
April 26 – 27	4.86	April 27	Self
April 29 – 30	4.44[b]	May 1	Self
May 4 – 8	6.51	May 8	Self
September 17 – October 22	8.68	October 22	Artificial
October 24 – November 17	7.92	November 17	Artificial
November 19 - 26	7.16	November 26	Artificial

[a] *Gauge data not available from December 22, 2013, 12:00 to December 27, 2013, 04:44 or December 31, 2013, 16:58 to January 2, 2013, 18:16. Peak gauge height given is from January 2, 2014 as read at the staff gauge at the California State Parks Jenner Visitors Center.*

[b] *Gauge data not available from April 30, 2014, 09:34 to May 2, 2014, 19:34. Peak gauge height given is from April 30, 2014, 09:20.*

In order to evaluate whether or not beach management activities cause harbor seals to leave the Jenner haul-out for near-by peripheral sites we compared average seal abundance for each peripheral site before, during and after breaching activities for 2014 (Figure 7). Very few seals were observed at the estuary haul-out sites, regardless of timing. All of the coastal haul-outs monitored exhibited an increase in seal abundance during breaching surveys compared with pre-breaching and post-breaching surveys. However the only significant differences were for Odin Cove and Rock Point where there were more seals observed during breaching surveys compared to both pre- and post- breaching surveys (Unequal N HSD multiple comparisons, $p < 0.001$) (Figure 7).

Due to the small sample sizes used for comparisons of seal abundance during water level management activities for 2014 only, a similar comparison of seal abundance at the peripheral haul-outs was made for 2010-2014 observations combined. Results for the estuarine sites were similar when compared to those for 2014 observations only, with very few seals observed (Figure 8). The most notable difference for the coastal haul-out sites was that at North Jenner there were more seals observed during pre-breaching, rather than breaching surveys (Figure 8). The only significant differences in the number of seals observed during water level management monitoring were found at Rock Point and Odin Cove. At Odin Cove there were more seals during breaching surveys (mean = 5.9 ± 0.98 s.e., n = 55) compared to pre-breaching surveys (mean = 2.2 ± 0.56 s.e., n = 58) (Unequal N HSD multiple comparisons test, $p < 0.05$). Similarly, at Rock Point there were more seals were observed during breaching surveys (mean = 9.5 ± 1.40 s.e., n = 55) compared to pre-breaching surveys (mean = 3.6 ± 0.83 s.e., n = 53) (Unequal N HSD $p < 0.001$) (Figure 8). For data from 2010 – 2014 there was no significant difference in the number of seals at any peripheral site during mouth open vs closed conditions (Unequal N HSD multiple comparisons test, $p > 0.50$) (Figure 8).

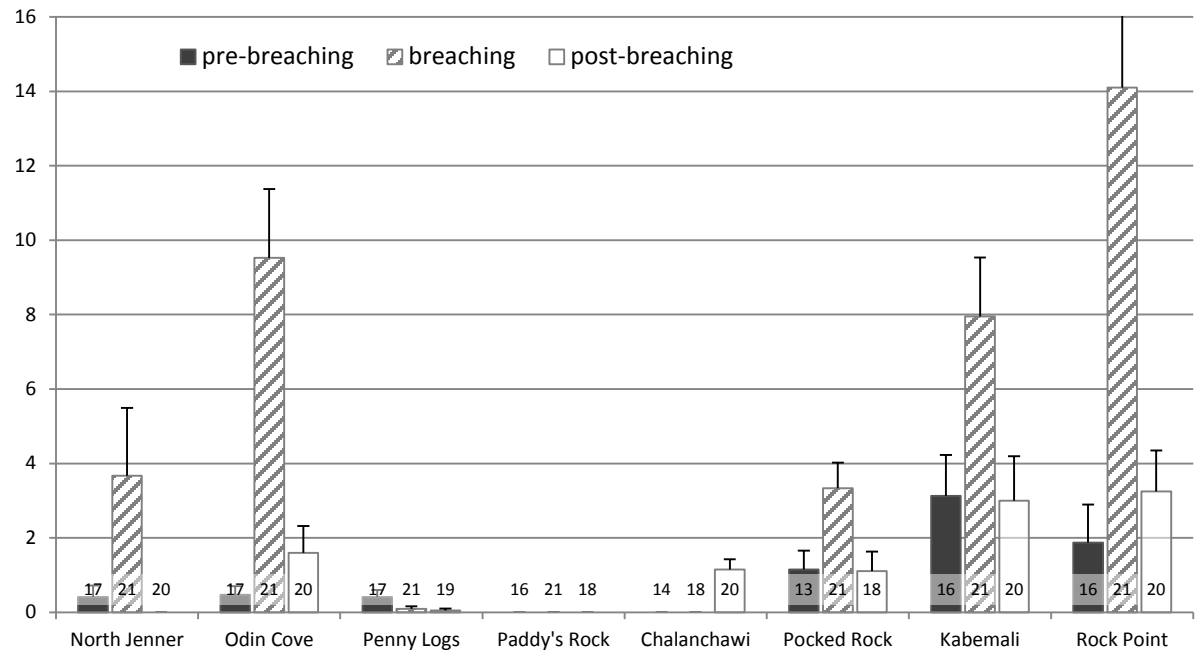


Figure 7. Average seal abundance at peripheral haul-outs as observed during pre-breaching, breaching and post-breaching surveys during 2014. Error bars represent standard error and sample size used to calculate means are presented inside the bars.

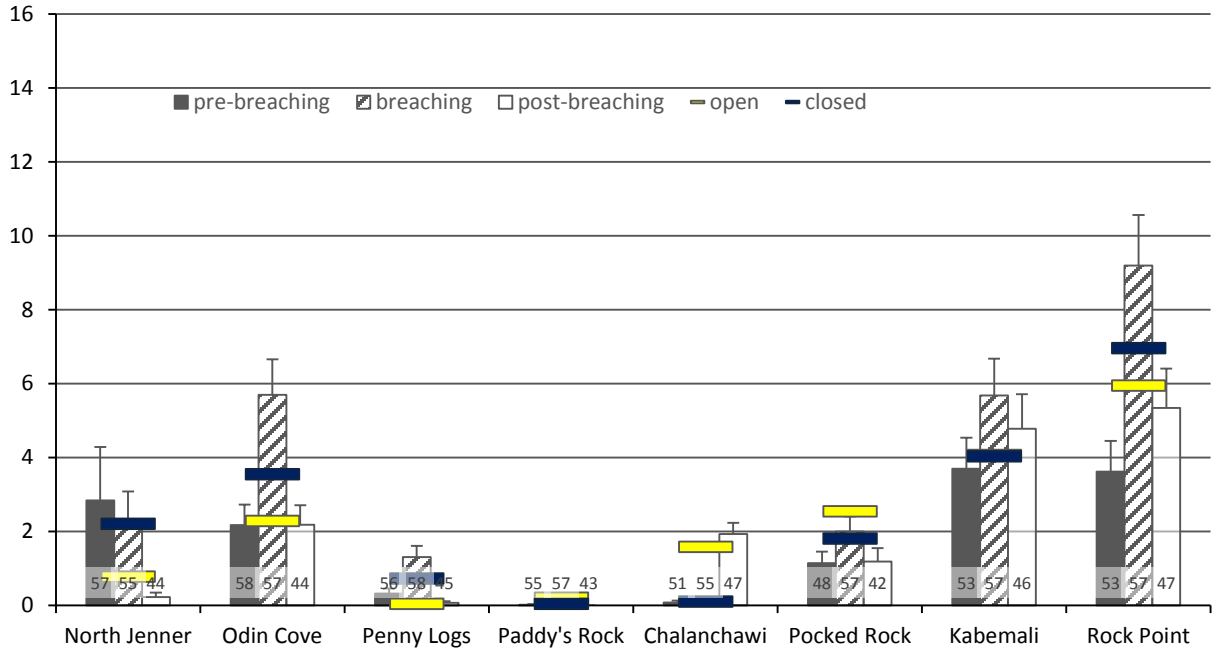


Figure 8. Average seal abundance at peripheral haul-outs as observed during pre-breaching, breaching and post-breaching surveys during 2010-2014 combined. Colored bars represent the average seal abundance during mouth open (yellow) and closed (blue) conditions for all surveys during 2010-2014. Error bars represent standard error and sample size used to calculate means are presented inside the bars.

Biological and Physical Monitoring

The NMFS IHA (2014) 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 2014 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 2) seals either had no reaction or raised their heads in alert as a boat passed. The most seals hauled out in the Estuary as observed by Water Agency field staff were six at Chalanchawi (middle reach), while the most seals observed in the lower reach was one at Penny Logs. Other disturbances resulting from monitoring of the biological resources and physical processes in the Estuary occurred at the Jenner haul-out. Only one of 24 fisheries seining and none of the 24 water quality monitoring events or 61 acoustic telemetry surveys conducted in the Estuary resulted in a disturbance to harbor seals (Table 4).

The Russian River Biological Opinion requires monthly topographic surveys of the barrier beach at the mouth of the Russian River. A Water Agency biologist was present during topographic surveys to monitor the seal response to the survey crew. With the exception of the harbor seal pupping season, when survey personnel will avoid the haul-out when neonates are present, between 53% and 100% of seals were flushed from their haul-out during the monthly mapping activities (Table 4).

Table 4. Number of pinnipeds disturbed as a result of Russian River Estuary Management and Monitoring Activities for 2014, 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-Jan	breaching	harbor seal	adult	80(65)	93%
16-Jan	topo survey	harbor seal	adult	54(34)	71%
30-Jan	breaching	harbor seal	adult	163(137)	83%
6-Feb	topo survey	harbor seal	adult	35(29)	54%
20-Feb	baseline[b]	harbor seal	adult	12(10)	5%
5-Mar	jetty study	harbor seal	adult	53(26)	7%
20-Mar	topo survey	harbor seal	adult	172(172)	100%
23-Mar	pre-breaching[c]	harbor seal	adult	2(1)	1%
24-Mar	breaching	harbor seal	adult	110(84)	69%
9-Apr	topo survey	harbor seal	adult	10(3)	1%
29-May	fish seining	harbor seal	adult	12(6)	26%
5-Jun	topo survey	harbor seal	adult	142(139)	77%
			pup	5(5)	
3-Jul	topo survey	harbor seal	adult	228(228)	53%
22-Jul	jetty study	harbor seal	adult	186(186)	60%
		elephant seal	juvenile	1(1)	100%[d]
29-Jul	jetty study	harbor seal	adult	33(18)	9%
6-Aug	topo survey	harbor seal	adult	169(163)	84%
		elephant seal	juvenile	1(0)	0%[d]
18-Sep	topo survey	harbor seal	adult	165(119)	100%
30-Sep	jetty study	harbor seal	adult	3(0)	0%
16-Oct	topo survey	harbor seal	adult	129(92)	100%
22-Oct	breaching	harbor seal	adult	47(28)	100%
14-Nov	pre-breaching[c]	harbor seal	adult	46(46)	100%
17-Nov	breaching	harbor seal	adult	103(69)	100%
26-Nov	breaching	harbor seal	adult	162(114)	81%
	2014 total	**harbor seal**	**adult**	**2,116(1,769)**	
			pup	**5(5)**	
		elephant seal	**juvenile**	**2(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.*
[b] *Disturbance was caused by Water Agency conducting annual plant survey on beach dunes south of jetty structure on Goat Rock State Beach.*
[c] *Disturbance was caused by Water Agency personnel posting warning signs on beach, prior to breaching activities.*
[d] *Percentage of seals flushed is for total number of elephant seals present on the beach.*

CONCLUSIONS

The water level management activities and biological and physical monitoring activities conducted by the Water Agency resulted in incidental harassment (Level B harassment) of 2,116 harbor seals and 2 juvenile elephant seals in 2014, well under the total allowed by NMFS IHA.

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

1. Under what conditions do pinnipeds haul out at the Russian River Estuary mouth at Jenner?

2. How do seals at the Jenner haul-out respond to activities associated with the construction and maintenance of the lagoon outlet channel and artificial breaching activities?

3. Does the number of seals at the Jenner haul-out significantly differ from historic averages with formation of a summer (May 15th to October 15th) lagoon in the Russian River Estuary?

4. Are seals at the Jenner haul-out displaced to nearby river and coastal haul-outs when the mouth remains closed in the summer?

Harbor seals are found at the mouth of the Russian River (Jenner haul-out) throughout the year. They are observed on the beach throughout the tidal cycle and at any time of day. Our baseline pinniped monitoring concluded that tidal state and time of day influenced harbor seal abundance at the Jenner haul-out, with seals less abundant in the early morning and at high tide (SCWA 2012). Harbor seals were most abundant on the Jenner haul-out in July during their annual molt (SCWA 2012), with these same trends being observed in subsequent years (SCWA 2013, 2014). Seasonal variation in the abundance of harbor seals at their haul-out locations is commonly observed throughout their range (Allen et al. 1989, Stewart and Yochem 1994, Gemmer 2002). The variation in their abundance can mostly be explained by changes in their biological and physiological requirements throughout the year. Peak seal abundance occurring in July during their molting season is likely a result of seals spending more time on land in order to help facilitate the molting process. This annual peak is typically followed by a decline in seal abundance which is likely a result of individual seals decreasing the amount of time on the haul-out post-molt to spend more time foraging and also coincides with the time that young seals may temporarily disperse from their natal haul-out (Stewart and Yochem, 1994, Thompson et al. 1994, Small et al. 2005). Most notable for 2014 was the increase in the number of seals observed during February, March and December. While it is difficult to speculate the reasons for these increases after just one year, it could be that it is a result of an overall increase in the number of harbor seals utilizing the Jenner haul-out as a resting area. We do not have the ability to determine if these increases are due to an increase in immigration to or a decrease in emigration from the haul-out.

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

Harbor seals will use the beach when there is an open channel or when a barrier beach has formed, however, the number of seals at Jenner was influenced by river mouth condition. Daily average seal abundance was lower during closed conditions compared to open conditions. This effect is also closely related to time of year, since most closures occur during the fall and winter, when seal abundance is low. While earlier results suggested there may have been a relationship between the level of disturbance and river mouth condition (SCWA 2013, 2014), we did not find evidence that there was a significant increase in the number of people near the haul-out or the number of disturbance events during mouth closed conditions.

The response of harbor seals at the Jenner haul-out to water level management activities in 2014 (Question 2 above) was similar to the responses observed in previous years of monitoring (Merritt Smith Consulting 1997, 1998, 1999, 2000; Sonoma County Water Agency and Merritt Smith Consulting 2001; SCWA 2011, 2012, 2013 and 2014). Harbor seals alerted to the sound of equipment on the beach and left the haul-out as the crew and equipment approached closer on the beach. When breaching activities were conducted south of the haul-out location seals often remained on the beach during all or some of the breaching activity. This indicates that seals are less disturbed by activities when equipment and crew do not pass directly past their haul-out.

Since the beginning of the modified estuary water level management procedures as a result of the NMFS 2008 Biological Opinion a lagoon outlet channel has only been implemented once (July 2010). While the Water Agency has not had further opportunity to implement and sustain an outlet channel, observations when a barrier beach has formed during the lagoon management period provide information as to how harbor seals respond when aquatic access between the estuary and the ocean is limited (Question 3 above). A barrier beach has formed during the lagoon management period thirteen times, the longest incidence lasting 29 days, with an average duration of ten days. While seal abundance was lower during closed conditions, overall there continues to be a slight increasing trend in seal abundance. These results indicate that while seal abundance may exhibit a short term decline during closed conditions it has not inhibited seals from using the Jenner haul-out during any period of the year. We conclude that the effect of barrier beach condition on seal abundance represents only a short term response, and is not an indication that seals are less likely to choose Jenner as a haul-out overall. We do not yet know how seals would respond to a maintained lagoon outlet channel.

As stated above we are unable to draw conclusions about the response of harbor seals to the implementation and maintenance of summer lagoon as outlined in the NMFS 2008 Biological Opinion. Results to date indicate that the peripheral haul-outs located in the Estuary are little used by seals, and even though access is limited by rising water level in the Estuary there is no effect of mouth condition on seal abundance at these sites. The coastal sites are regularly used by harbor seals, albeit in low numbers. Again, we found no effect of mouth condition in the abundance of seals at these peripheral haul-outs.

Harbor seals are generalists in many ways: including diet, resting locations and activity patterns. They are able to find refuge on sandy beaches, tidal mud flats and rocky shores (Allen et al. 1989, Gemmer 2002, Small et el. 2005). Seals exploit a wide range of locally abundant prey (Gemmer 2002, Hanson 1993, Tollit et al. 1997): they may forage during the day and come ashore at night, or forage at night and come ashore during the day, or even spend multiple days at sea (Small et al. 2005, Suryan and Harvey 1998, Yochem et al. 1987). Given that harbor seals exhibit this range of behaviors our ability to understand temporal changes in seal behavior and population abundance is limited by the use of periodic count data.

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Appendix A. Summary of pinniped monitoring activities at the Jenner haul-out (Goat Rock State Beach, Sonoma County) conducted by the Sonoma County Water Agency and Stewards of the Coast and Redwoods from January – December 2014 for the Russian River Estuary Management Project, including summary of pinniped abundance and Estuary water level.

			HASE adult			HASE neonates			HASE pups					
date	**activity**	**Estuary water level**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
1/1/2014	pre-breaching	--	51	50.5	1.01							2		
1/2/2014	breaching	5.11	70	29.6	6.56							14		
1/3/2014	post-breaching	1.65	199	165.4	5.46							17		
1/6/2014	baseline	1.11	173	127.1	9.47							18		
1/16/2014	topo survey	4.91	70	40.8	7.33							8		
1/28/2014	baseline/pre-breaching	--	77	66.5	3.69							17		
1/30/2014	breaching	7.99	157	57.9	13.04							16		
1/31/2014	post-breaching	--	261	192.8	13.93							18		
2/6/2014	topo survey	4.38	41	21.6	5.33							7		
2/10/2014	baseline	3.20	282	209.9	19.28							15		
2/20/2014	baseline	--	316	207.7	24.49							17	Y	
3/3/2014	jetty study	2.21	158	158.0								1		
3/5/2014	jetty study	3.12	381	215.7	26.59							21		
3/6/2014	baseline	2.92	424	352.1	12.37							18		
3/10/2014	jetty study	1.94	291	203.2	24.54							16		
3/11/2014	jetty study	2.32	242	147.1	22.95							16		
3/20/2014	topo survey	4.20	151	113.0	9.07							13		
3/23/2014	pre-breaching	8.44	81	71.2	2.20							13		
3/24/2014	breaching	9.38	101	53.1	6.59							15		
3/25/2014	baseline/post-breaching	1.41	229	126.9	17.17							17		
4/9/2014	topo survey	1.37	302	200.5	25.24	2	1.1	0.28	1	0.1	0.09	11		

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			HASE adult			HASE neonates			HASE pups					
date	**activity**	**estuary water level**	**Max**	**mean**	**s.e.**	**Max**	**mean**	**s.e.**	**Max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
4/29/2014	baseline	3.43	138	98.4	5.80	7	2.5	0.38	27	19.1	1.45	17		
5/8/2014	topo survey	5.79	105	88.6	3.62	3	2.4	0.18	20	15.6	0.78	8		
5/9/2014	baseline	1.88	197	164.8	5.89	2	0.4	0.18	16	10.6	0.53	16		
5/20/2014	baseline	1.39	110	99.6	2.04	0	0.0		25	16.3	1.01	17		
6/3/2014	baseline	--	141	124.4	2.78	0	0.0		9	7.6	0.22	16		
6/5/2014	topo survey	--	168	139.3	11.09	0	0.0		8	6.1	0.58	11		
6/20/2014	baseline	1.05	231	197.4	9.68	0	0.0		0	0		9		
7/3/2014	topo survey	1.48	355	293.3	15.44							8		
7/9/2014	baseline	1.72	405	373.5	4.16							17		
7/21/2014	jetty study	1.30	316	286.3	5.94							15		Y
7/22/2014	jetty study	1.31	283	190.4	18.15							8		Y
7/23/2014	jetty study	1.30	287	218.8	15.37							13		
7/24/2014	jetty study	1.29	336	264.2	9.99							12		Y
7/28/2014	baseline	1.19	212	151.8	13.86							16		
7/29/2014	jetty study	1.22	202	190.5	2.31							11		
8/6/2014	topo survey	--	154	93.7	13.06							13		Y
8/7/2014	baseline	--	188	148.4	6.80							17		
8/26/2014	baseline	1.42	204	119.8	7.80							18		
9/10/2014	baseline	1.73	129	52.8	8.40							17		
9/18/2014	topo survey	2.81	98	68.1	5.87							10		
9/19/2014	baseline	3.22	87	53.4	6.82							14		
9/30/2014	jetty study	3.01	83	12.6	6.34							17		
10/10/2014	baseline	6.73	63	22.1	7.60							11	Y?	
10/16/2014	topo survey	7.83	101	45.0	16.39							9		

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			HASE adult			HASE neonates			HASE pups					
date	**activity**	**estuary water level**	**Max**	**mean**	**s.e.**	**Max**	**mean**	**s.e.**	**Max**	**mean**	**s.e.**	**n**	**CASL present**	**NES present**
10/20/2014	baseline/pre-breaching	8.29	19	10.4	1.56							17		
10/22/2014	breaching	8.60	167	29.4	14.49							15		
10/23/2014	post-breaching	4.99	165	134.6	3.64							17		
11/5/2014	baseline	6.68	104	26.9	9.85							17		
11/14/2014	pre-breaching	7.54	47	35.4	1.94							18		
11/17/2014	breaching	7.88	70	18.1	7.94							15		
11/18/2014	post-breaching	2.36	108	85.8	3.83							17		
11/25/2014	baseline/pre-breaching	6.74	87	27.4	8.49							18		
11/26/2014	breaching/ topo survey	7.16	113	34.0	9.86							15		
11/28/2014	post-breaching	2.31	72	26.8	6.68							17		
12/9/2014	baseline	3.53	166	119.4	6.90							18		
12/17/2014	baseline	4.03	297	228.4	17.03							17		

[a] *For breaching events Estuary water level from time of breaching*
[b] *For all other events Estuary water level is average height for the day*
[c] *Only counts for sea lions on land, does not include sea lions observed in the water*
[d] *No water level management occurred during closure, barrier beach breached naturally*
[e] *Remote link to Jenner river gauge not working, data was recorded from gauge at beginning of pinniped monitoring*
[f] *Some data is missing for the day, including at time of breach, data reported is average of gauge height available for the day*
-- missing data