

Russian River Estuary Management Project

Marine Mammal Protection Act Incidental Harassment Authorization

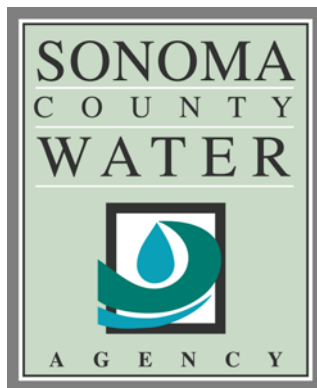
Report of Activities and Monitoring Results – April 2009 to December 31, 2011

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



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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 (issued April 20, 2011, original authorization dated March 30, 2010, 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. In February 2011 the Water Agency requested that NMFS issue a new IHA for the same activities and a subsequent IHA was issued on April 20, 2011. This report provides the results of all baseline monitoring and water level management activities since the beginning of pinniped monitoring activities in April 2009 to December 31, 2011.

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 (referred to hereafter as 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 haulout). California sea lions (*Zalophus californianus*) and northern elephant seals (*Mirounga angustirostris*) are occasionally observed at the haulout. There are also several known river haulouts 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 haulouts, including:

- excavation and maintenance of a lagoon outlet channel that would facilitate management of a barrier beach (closed sandbar) at the mouth of the Russian River and creation of a summer lagoon to improve rearing habitat for listed steelhead as mandated 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; and
- biological and geophysical monitoring activities associated with the management actions described above.

Monitoring was performed in accordance with the requirements of NMFS IHA issued April 20, 2011, 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 haulout and nearby coastal and river (peripheral) haulouts, several other haulouts on the coast and in the Russian River estuary were monitored. These haulouts included 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.

Two types of monitoring were performed: baseline and water level management activities. Baseline monitoring was performed to gather additional information regarding a possible relationship between tides, time of day, and the highest pinniped counts at the Jenner haulout and to gain a better understanding about which specific conditions harbor seals may prefer for hauling out at the mouth. Baseline monitoring of the peripheral haulouts was completed concurrently with the monitoring of the Jenner haulout. Pinniped use of the haulouts was also monitored in relation to Water Agency water level management events (lagoon outlet channel implementation and artificial breaching). Each of the peripheral haulouts was monitored concurrently with baseline and monitoring of water level management activities in the vicinity of the Jenner haulout.

In 2011 no water level management activities occurred. There was a short-term closure on September 24, 2011, which was followed by a perched outlet channel forming on September 26, and no beach management activities occurred. In 2010 one lagoon management event and two artificial breaching events occurred (SCWA 2011). Pinniped monitoring occurred the day before, the day of, and the day after each water level management activity. The NMFS IHA allowed 4,200 occurrences of incidental harassment during the lagoon management period and 258 occurred in 2010. In 2009 eleven artificial breaching events occurred. Pinniped monitoring occurred during each breaching event.

The Water Agency's Estuary 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 was present during these surveys to record any disturbances of the Jenner haulout during the survey. Additionally, Water Agency field staff conducting

biological and physical monitoring in the Estuary recorded any pinnipeds they encountered hauled out in the Estuary and any recorded disturbance to pinnipeds associated with their activities. The NMFS IHA allows 64 occurrences of incidental harassment and an estimated 32 occurred in 2010 and 42 occurred in 2011.

The Russian River Estuary Management and Monitoring Activities in 2011 resulted in incidental harassment (Level B harassment) of 42 marine mammals, well under the total allowed by NMFS IHA. The Russian River Estuary Management activities in 2010 resulted in incidental harassment (Level B harassment) of 290 marine mammals.

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 (issued April 20, 2011, original authorization dated March 30, 2010, NMFS IHA).

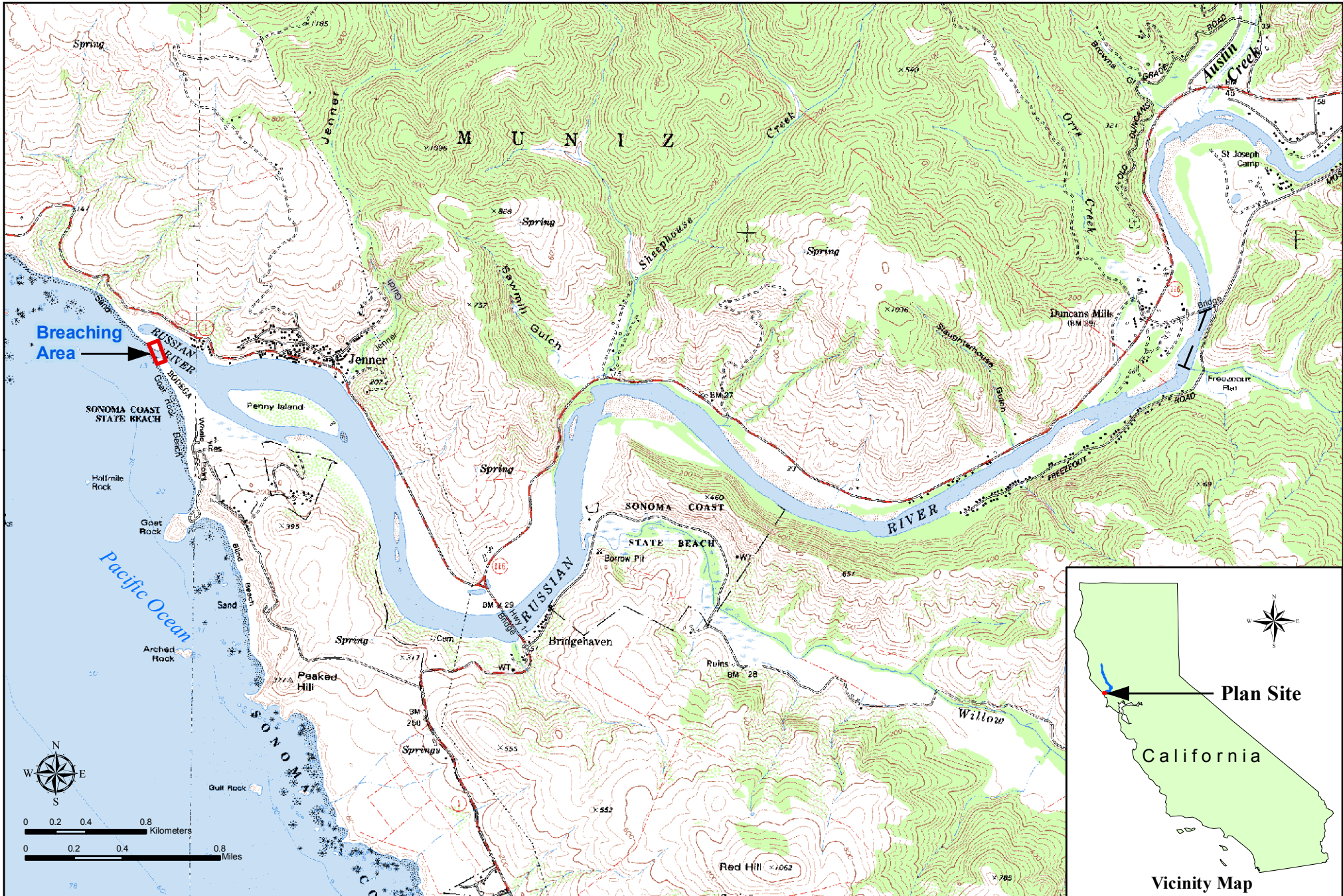
The Water Agency first applied in 2009 to the National Marine Fisheries Service (NMFS) Office of Protected Resources for an IHA under the Marine Mammal Protection Act (MMPA) for activities associated with water level management activities in the Russian River estuary (Estuary). NMFS issued an IHA to the Water Agency on March 30, 2010. In February 2011 the Water Agency requested that NMFS issue a new IHA for the same activities and a subsequent IHA was issued on April 20, 2011. This report provides the results of all baseline monitoring and water level management activities since the beginning of pinniped monitoring activities in April 2009 to December 31, 2011.

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.



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 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 historic 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) 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 (referred to hereafter as 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 haulout) (Figure 2). California sea lions (*Zalophus californianus*) and northern elephant seals (*Mirounga angustirostris*) are occasionally observed at the haulout. There are also several known river haulouts 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 barrier beach (closed sandbar) at the mouth of the Russian River and creation of a summer lagoon to improve rearing habitat for listed steelhead as mandated 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; and
- biological and geophysical monitoring activities associated with the management actions described above.



METHODS

Monitoring was performed in accordance with the requirements of NMFS IHA issued April 20, 2011 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 haulouts. The Stewards provide annual training for all volunteers, trainings occurred on March 10, 2010, and January 10, 2011. The training session was also attended by Water Agency biologists participating in the monitoring program. 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 haulout monitoring location.

In an attempt to understand possible relationships between use of the Jenner haulout and nearby coastal and river (peripheral) haulouts, several other haulouts on the coast and in the Russian River estuary were monitored (Figure 2). These haulouts included 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. These are known harbor seal haulouts that have been monitored by Joe Mortenson for the past 25 years.

Two types of monitoring were performed: baseline and water level management activities. Baseline monitoring of the Jenner haulout was shared by Water Agency biologists and Stewards volunteers (each group monitored once a month), with volunteers monitoring the peripheral haulouts for all baseline monitoring. The water level management activity monitoring at the Jenner haulout was also shared, but Water Agency biologists monitored lagoon outlet channel and artificial breaching activities on the day of the event. Pre- and post-management activity monitoring was shared by the organizations depending on the availability of volunteers and Water Agency staff. Stewards' volunteers monitored the peripheral haulouts during most of the pre- and post-management monitoring events.

Baseline (Jenner Haulout Use)

Baseline monitoring was performed to gather additional information regarding a possible relationship between tides, time of day, and the highest pinniped counts at the Jenner haulout and to gain a better understanding about which specific conditions harbor seals may prefer for hauling out at the mouth. Baseline monitoring of the peripheral haulouts was completed concurrently with the monitoring of the Jenner haulout. 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.

Pinnipeds at the Jenner and peripheral haulouts were counted twice monthly. This census began at local dawn and continued for 8 hours. All pinnipeds hauled out on the beach were counted every 30 minutes from the overlook on the bluff along Highway 1 adjacent to the Jenner haulout using binoculars or a

high-powered spotting scope. Depending on how the sandbar is formed, harbor seals may haul out in multiple groups at the Jenner haulout. 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. 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 by 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.

The peripheral haulouts 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 haulout using a high-powered spotting scope or binoculars.

In addition to the census data, disturbances of the haulouts 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 haulout, were recorded.

Table 1. Levels of pinniped response to disturbance used for Russian River Estuary Management Project pinniped monitoring.

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.		

Weather conditions were recorded at the beginning of each census. These included temperature, visibility, ocean conditions and wind speed (Beaufort scale). Tide levels and Estuary water surface elevations were correlated to each monitoring day.

Water Level Management Activities

Pinniped use of the haulouts was also monitored in relation to Water Agency water level management events (lagoon outlet channel implementation and artificial breaching). Each of the peripheral haulouts were monitored concurrently with monitoring of water level management activities in the vicinity of the Jenner haulout. This provided an opportunity to investigate if there was any correlation to water level management activities and the number of seals using these nearby coastal haulouts. As the exact movements of individual seals are not tracked, the number of seals displaced from the Jenner haulout to the peripheral haulouts cannot be quantified; however, potential trends may be observed. As there were no water level management activities in 2011, only Baseline monitoring described in the “Baseline (Jenner Haulout Use)” section above were performed in 2011. The methods for monitoring water levels management activities would have been as follows. 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 haulouts. Methods followed the census and disturbance monitoring protocols described in the “Baseline (Jenner Haulout Use)” section above.

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. Although not specified in the current NMFS IHA, a Water Agency biologist was present during topographic surveys to provide guidance to the survey crews on minimizing disturbance of the haulout and to observe pinniped response to the survey work in the vicinity of the Jenner haulout. Once survey crews approached a seal haulout the Water Agency monitor would notify the survey crew as soon as the seals became alert to their presence via radio, in an effort to minimize any disturbance.

Monitoring During Pupping Season

If any pup which was potentially abandoned was observed during monitoring, the Water Agency contacted the NMFS stranding response network (Marine Mammal Center in Sausalito, CA) immediately and also reported 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.

Additional Training

As there were no water level management activities in 2011, a worker training was not held in 2011. However, prior to each beach topographic survey beginning, the biologist monitoring the survey participated in the onsite tailgate safety meeting to discuss the location(s) of pinnipeds at the Jenner haulout that day and methods of avoiding and minimizing disturbances to the haulout as outlined in NMFS IHA.

RESULTS

The NMFS IHA (April 20, 2011) 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) haulout 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 haulout monitoring; and
- (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 2009 - 2011, including both baseline and water level management events.

Baseline (Jenner Haulout Use)

Beginning in July 2009 baseline monitoring of the Jenner and peripheral haulouts was performed two days out of each month with the intention of capturing a low and high tide each in the morning and afternoon. In 2009 baseline surveys were only conducted once per month in October, November and December due to the additional number of days monitoring was required for the artificial breaching events in these months. In January 2010 only one baseline survey was conducted due to the additional monitoring required for an artificial breaching event that occurred on January 11, 2010. Appendix A lists all pinniped monitoring activity.

Pups are born at the Jenner haulout beginning in March (with the earliest observations during Baseline monitoring occurring on March 25, 2010, and March 17, 2011) and continuing into May (with the latest observation of neonates occurring on May 27, 2010 and May 23, 2011). 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 2011.

Peak seal abundance occurred during the summer molting period (Figure 3). Peak seal abundance, as determined by the single greatest count of harbor seals at the Jenner haulout, was on July 23, 2009 (292 seals), July 19, 2010 (416 seals) and June 29, 2011 (329 seals) (Appendix A). Abundance of seals on the Jenner haulout varies with month (ANOVA (11, 916) $F = 101.5$, $p < 0.000$) with declines in the fall and early winter months when seals may spend more time off their haulouts foraging or travelling (Figure 4).

Overall, the abundance of harbor seals at the Jenner haulout across months was similar between years (Figure 5). Formation of a barrier beach resulting in closures of the Estuary likely contributed to declines in seal abundance during September and October of 2009 and January and October of 2010. Even though there were no water level management events during 2011, perched conditions and increased Estuary water levels (Appendix A) during September of 2011 likely contributed to lower than expected harbor seal abundance at Jenner.

To best illustrate the affect of tide, tidal cycles throughout the day were separated into six categories: high-high (highest of high tides in a single day), low-high (lowest of high tides in a single day), falling (period between a high and low tide), high-low (highest of low tides in a single day), low-low (lowest of low tides in a single day), and rising (period between a low and high tide). Pinnipeds using the Jenner haulout are subjected to increased wave over wash and reductions in available haulout space with rising ocean tides. Harbor seals have been observed hauled out at the mouth of the Russian river throughout the tide cycle. However, they are less abundant during the highest of high tides (ANOVA: $F(5, 922) = 22.4$, $p < 0.000$) (Figure 6).

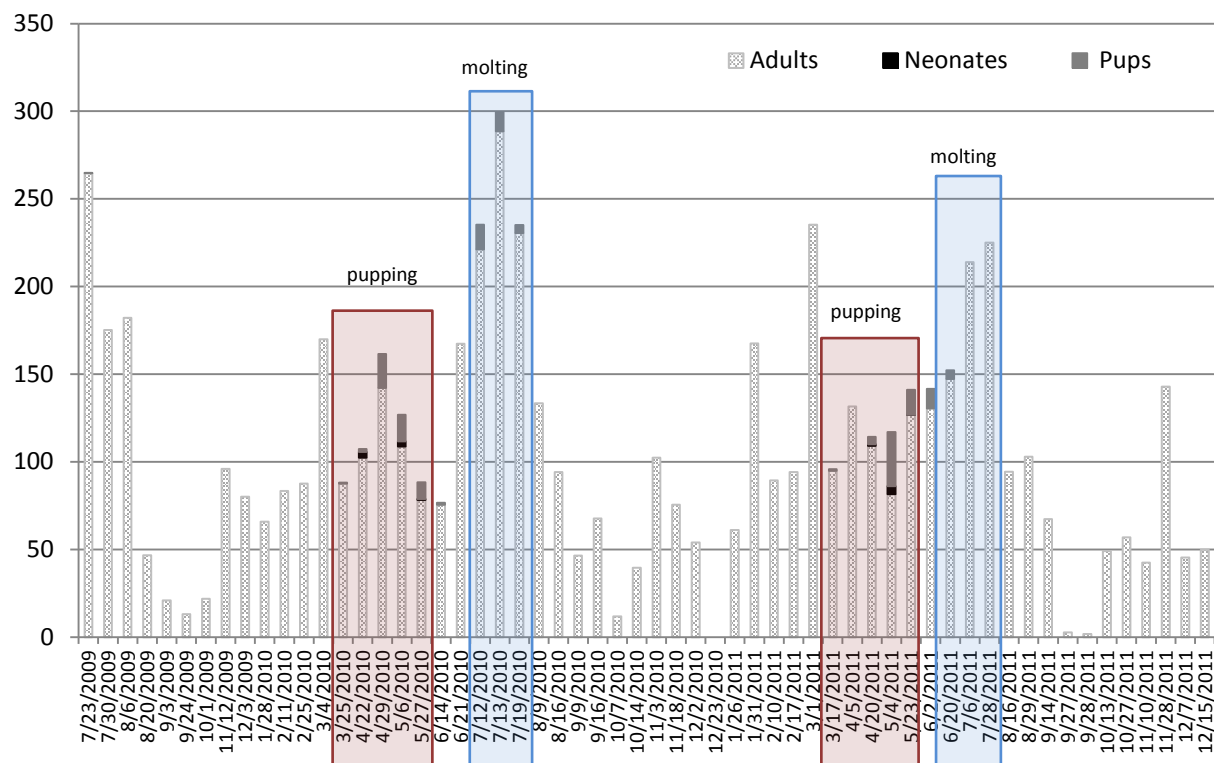


Figure 3. Mean number of harbor seals observed at the Jenner haulout (Russian River mouth at Goat Rock State Beach) during Russian River Estuary Management Project baseline pinniped monitoring from July 2009 to December 2011. Pups are counted separately through June, after which all seals are counted as adults as it becomes more difficult to accurately assess age.

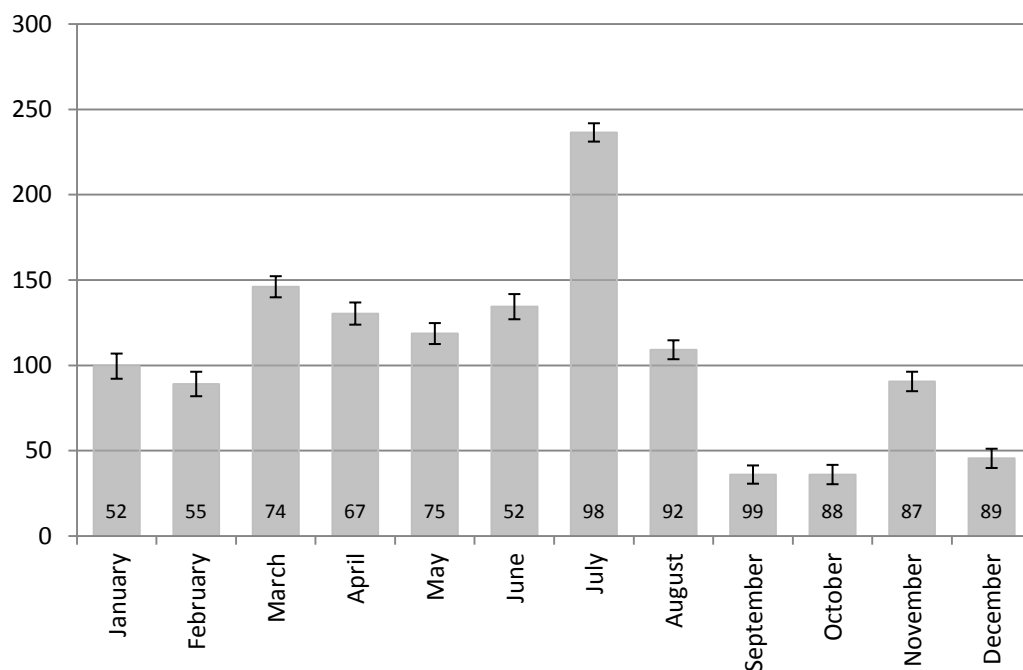


Figure 4. Mean number of harbor seals hauled out at the Jenner haulout (Russian River mouth at Goat Rock State Beach) as counted during baseline surveys from July 2009 – December 2011, categorized by month. Error bars represent +/- standard error and sample size used to calculate means are presented inside the bars.

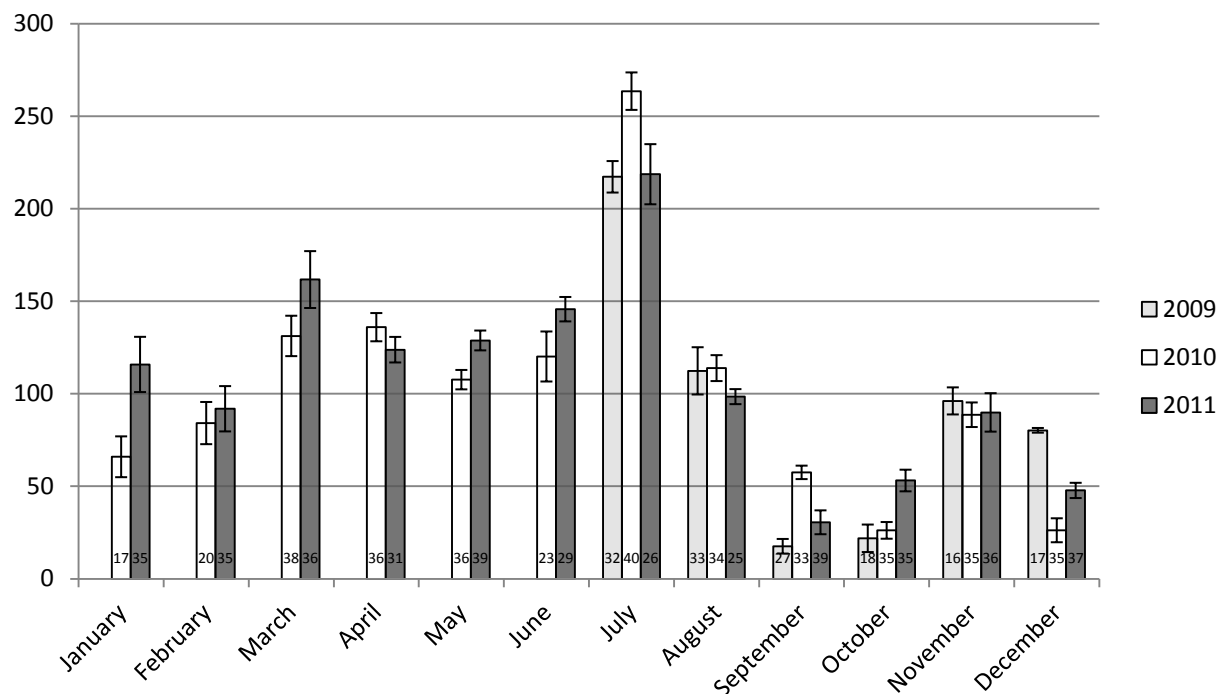


Figure 5. Mean number of harbor seals hauled out at the Jenner haulout (Russian River mouth at Goat Rock State Beach) as counted during baseline surveys for each year (2009 – 2011) categorized by month. Error bars represent +/- standard error and sample size used to calculate means are presented inside the bars.

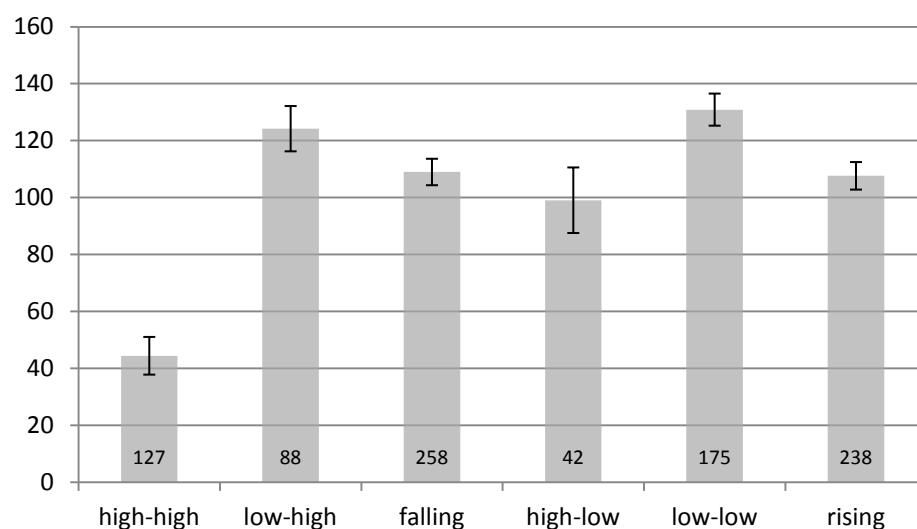


Figure 6. Mean number of harbor seals hauled out at the Jenner haulout (Russian River mouth at Goat Rock State Beach) as counted during baseline surveys from July 2009 – December 2011, categorized by tidal state. Error bars represent +/- standard error and sample size used to calculate means are presented inside the bars.

Time of day did effect the abundance of seals at the Jenner haulout (ANOVA: $F(10,917) = 4.6, p < 0.000$). Seals were more abundant in the afternoon hours compared to the morning hours. A few counts were conducted in the early morning hours (from 06:00 to 06:59) and the late afternoon hours (16:00-16:59) when seal abundance was relatively high (Figure 7). The early morning counts were conducted mostly in

July and August around the time of peak seal abundance. The late afternoon counts were mostly conducted in the winter months when seals may haul out in greater abundance after the ambient temperatures increase. In both cases too few counts were conducted at these hours for these results to reach statistical significance. This small variation in seal abundance across time is likely due to a number of factors including: seal daily activity patterns of resting and foraging, preference for hauling out when ambient temperature is higher and preference for hauling out when human interactions are less likely. More information about the activity patterns of individual seals would be helpful in determining the factors that influence seal abundance on the haulout.

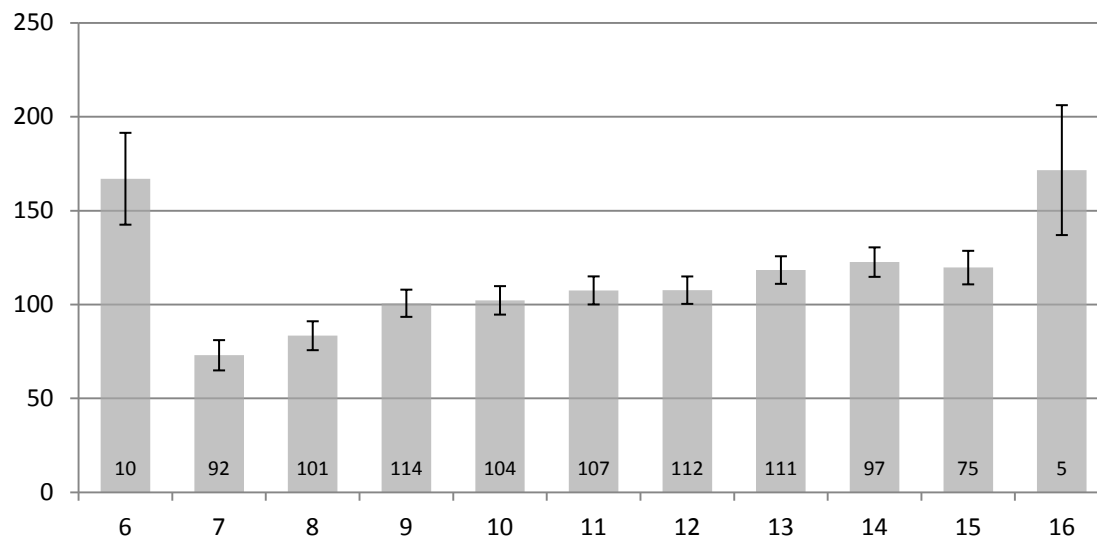


Figure 7. Mean number of harbor seals hauled out at the Jenner haulout (Russian River mouth at Goat Rock State Beach) as counted during baseline surveys from July 2009 – December 2011, categorized by hour. Error bars represent +/- standard error and sample size used to calculate means are presented inside the bars.

Water Level Management Activities

No water level management activities were conducted in 2011. There were 6 barrier beach formations (sandbar closures) at the mouth of the Russian River in 2010 (SCWA 2011). The February 2011 Report of Activities and Monitoring Results – April 1 to December 31, 2010 provides a detailed description of each of the water level management activities conducted in 2010 (SCWA 2011). For the breaching events in 2009 and 2010 harbor seals were less abundant at the Jenner haulout both before and during breaching activities, with abundance increasing the day following a breaching event (ANOVA: $F(2, 406) = 217.1$, $p < 0.000$) (Figure 8). During the single lagoon outlet implementation on July 8, 2010 harbor seals were more abundant both before and after the day of lagoon outlet implementation (ANOVA: $F(2, 42) = 15.5$, $p < 0.000$) (Figure 9). When a barrier beach forms and the river outlet to the ocean closes, harbor seals can only access their preferred haulout on the estuary side of the barrier beach by scooting across the sand. While harbor seals have been observed scooting across the sandbar, they prefer to remain at the water's edge when they haul out on land, more so than other local pinnipeds like California sea lions and northern elephant seals. Generally, seals are less abundant when the river outlet channel is closed in part due to this preference. Also, human interactions with the seals are increased during closures, since there is no natural barrier between beach goers and the harbor seals. These factors are less of an influence on harbor seals during their molting period when their drive to remain on land is high as observed during the closures that led to the lagoon outlet implementation in July of 2010.

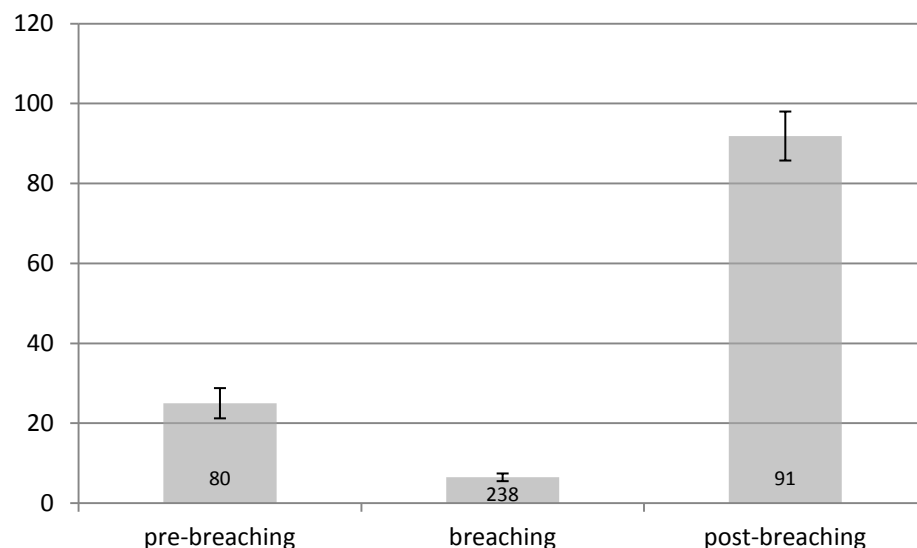


Figure 8. Mean number of harbor seals hauled out at the Jenner haulout (Russian River mouth at Goat Rock State Beach) as counted during pre-breaching (8 days), breaching (17 days) and post-breaching (8 days) monitoring conducted by the Water Agency in 2009 and 2010. No water level management activities occurred in 2011. Error bars represent +/- standard error and sample size used to calculate means are presented inside the bars.

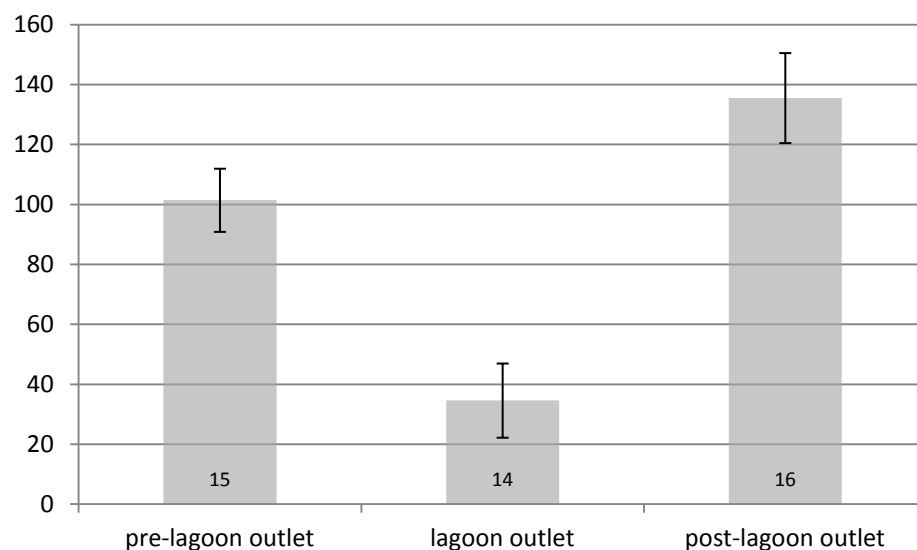


Figure 9. Mean number of harbor seals hauled out at the Jenner haulout (Russian River mouth at Goat Rock State Beach) as counted on July 7-9, 2010, during pre-lagoon outlet, lagoon outlet and post-lagoon outlet implementation monitoring respectively, conducted by the Water Agency. Error bars represent +/- standard error and sample size used to calculate means are presented inside the bars.

Biological and Physical Monitoring

The NMFS IHA (2011) also 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 2011 was calculated based on the number of animals that responded to disturbance by either moving or flushing. Alerts were also recorded by monitors, but are not included in

the number of incidental takes reported. All disturbances recorded were a result of field staff driving boats past the Estuary haulout at Chalanchawi (Figure 2). When seals were present at the haulout they either had no reaction or most often raised their heads in alert as the boat passed. On one occasion in May of 2011 three seals flushed from the haulout as the boat passed, clearing the haulout. The most seals hauled out in the middle reach of the Estuary as observed by Water Agency field staff were nine at Chalanchawi.

The Russian River Biological Opinion requires monthly topographic surveys of the sandbar at the mouth of the Russian River. Although not specified in the current NMFS IHA, a Water Agency biologist was present during topographic surveys to provide guidance to the survey crews on minimizing disturbance of the haulout and to observe pinniped response to the survey work in the vicinity of the Jenner haulout. While having a monitor present greatly minimized the disturbance of seals during the topographic surveys some incidence of take occurred in response to seals alerting at the presence of the survey crew. Of thirteen topographic surveys in 2011, seven surveys resulted in a total of 38 occurrences of incidental take of seals in the form of seals moving along the beach (22 seals) or flushing into the Estuary (16 seals). These numbers represent a small proportion of the total amount of seals on the haul out (range = 0.5% - 19.2%).

The estimated Level B Harassment (incidental take) of pinnipeds during Russian River Estuary biological and physical monitoring activities is summarized in Table 2. The IHA allows 64 occurrences of incidental harassment from monitoring activities and an estimated 42 occurred. In 2010 an estimated 32 occurrences of incidental take were reported from the Russian River Estuary biological and physical monitoring activities and monthly topographic surveys combined (SCWA 2011).

Table 2. Estimated number of disturbances of pinnipeds during Russian River Estuary Management Activities from 2009 to 2011. Disturbances reported here are pinnipeds moving on or flushing from their haulout.

Date	Event Type	Estimated Disturbance ^a		
		Species	Age Class	Number
24-Jun-09	pre-breach	harbor seal	adult	43(13)
25-Jun-09	artificial breaching	harbor seal	adult	54(40)
5-Oct-09	artificial breaching	harbor seal	adult	0
16-Oct-09	artificial breaching	harbor seal	adult	55(55)
26-Oct-09	artificial breaching	harbor seal	adult	88(53)
9-Nov-09	artificial breaching	harbor seal	adult	59(55)
10-Nov-09	artificial breaching	harbor seal	adult	38(38)
23-Nov-09	artificial breaching	harbor seal	adult	19(2)
24-Nov-09	artificial breaching	harbor seal	adult	14(14)
2-Dec-09	artificial breaching	harbor seal	adult	0
	2009 total	harbor seal	adult	370(270)
8-Jul-10	lagoon outlet implementation	harbor seal	adult	170(148)
30-Sep-10	artificial breaching	harbor seal	adult	42(42)
1-Oct-10	artificial breaching	harbor seal	adult	38(38)
11-Oct-10	artificial breaching	harbor seal	adult	5(5)
12-Oct-10	artificial breaching	harbor seal	adult	3(2)
14-Jun-10	Biological and physical monitoring in the Estuary	harbor seal	adult	5
30-Jun-10	beach topographic survey	harbor seal	adult	5
17-Nov-10	beach topographic survey	harbor seal	adult	22
	2010 total	harbor seal	adult	290(235)
12-Jan-11	beach topographic survey	harbor seal	adult	4
9-Mar-11	beach topographic survey	harbor seal	adult	12(1)
27-Apr-11	beach topographic survey	harbor seal	adult	1
18-May-11	Biological and physical monitoring in the Estuary	harbor seal	adult	4
18-Jul-11	beach topographic survey	harbor seal	adult	3(3)
19-Sep-11	beach topographic survey	harbor seal	adult	6(6)
16-Nov-11	beach topographic survey	harbor seal	adult	6(6)
14-Dec-11	beach topographic survey	harbor seal	adult	6
	2011 total	harbor seal	adult	42(16)

Peripheral Haulout Use

In addition to monitoring harbor seal abundance at the Jenner haulout, eight additional coastal and estuary haulouts were monitored. Most of these peripheral haulouts had very low seal abundance with three sites averaging less than one seal as observed during baseline surveys (Penny Logs = 0.5, Paddy's Rock = 0.4 and North Jenner = 0.3) and four sites averaging less than 3 seals as observed during baseline surveys (Chalanchawi = 1.4, Odin Cove = 1.9, Pocked Rock = 1.4 and Kabemali = 2.6). The southernmost rocky haulout included in our monitoring surveys, Rock Point, had the highest abundance of seals with a baseline average of 5.2. Seasonal variation was observed at a few of the peripheral haulouts with the monthly abundance patterns similar to those observed at the Jenner haulout, with higher abundance during the spring and summer months coinciding with pupping and molting respectively (Table 3). Seasonal variations among peripheral haulout use may become more evident as additional monitoring data are gathered over several years.

Table 3. Mean number of harbor seals by month hauled out at peripheral sites as observed during monitoring surveys conducted in 2009-2011.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
North Jenner	0.0	0.0	0.0	0.1	0.8	0.1	1.5	0.7	0.2	0.4	0.0	0.0
Odin Cove	0.9	1.2	0.0	2.8	1.7	0.1	6.4	1.1	1.6	3.1	0.9	0.8
Penny Logs	0.1	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.7	1.3	0.4	0.7
Paddy's Rock	1.1	0.2	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8
Chalanchawi	2.0	1.1	0.9	1.3	2.0	3.7	1.8	1.7	1.7	0.9	1.2	0.6
Pocked Rock	1.5	0.3	2.7	2.0	4.8	4.8	2.1	1.1	1.6	0.4	0.6	0.7
Kabemali	3.3	5.0	2.5	0.5	4.5	1.6	1.1	4.2	0.8	3.0	2.7	1.7
Rock Point	0.9	1.4	0.0	0.9	4.9	6.3	18.8	10.3	4.2	5.2	3.0	3.1

Mostly, the average number of seals observed during breaching activities at the peripheral sites was not different from the average number of seals observed during baseline surveys. This was true for North Jenner, Odin Cove, Paddy's Rock, Pocked Rock and Kabamali. Slightly more seals were observed at Penny Logs during breaching events (Figure 10) where at Chalanchawi and Rock Point fewer seals were observed during breaching events (Figures 11 and 12). The haulout at Chalanchawi does become submerged as river levels rise during closed mouth conditions, explaining the decrease in seal abundance for that site.

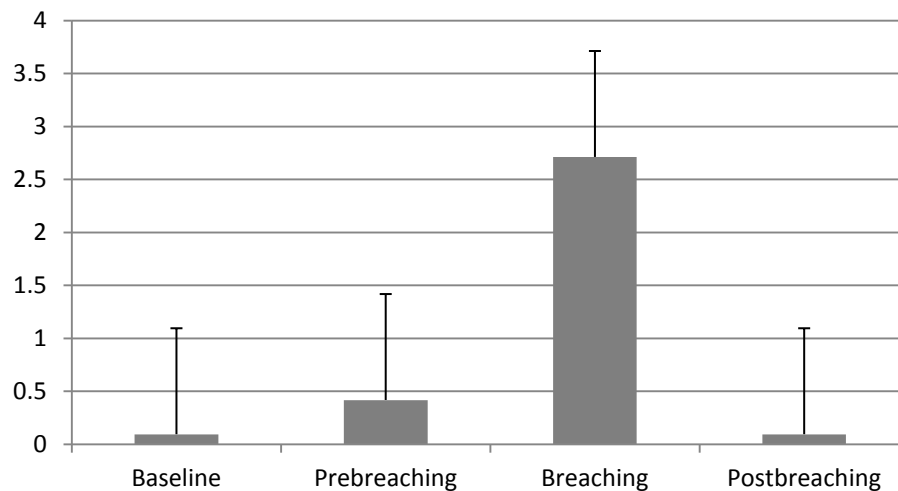


Figure 10. Mean number of harbor seals observed at Penny Logs as observed during baseline, pre-breaching, breaching and post-breaching monitoring in years 2009-2011. Error bars represent standard error.

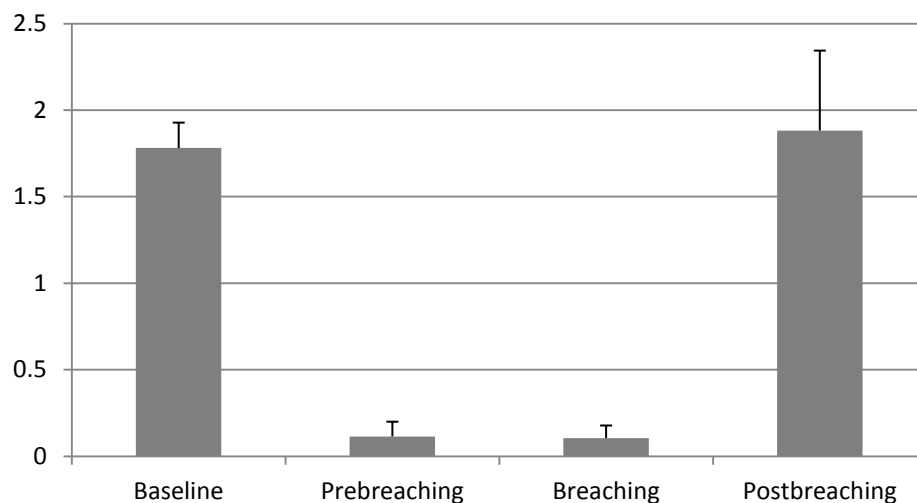


Figure 11. Mean number of harbor seals observed at Chalanchawi as observed during baseline, pre-breaching, breaching and post-breaching monitoring in years 2009-2011. Error bars represent standard error.

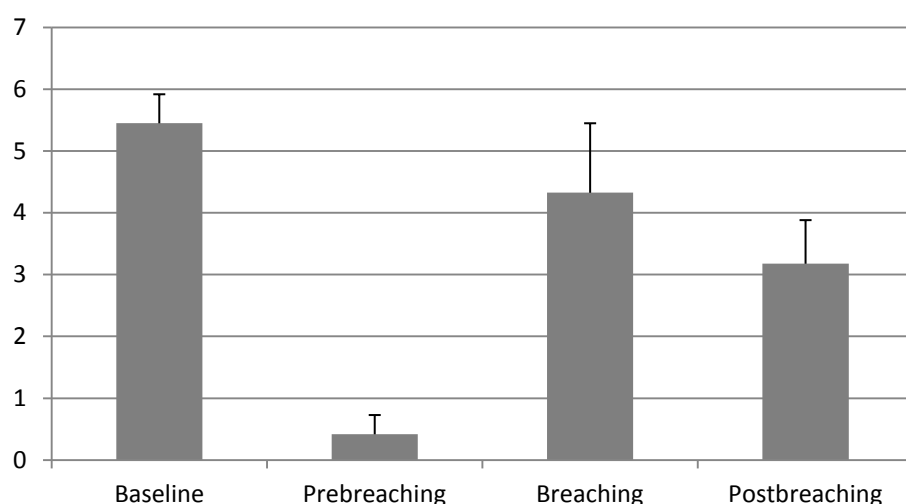


Figure 12. Mean number of harbor seals observed at Rock Point as observed during baseline, pre-breaching, breaching and post-breaching monitoring in years 2009-2011. Error bars represent standard error.

During the single lagoon outlet implementation in July 2010 high seal abundance was recorded at Rock Point (Figure 13) and Odin Cove (Figure 14). Seal abundance was little changed at Rock Point on the day after the lagoon outlet implementation, but decreased at Odin Cove. It is difficult to interpret these results as related to the formation of a seasonal lagoon in the Estuary since this event also coincided with the molting period where harbor seal haulout abundance is high. It is also unknown if these increases in seal abundance at the peripheral sites are a result of seals moving from the Jenner haulout during mouth closures or beach management activities since we are unable to track the movements of individual seals. However, looking at the combined pattern of seal abundance at Odin Cove and Jenner during and after lagoon outlet implementation does suggest that it is possible seals moved from the Jenner haulout when lagoon outlet implementation occurred and then returned the day after. Since the river mouth was closed again on the day after lagoon outlet implementation, this would not be merely a result of the mouth returning to an open condition, but more a response of seals to disturbance on their

haulout. This pattern was not observed at Rock Point, which is approximately 8 km south of the Jenner haulout and less likely to be a site of temporary refuge for seals during a disturbance event.

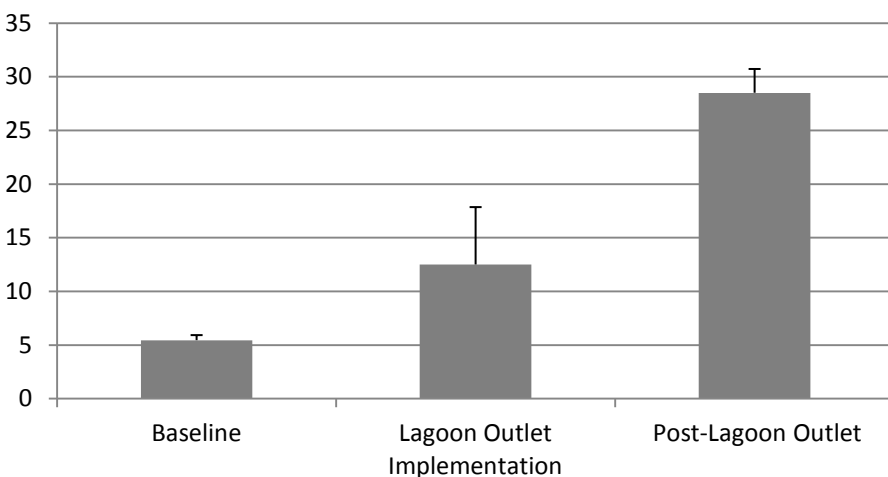


Figure 13. Mean number of harbor seals observed at Rock Point as observed during baseline, lagoon outlet implementation and post-lagoon outlet implementation monitoring. Error bars represent standard error.

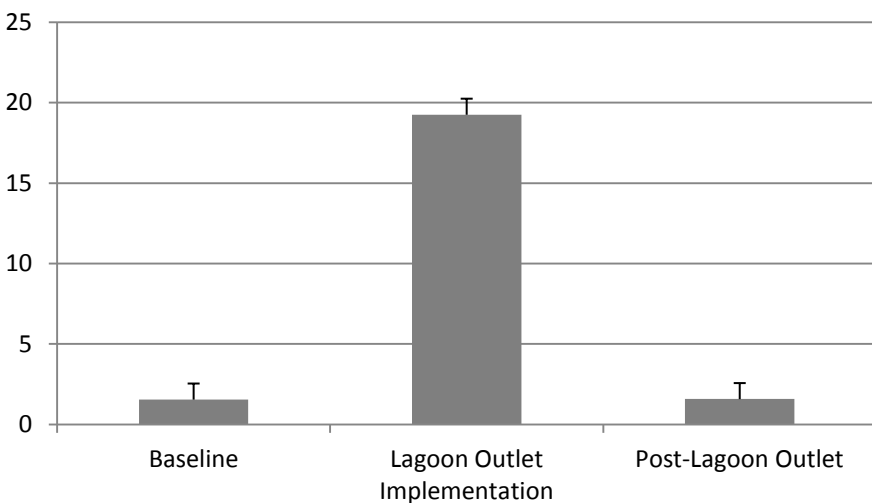


Figure 14. Mean number of harbor seals observed at Odin Cove as observed during baseline, lagoon outlet implementation and post-lagoon outlet implementation monitoring. Error bars represent standard error.

CONCLUSIONS

The biological and geophysical monitoring activities conducted by the Water Agency in 2011 resulted in incidental harassment (Level B harassment) of 42 marine mammals. There were no closures (formation of the barrier beach) at Goat Rock State Beach that resulted in any Russian River Estuary Management Activities during 2011. The Russian River Estuary Management Activities from April to December 2010 resulted in incidental harassment (Level B harassment) of 290 marine mammals, well under the total allowed by NMFS IHA (2011).

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 haulout 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 haulout 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 haulout displaced to nearby river and coastal haulouts when the mouth remains closed in the summer?

The baseline data collected since 2009 shows the highest number of pinnipeds observed at the Jenner haulout occurs in July, during the molting season (Figure 3). The baseline effort focused on understanding if time of year, tides, and time of day affected harbor seal abundance at the Jenner haulout. Harbor seals are found at the Jenner haulout throughout the year. Seasonal variation in the abundance of harbor seals at their haulout 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 then followed by a decline in seal abundance which is likely a result of individual seals decreasing the amount of time on the haulout post-molt to spend more time foraging and also coincides with the time that young of the year pups may disperse from their natal haulout. Overall, seals utilize the Jenner haulout throughout the tidal cycle. Their abundance is significantly lower during the highest of tides when the haulout is smaller and subjected to an increase in wave over wash. Time of day did have some affect on seal abundance at the Jenner haulout. Seal abundance was greater in the afternoon hours compared to the morning hours. This could be due to individual attendance patterns possibly related to foraging, ambient temperature and human interactions. More analysis exploring the relationship of ambient temperature, incidence of disturbance and season on time of day effects would help to explain why these variations in seal abundance occur. It is likely a combination of multiple factors (e.g. season, tides, wave heights, level of beach disturbance) that influence when the haulout is most utilized.

The Water Agency implemented the lagoon outlet channel in a single event on July 8, 2010. The response of harbor seals at the Jenner haulout to the outlet channel implementation activities (Question 2 above) was similar to the responses observed during artificial breaching events in 2010 and in previous years of monitoring the Jenner haulout during breaching events (Merritt Smith Consulting 1997, 1998, 1999, 2000; Sonoma County Water Agency and Merritt Smith Consulting 2001). The harbor seals alerted to the sound of equipment on the beach and left the haulout as the crew and equipment approached closer on the beach. Harbor seals hauled out on the beach while equipment was operating, left the beach when equipment and staff were leaving the beach, and began to return to the haulout within 30 minutes to 3 hours of the work ending. Because the barrier beach reformed soon after outlet channel implementation and subsequently breached on its own, maintenance of the outlet channel was not

necessary and the response of pinnipeds at the Jenner haulout to maintenance of the outlet channel and management of the lagoon for the duration of the lagoon management period was not possible in 2010. For the same reason, Question 3 above cannot be definitively answered as the duration of closure associated with the lagoon outlet channel implementation was not dissimilar from the duration of closure that have been previously observed at the Estuary.

Responding to Question 4 is also difficult due to the lack of extended lagoon conditions in 2010. However, initial comparisons of peripheral (river and coastal) haulout baseline and water level management activity count data to the Jenner haulout counts suggest that further information from subsequent Estuary management activities are needed. For example, during the single lagoon outlet implementation in July of 2010 low seal abundance was recorded at Jenner and high seal abundance was recorded at Odin Cove. On the day after the lagoon outlet implementation seal abundance rose at Jenner and decreased at Odin Cove. This pattern is consistent with the idea that seals disturbed from the Jenner haulout would temporarily relocate to a nearby haulout. However, these results are inconclusive since we are not able to track the movements of individual seals.

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 haulouts in and around the Russian River estuary. M. Luna, J. Mortenson, D. Dekelaita and A. Cresswell provided the training and support that made the monitoring effort possible. Special thanks to the volunteers that provided their time and keen observations to monitoring pinnipeds: B. Bambrick, D. Barth, J. Cross, C. Duncan, C. Else, C. Farnes, L. Fisher, K. Ludwig, T. Macaluso, B. Madrone, R. Muszynski, K. O'Conner, T. Pohlmann, A. Southwick, T. Watts, J. Wilson and T. York.

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Appendix A. Summary of pinniped monitoring activities conducted by the Sonoma County Water Agency and Stewards of the Coast and Redwoods from April 2009 – December 2011, including summary of pinniped abundance and Estuary water level.

date	activity	estuary water level ^{a,b} (ft)	HASE adults			HASE neonates			HASE pups			n	CASL present ^c	NES present
			max	mean	s.e.	max	mean	s.e.	max	mean	s.e.			
4/16/2009	pre-breach (bar naturally breached)	5.8	104	68.0	12.78	0	0.0		5	4.0	0.27	8		
6/24/2009	pre-breach	6.2	110	91.0	3.87	0	0.0		0	0.0		9		
6/25/2009	breach	6.4	60	6.4	2.16	0	0.0		9	0.5	0.37	27		Y
6/26/2009	post-breach	1.7	246	237.4	2.28	0	0.0		0	0.0		8		
7/23/2009	baseline	1.0	289	264.7	3.64	0	0.0		3	0.2	0.20	15		
7/30/2009	baseline	-	204	175.2	4.29	0	0.0		0	0.0		17		
8/6/2009	baseline	-	228	182.1	7.48							16	Y	
8/20/2009	baseline	1.2	81	46.7	5.28							17		
9/3/2009	baseline	-	53	21.1	5.79							15		
9/24/2009	baseline	6.3*	44	13.3	5.15							12	Y ^c	
10/1/2009	baseline	7.0*	68	21.9	7.43							18		
10/4/2009	pre-breach	7.2	20	13.2	1.29	0	0.0		0	0.0		13	Y ^c	
10/5/2009	breach	7.3	61	13.2	5.76	0	0.0		0	0.0		18	Y ^c	
10/6/2009	post-breach	1.9	110	95.5	3.95	0	0.0		0	0.0		13		
10/16/2009	breach	7.7	54	35.0	8.84	0	0.0		8	4.8	1.54	6		
10/26/2009	breach	6.8	53	10.8	4.59	0	0.0		0	0.0		19		
10/27/2009	post-breach	2.1	122	108.5	2.88	0	0.0		0	0.0		16		
11/9/2009	breach	7.6	46	8.5	3.87	0	0.0		0	0.0		17		
11/10/2009	breach	8.1	26	6.5	3.12	0	0.0		12	2.1	1.19	11		
11/12/2009	baseline	1.3	131	96.1	7.32							16		
11/23/2009	breach	6.9	12	1.8	0.98	0	0.0		2	0.3	0.18	12		
11/24/2009	breach	7.5	12	1.8	1.18							10		
11/25/2009	post-breach	1.9*	95	86.2	2.32							11		
12/1/2009	breach	7.3	7	0.4	0.37							19		
12/2/2009	post-breach	7.5	29	22.3	1.38							11		

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			HASE adults			HASE neonates			HASE pups					
date	activity	estuary water level ^{a,b} (ft)	max	mean	s.e.	max	mean	s.e.	max	mean	s.e.	n	CASL present ^c	NES present
12/3/2009	baseline	1.9	89	80.2	1.27							17		
12/13/2009	breach	9.0	0	0.0								6		
12/14/2009	post-breach	2.8*	42	35.1	1.06							11		
12/22/2009	pre-breach	6.7	0	0.0								11		
12/23/2009	breach	8.2	0	0.0								7		
12/27/2009	pre-breach	7.8	10	1.2	0.92							11		
12/28/2009	breach	9.1	2	0.2	0.17							12		
1/11/2010	breach	7.5	1	0.2	0.15	0	0.0		0	0.0		9		
1/28/2010	baseline	1.7*	116	65.9	11.03	0	0.0		0	0.0		17		
2/11/2010	baseline	-	147	83.5	11.60	0	0.0		0	0.0		17		
2/25/2011	baseline	3.2	156	87.7	46.06	0	0.0		0	0.0		3		
3/4/2010	baseline	3.1*	230	170.0	14.19	0	0.0		0	0.0		20		
3/25/2010	baseline	2.5*	125	87.6	9.43	0	0.0		1	0.7	0.11	18		
4/22/2010	baseline	1.6	142	102.4	8.43	5	3.4	0.19	4	1.6	0.28	17		
4/29/2010	baseline	2.3	177	142.3	7.74	0	0.0		31	19.3	1.35	19		
5/6/2010	baseline	0.7	136	108.7	5.33	5	3.1	0.38	23	15.1	0.95	18		
5/27/2010	baseline	2.8*	102	78.3	5.31	1	0.5	0.12	16	9.5	0.89	18		
6/14/2010	baseline	1.8	117	75.6	14.42	0	0.0		7	1.2	0.59	12		
6/21/2010	baseline	1.7	202	167.5	12.56	0	0.0		0	0.0		11		
6/30/2010	topo survey	4.1	203	179.7	5.75	0	0.0		2	1.3	0.21	6		
7/1/2010	topo survey	3.8	159	140.4	7.70	0	0.0		0	0.0		5		
7/7/2010	pre-lagoon outlet channel	5.1	175	101.4	10.54	0	0.0		0	0.0		15		
7/8/2010	lagoon outlet channel	5.6	135	33.4	12.03	0	0.0		8	1.5	0.68	14		
7/9/2010	post-lagoon outlet channel	4.8	208	135.5	15.02	0	0.0		0	0.0		16		
7/12/2010	baseline	2.5*	270	221.3	24.87	0	0.0		15	14.0	1.00	4		
7/13/2010	baseline	-	323	288.6	5.28	0	0.0		12	11.0	0.58	21		

Appendix A. Summary of pinniped monitoring activities conducted by the Sonoma County Water Agency and Stewards of the Coast and Redwoods from April 2009 – December 2011, including summary of pinniped abundance and Estuary water level.

			HASE adults			HASE neonates			HASE pups					
date	activity	estuary water level ^{a,b} (ft)	max	mean	s.e.	max	mean	s.e.	max	mean	s.e.	n	CASL present ^c	NES present
7/19/2010	baseline	0.9	410	230.6	22.85	0	0.0		6	4.5	0.40	15		
8/3/2010	topo survey	1.0	237	210.5	4.33	0	0.0		0	0.0		15		
8/9/2010	baseline	1.2	171	133.4	6.74							17		
8/16/2010	baseline	0.8	162	94.3	10.44							17		
9/7/2010	topo survey	1.9	80	74.1	1.48							8		
9/9/2010	baseline	0.4*	60	46.6	1.29							16		
9/16/2010	baseline	0.9	103	67.8	5.99							17		
9/27/2010	pre-breach	5.9	25	19.3	3.22							4		
9/29/2010	pre-breach	6.4	28	27.5	0.29							4		
9/30/2010	breach	7.1	10	6.6	1.72							5		
10/1/2010	breach	7.7	41	9.6	4.05							17		
10/2/2010	post-breach	2.2	129	111.6	8.63							11		
10/7/2010	baseline	5.1*	42	11.8	3.60							17		
10/10/2010	pre-breach	6.1	37	11.7	3.35							20		
10/11/2010	breach	6.6	11	4.1	1.66	1	0.5	0.50	0	0.0		9		
10/12/2010	breach	6.9	55	5.0	4.55							12		
10/13/2010	post-breach	1.3	119	67.6	15.13							10		
10/14/2010	baseline	1.2	116	39.7	6.73							18		
10/20/2010	topo survey	2.0	25	6.6	3.18							8		
11/3/2010	baseline	3.2	142	102.4	9.86							17		
11/17/2010	topo survey	2.4*	109	59.6	13.30							7		
11/18/2010	baseline	2.6	120	75.7	8.04							18		
12/2/2010	baseline	2.0	88	54.0	9.47							17		
12/23/2010	baseline	2.1	0	0.0								18		
1/12/2011	topo survey	1.2	149	115.2	8.98	0	0.0		0	0.0		9		
1/26/2011	baseline	2.6*	116	61.1	11.66	0	0.0		0	0.0		17	Y	

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			HASE adults			HASE neonates			HASE pups					
date	activity	estuary water level ^{a,b} (ft)	max	mean	s.e.	max	mean	s.e.	max	mean	s.e.	n	CASL present ^c	NES present
1/31/2011	baseline	3.0*	242	167.5	20.54	0	0.0		0	0.0		18		
2/10/2011	baseline	-	156	89.5	14.57	0	0.0		0	0.0		17		
2/14/2011	topo survey	-	2	1.0	1.00	0	0.0		0	0.0		2		
2/17/2011	baseline	-	196	94.2	19.83	0	0.0		0	0.0		18		
3/1/2011	baseline	1.1	276	235.4	13.34	0	0.0		0	0.0		17		
3/9/2011	topo survey	0.9	233	196.4	11.77	0	0.0		0	0.0		10		
3/17/2011	baseline	-	190	94.9	14.75	0	0.0		8	0.9	0.51	19		
4/5/2011	baseline	1.0	179	131.6	10.30	0	0.0		0	0.0		17		
4/20/2011	baseline	1.6	137	109.1	8.21	2	1.0	0.18	7	4.2	0.59	14		
4/27/2011	topo survey	-	204	167.5	9.28	4	2.3	0.41	24	18.1	0.94	11		
5/4/2011	baseline	-	134	81.7	6.96	10	4.4	0.54	43	31.0	1.90	20		
5/23/2011	baseline	0.6	155	126.8	4.88	1	0.1	0.05	19	14.3	0.81	19		
5/31/2011	topo survey	0.1	147	132.0	4.04	0	0.0		0	0.0		10		
6/2/2011	baseline	0.8	173	130.5	4.66	0	0.0		18	11.2	0.91	18		
6/20/2011	baseline	1.0	223	147.4	15.18	0	0.0		9	4.8	0.89	11		
6/23/2011	topo survey	0.5*	194	139.8	14.44	0	0.0		8	2.7	0.89	11		
6/29/2011	topo survey	0.8	322	227.4	35.12	0	0.0		7	4.2	0.83	11		
7/6/2011	baseline	0.8	290	213.9	28.35	0	0.0		0	0.0		15		
7/18/2011	topo survey	0.6	320	260.9	12.62	0	0.0		0	0.0		10		
7/28/2011	baseline	0.8	245	225.1	4.29	0	0.0		0	0.0		11		
8/15/2011	topo survey	-	95	76.8	3.46	0	0.0		0	0.0		11		
8/16/2011	baseline	-	122	94.3	3.70							13		
8/29/2011	baseline	-	148	102.9	7.43							12		
9/14/2011	baseline	1.4	121	67.4	8.65							17		
9/19/2011	topo survey	1.2	62	45.5	4.27							8		
9/27/2011	baseline	4.4*	11	2.8	2.75							4		

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			HASE adults			HASE neonates			HASE pups					
date	activity	estuary water level ^{a,b} (ft)	max	mean	s.e.	max	mean	s.e.	max	mean	s.e.	n	CASL present ^c	NES present
9/28/2011	baseline	4.6*	14	1.9	1.07							18		
10/13/2011	baseline	5.2	86	49.1	6.10							17		
10/19/2011	topo survey	1.4	106	97.9	2.30							7		
10/27/2011	baseline	1.4*	130	56.9	9.91							18		
11/10/2011	baseline	1.8	104	42.5	9.09							19		
11/16/2011	topo survey	1.1	94	85.5	1.86							8		
11/28/2011	baseline	1.8	186	142.9	8.02							17		
12/7/2011	baseline	0.9*	85	45.4	7.96							18	Y	
12/14/2011	topo survey	2.6	117	99.7	5.57							9		
12/15/2011	baseline	2.6	63	49.9	2.96							19		

^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 California sea lions observed on Paddy's Rock haulout in Estuary

* some estuary water level values from the day are missing

-- missing data