

**NOAA ARRA Tidal Marsh
Restoration Project
San Francisco Bay Estuary:**

**South Bay Fish Acoustic Tagging
and Monitoring Study**

**DU Project Number
US-CA-446-5**



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INTRODUCTION

South San Francisco Bay (south of the Bay Bridge and San Francisco waterfront) historically supported large salmonid populations, including Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*) populations, as well as green sturgeon (*Acipenser medirostris*) and white sturgeon (*A. transmontanus*). Little is known about current species abundance, richness, or distribution. However, the large-scale restoration of thousands of acres of diked and undeveloped baylands yields unprecedented opportunities to bolster populations and habitat of these trust species.

In 2003, Cargill, Inc. sold 15,100 acres of salt production ponds to the US Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW); which became known as the South Bay Salt Ponds Restoration Project (SBSP). Implementation has been completed in phases, with the Island ponds (A19, A20, and A21), Alviso ponds (A6 and A8), and Eden Landing Ponds (E8a, E8x, and E9) among the Phase 1 projects (Figure 1). The first phase of SBSP restoration actions started in 2008 and is expected to be completed in 2013. The recently restored tidal habitats of the SBSP Project are already beginning to provide salt marsh, intertidal mudflat, and channel microhabitats within the floodplain of South San Francisco Bay (South Bay), including Alviso Slough, Coyote Creek, Mt. Eden Creek, Coyote Hills Slough, and Alameda Creek.

To improve understanding of salmonid and sturgeon use of South Bay habitats, in general, and of newly restored former salt ponds and tidal sloughs, acoustic tag receivers were deployed across South Bay along the alignment of the Dumbarton Railroad Bridge (DRRB), and in strategic locations within recently-breached salt ponds and surrounding sloughs in the Alviso area during 2011. Additional receivers were deployed throughout the Eden Landing Area (Mt. Eden Creek, Alameda Creek and Coyote Hills Slough) in December 2012. These receivers were deployed to detect previously-tagged fish species that were tagged and released in the Sacramento River and Sacramento-San Joaquin River Delta (Delta) by various investigators. No fish were tagged as part of this project. The findings of the first year of effort were published under separate cover (ECORP Consulting, Inc. 2011). This final report presents the data

collected during the approximately two years of study (2010 – 2013), including an analysis of all two years of data.

Background

ECORP Consulting, Inc. (ECORP) was contracted with Ducks Unlimited (DU), as agent to the National Oceanic and Atmospheric Administration (NOAA), since receiving the award for conducting the *Fish Acoustic Tagging and Monitoring Study* at the Napa Plant Site adjacent to the Napa River, Solano County, California. Please refer to ECORP 2011 and ECORP 2013 for a detailed description of responsibilities, duties and results from the Napa River companion project. This award was then expanded in 2011 to include the South Bay with NOAA funds made available through the State Coastal Conservancy. This report covers the project activities covered under the award from the Conservancy.

The current project focuses on detecting Central Valley ESU (CV) steelhead, CV late-fall run Chinook salmon, Southern Distinct Population Segment (DPS) green sturgeon, white sturgeon, and striped bass (*Morone saxatilis*) in recently restored tidal marsh habitat (SBSP Restoration Project) in the South Bay, that have been and are being tagged and released into the Sacramento River, its tributaries, and Delta by numerous collaborating fish scientists working with the U.S. Army Corps of Engineers, San Francisco District (USACE), USFWS, CDFW, US Geologic Survey (USGS), NOAA Fisheries (Santa Cruz Laboratory), East Bay Municipal Utilities District (EBMUD), California Department of Water Resources (DWR), UC Davis Biotelemetry Laboratory, DU and ECORP, and many local watershed-specific entities, which collectively form the California Fish Tagging Consortium (CFTC). Additionally, both juvenile and adult green sturgeon have been tagged over the past several years, and continue to be tagged along the west coast from the Columbia River to the San Francisco Bay and Delta. As such, they are potentially vulnerable to being detected during the current effort. More information regarding the efforts of the CFTC investigations, equipment (VEMCO® receivers and tags), receiver deployment, tag detection studies, quality assurance/quality control (QA/QC), and a listing of then-proposed receiver locations is available in the Study Design (USACE 2009), and in a series of annual reports produced by the USACE Long-Term Management Strategy (LTMS) Science

Work Group; the most current of which was entitled *Salmonid smolt outmigration and distribution in the San Francisco Estuary 2010. Interim Draft Report* (USACE 2012).

Several hundred hatchery-raised late-fall run Chinook salmon and steelhead were tagged from December 2010 through July 2011, and from December 2011 through July 2012 with acoustic tags by CFTC investigators. Most late-fall run Chinook salmon and steelhead were collected from the Coleman National Fish Hatchery, tagged and released at various locations from the confluence of Battle Creek with the Sacramento River to the City of Sacramento, and in various locations within the Delta. Additionally, wild Napa River steelhead (central coast ESU, CC), collected via rotary screw trap (RST), were tagged and released about 33 km upstream from the mouth of the Napa River (Mare Island Strait) between March and April of 2010, 2011 and 2012 (ECORP 2013). Further, several investigators associated with UC Davis have been tagging and releasing both green and white sturgeon throughout the Delta during the past few years, and numerous striped bass were tagged and released in the Delta by DWR investigators in 2010 and 2011.

A large-scale array of VEMCO® acoustic receivers was installed from the upper reaches of the Sacramento River, throughout the Delta, Suisun Bay, San Pablo Bay, and Central San Francisco Bay, to the Golden Gate Bridge (over 400 receivers), including an offshore array at Pt. Reyes (15 receivers) by the USACE LTMS and associated investigators with the CFTC. The current project is the first and only project to deploy VEMCO® receivers in South Bay to take advantage of the current tagging programs in the North Bay, with the objective of delineating the movement of Sacramento River salmon, steelhead, and green and white sturgeon through the San Francisco Bay and Delta, and into the South Bay, as well as to provide information on the residency of those species.

Objectives and Purpose

The primary objective of the Project is to improve knowledge of fish movement within the South Bay of the San Francisco Estuary. In essence, the purpose of this project was to supplement the tagging programs occurring in the North Bay, Delta and Sacramento River, and to monitor the occurrence of those previously-tagged fish in restored salt pond habitat of the SBSP

Projects in South Bay. Test fish species include juvenile late-fall run Chinook salmon, steelhead, white sturgeon and green sturgeon that had been tagged and released CFTC investigators.

The study plan includes the strategic deployment of VEMCO® acoustic receivers in 1) the vicinity of Alviso Slough and Eden Landing restored salt ponds, and 2) a gate array over the entire South Bay near the Hwy 84 Dumbarton Bridge (specifically, along the defunct Dumbarton Railroad Bridge), which is adjacent to the Ravenswood Restoration Area (Figure 1). However, monitoring of the Ravenswood Restoration Area was not conducted under this project. This project included periodic maintenance, regular data downloads, data analysis, and annual reporting for fish detections at all aforementioned locations.

As 2012 was the second and final monitoring year, this final report provides 1) the detections of various fish species, 2) habitat utilization, 3) residence times of the detected species, and 4) the overall movement of fish throughout the Bay.

METHODS

In January 2011, ECORP submitted a preliminary receiver placement plan to NOAA and DU for approval. Upon approval, receivers were then deployed in historic salt ponds restored to tidal inundation (breached) in the lower South Bay to 1) monitor detections of fish tagged and released in the Sacramento-San Joaquin River and Delta, and possibly the Napa River; and 2) to document utilization of the South Bay habitats and restored habitats by these fish. Later in 2011, NOAA approved deployment of a receiver gate array along the Dumbarton Railroad Bridge (DRRB) with the purpose of detecting all tagged fish that could potentially move into the Alviso Slough and Island ponds. Nine receivers, spaced at 250 meter centers based on earlier tag reception studies conducted by UC Davis investigators in San Francisco Bay (USACE 2011), were deployed in January 2011 as an array along the now defunct DRRB from east to west; thereby covering the entire width of South Bay. In addition, seven receivers were deployed within the breached Alviso Slough restored salt ponds, Island ponds and Coyote Creek in 2011. In 2012, nine additional receivers that had been previously deployed for the companion Napa River *Fish Acoustic Tagging and Monitoring Study* (ECORP 2013) were removed upon project completion and redeployed in the vicinity of the Eden Landing and Alameda Creek marsh

restoration area. Receivers deployed at the restoration sites were placed so that they could only detect fish that had entered the breached sites and not detect fish that passed by in the main-stem of Alviso Slough, Coyote Creek, Alameda Creek, Coyote Hills Slough and Mt. Eden Creek, thereby falsely increasing the number of fish utilizing the restored marsh habitat.

Deployment of Receiver Assemblies

VEMCO® VR2W receivers were attached to three-inch OD PVC pipe deployment brackets, 12 feet in length with a one-foot square boxed end. The receiver was attached in a downward position directly to the outer edge of the boxed end of the bracket with heavy duty cable ties. The receiver-bracket assembly was then attached to an existing post, piling, or pier with heavy duty cable ties. The assembly included an internal safety line attached directly to the receiver and to the pier, so that in the event of bracket failure (e.g., from a boat strike) the receiver would not be lost.

Receiver assemblies were deployed at low tide. In general, the receiver (with the boxed end down) was positioned at least eight feet below the mean water depth. This facilitated detections of tagged fish positioned anywhere throughout the water column, and protected the receiver assemblies from potential boat strikes.

In areas where piers and/or posts were not present, such as Eden Landing, Alameda Creek, the Alviso Slough and Island salt ponds, a unique deployment method developed for the Napa River project was utilized; three foot long, 5/8 inch diameter all-thread rods were bolted through the center of 25 lb. plates with the receiver (downward position) attached directly to the top of the all-thread rods. These assemblies were deployed offshore, in as much as eight feet of water (if possible), and attached to a shore-based metal stake with a braided line.

Seven VEMCO® VR2W receivers (all of which were attached to 25 lb. plate assemblies, except for the Coyote Creek receiver that was attached via the PVC pipe deployment bracket to a mid-channel pier-like structure) were deployed in the vicinity of Alviso Slough and Coyote Creek at the following locations (Figure 2, Table 1):

- A19 – Island Pond 19
- A21 – Island Pond 21
- A61 – Inside Pond A6 at shoreward breach, adjacent to Alviso Slough
- A62 – Inside Pond A6 at bayward breach, adjacent to Alviso Slough
- A63 – Inside Pond A6 at western breach
- ASM1 – Confluence of Alviso Slough with Coyote Creek (Receiver lost – No data)
- CC1 – Main channel Coyote Creek

The nine VEMCO® VR2W receivers (all of which were attached to PVC pipe deployment brackets) that comprised the DRRB array were deployed across the South Bay along the defunct Dumbarton Railroad Bridge at the following locations (Figure 3, Table 1):

- DRRB 1 – East Bank – Wooden Pile
- DRRB 2 – East edge of main channel
- DRRB 3 – Within main channel
- DRRB 4 – Within main channel
- DRRB 5 – West edge of main channel
- DRRB 6 – Along west flat
- DRRB 7 – Along west flat
- DRRB 8 – Along west flat
- DRRB 9 – West Bank

Nine VEMCO® VR2W receivers (all of which were attached to 25 lb. plate assemblies) were deployed in the vicinity of Eden Landing and Alameda Creek on 9 November 2012 at the following locations (Figure 4, Table 1):

- AC 1 – Within main channel of Alameda Creek
- AC 2 – Within a breached channel of the E8A salt pond
- AC 3 – Within a breached channel of the E8A salt pond
- AC 4 – Along east bank of the E8A salt pond, just west of E8
- E 1 – Mouth of the main channel of Coyote Hills Slough
- E 2 – Along north bank of Coyote Hills Slough

- E 3 – Along the northwest of the E2 salt pond
- E 4 – Mouth of the main channel of Mt. Eden Creek
- E 5 – Within Mt. Eden Creek at the E9 salt pond breach

Since some fish were detected during both the South Bay and Napa River projects (beginning 1 November 2010), three additional receivers that were part of the Napa River study (ECORP 2013; Figure 5) were also queried and included in this analysis. The following three VEMCO® VR2W receivers from the Napa River study detected fish that were also detected during the South Bay monitoring (Figure 5, Table 1):

- NR-8 – One receiver within Dutchman Slough
- NR-9/10 – Two receivers (NR-9 on the east bank and NR-10 on the west bank) that comprised the Napa River Lower Gate upstream of Tennessee Bridge

Receiver Maintenance and Data Management

During the first year of the study (2011), three maintenance and data download events were performed (via VEMCO® VUE Bluetooth software installed on a laptop) for each of the 16 receivers installed in January 2011. During the second year of the study (2012), four maintenance and data download events were performed for the existing 16 receivers and two events for the additional nine receivers that were installed in November 2012.

All receivers were serviced by research vessel. File management activities were performed after each download event, which included uploading data in to a Microsoft Access database for post-processing, QA/QC, and summary data tabulation.

Data Analysis Methodology

After the data were processed they were uploaded to the Hydra database (Sound Data Management). Individual fish were identified either through 1) file sharing through the CFTC and Hydra databases, or 2) personal communication with researchers and government agencies. Since the CFTC database was no longer available by the end of this study, and due

to the limitations of the Hydra database, many fish could not be identified and were reported as “unknown” species. Several requests were sent out to members of the CFTC requesting identification of the unknown fish, but very few fish were identified in that manner. The unknown fish with very few detections (1 or 2 detections) were assumed to be false detections and were excluded from the data analysis. As researchers continue to upload to and edit data in Hydra; and as improvements are made to the database, more of the unknown individuals may become identifiable. We will continue to monitor the site for additional information.

Fish location data were queried from a project SQL server for 16 South Bay locations from 1 January 2011 thru 9 November 2012, and for all 25 locations from 9 November 2012 thru 11 March 2013. Individual fish detections were sorted by location and grouped into discrete datasets. Individual fishes were sorted by species, unique fish tag ID, and date and time within each study location area. Refer to Attachment A for a comprehensive list of all the fish detected between 1 January 2011 and 11 March 2013, their available release information, and a list of years they were detected by South Bay receivers.

Transit maps, including movement patterns and detection summaries were produced for 1) those white sturgeon detected at both South Bay and Napa River receivers (Attachment B), and 2) the Napa River steelhead tagged and released during the companion (Napa Plant Site) study (Attachments D and E), from data collected both during the current study and provided by the UC Davis Biotelemetry Laboratory. A list of receivers and the date/time individual steelhead were first detected at the receivers is provided in Attachment C.

This broad-scale mapping overview analysis was conducted to visualize the movement and habitat use by white sturgeon throughout the greater Bay Area. Transit patterns are shown for detections between receivers (discerned by linear pathways between receivers or receiver aggregates). Linear transit pathways are shown annually (2011, 2012 and 2013), although data are only provided for the first three months in 2013. In addition, the cumulative number of detections for each of the two species is provided per receiver (or receiver aggregate), summed over all study years, as discerned by the size of the dots, as indicated in the figure legends.

RESULTS AND DISCUSSION

Forty unique fish tags were detected within the South Bay between 1 January 2011 and 11 March 2013 (Attachment A). Thirteen of the 40 fish were also detected at the Napa River Lower Gate (NR-9/10) beginning in November 2010 (Tables 4, 5 and 6; Figure 5). Five of those 13 were also detected within Dutchman Slough (NR-8). Overall, one Chinook salmon, two green sturgeon, 17 white sturgeon, seven striped bass, and 13 unknown individuals were detected during the two study years (Table 6 and Attachment A).

Alviso Slough and Restored Habitat Utilization

During 2011, striped bass and white sturgeon were the only species detected within the Alviso and Coyote Creek areas (Tables 2 and 3; Figure 2). Two individuals (one of each species) were detected within A19 and six individuals (two striped bass and four white sturgeon) were detected within Coyote Creek at CC1 (Table 2). In 2012, nearly all of the receivers within Alviso Slough had detections (A19, A21, A62, A63 and CC1), and the number of species increased as one unknown fish and an adult Chinook salmon were detected within Coyote Creek (Table 3). One white sturgeon was detected within pond A6 (at receiver A63) during January 2013. This same sturgeon was also detected within pond A6 (at receiver A62) during 2012 and within Coyote Creek during 2011 and 2012. It could be expected that visitation in 2013 would be at least similar to that which was observed during 2012; especially with the increase in fish tagging that occurred during 2012 and 2013. Despite detecting only one sturgeon during early 2013 in pond A6, an adult white sturgeon was also observed rolling at the surface near A62.

Residency of striped bass within the Alviso ponds ranged from roughly one month (A19; 2011) to one hour (A21; 2012) (Table 3). Striped bass detected within Coyote Creek spent no more than one day in the vicinity of the CC1 receiver. White sturgeon resided within restoration areas for hours at a time, but repeat visitation to pond A21 occurred in 2012 by one sturgeon (63055) that returned to the pond during May, June, September and December. When not utilizing A21 habitat, this individual remained in Coyote Creek (CC1) for roughly seven months from May to December of 2012. All other sturgeon detected in Coyote Creek resided for days to hours per event and this behavior was consistent from 2011 to 2013. One Chinook salmon

was detected at CC1 for 10 minutes in August, while one of the unknowns was detected for about 45 minutes in early May, while the other unknown was detected for about eight days in late April to early May.

All 15 fish detected by Alviso Slough receivers were previously detected at DRRB (Figure 3; Tables 5 and 6). Of those 15 individuals, one striped bass and three white sturgeon were also detected by the Napa River (lower gate) receivers.

Dumbarton Railroad Bridge Detections

Receivers DRRB 2 through 6 had the most detections of the Dumbarton array (Tables 2 and Table 5; Figure 3). These receivers (2 through 6) were located within or directly adjacent to the deep water channel of the Bay. The DRRB array generally detected fish as they were migrating through to Coyote Creek and Alviso Slough, or potentially other areas (Table 6). In many cases, detections from the Dumbarton array were discussed within the Alviso Slough section (above) and fish movement and utilization section (below) of this report since the majority of identifiable fish detected at Dumbarton did so during migration into other areas.

Ninety-two percent of the 13 unknown individuals were detected exclusively at one of the nine DRRB receivers (Tables 4 and 6). One of the 13 unknowns (roughly 8%) was also detected within Coyote Creek for a short time before it was detected again, months later, at one of the DRRB receivers (Table 6).

During 2011, eight white sturgeon and seven striped bass were detected across all nine Dumbarton receivers (Table 4). One green sturgeon that was released at the Tisdale bypass on the Sacramento River was detected by the deep water channel receivers for roughly one day in August.

During 2012, another green sturgeon released in the Umpqua River in Oregon was detected by the deep water channel receivers at DRRB for up to 20 days. However, most of the fish detected at the Dumbarton array were white sturgeon, released at various locations along the Sacramento River, Suisun Bay or San Pablo Bay (Attachment A). Additionally, one striped bass

released from King Island was detected for roughly one day across two Dumbarton receivers during 2012. Sixteen white sturgeon were detected across seven of the receivers, including the westernmost receivers (DRRB 8 and DRRB 9) that were located adjacent to the Ravenswood restoration area. Three of the fish utilized habitat on the western side of the bridge; whereas, 13 fish were mostly in the deep water channel. Since there were no receivers deployed within the Ravenswood area, it is difficult to decipher whether fish were going back and forth between the Dumbarton Railroad Bridge and Ravenswood, or utilizing the Ravenswood habitat.

Within a four day period in August 2012, an adult Chinook salmon released in the ocean near Bodega Bay was detected at four of the Dumbarton array receivers. It resided at Dumbarton for roughly two days, and then was detected within Coyote Creek for 10 minutes (see the above section "Alviso Slough and Restored Habitat Utilization"), and returned to Dumbarton for roughly another two days (Table 6).

In 2013, 60% (six individuals) of the fish detected at Dumbarton were white sturgeon and were detected within the deep water channel only. In general, white sturgeon resided in the area for anywhere from one day to up to a month at most per visit. However, analysis of additional data for select sturgeon supplied by the UC Davis Biotelemetry Laboratory indicated that this species is constantly travelling throughout the bay. Many of those individuals detected at Dumbarton would leave and return many times over a fairly short period. This activity was documented regularly throughout the two years of this study (see Attachment B and the section "Fish Movement and Utilization throughout the San Francisco Bay", below). Presumably, other white sturgeon detected at Dumbarton exhibited similar behavior.

Eden Landing Habitat Utilization

Eden Landing receivers did not detect previously-tagged fish within the restoration areas and main channels of Coyote Hills Slough, Alameda Creek and Mt. Eden Creek (Figure 4). These receivers were deployed 9 November 2012 and then removed 13 February 2013; they were previously deployed in the Napa River and were only available to this study for a limited time. Additionally, the Eden Landing Restoration Area is a newly restored site, and as habitat matures over the next few years, it is expected that more fish will be utilizing that habitat. During field

visits at this site, fish were observed rolling at the surface throughout the area. These individuals were presumably locally resident to the South Bay.

We note that the main channel running north to south through the South San Francisco Bay runs along the western side of the Bay, many miles from the eastern side where Eden Landing is located. Results from the DRRB receivers indicate that the majority (nearly all) of the migrating fish do so within the deepwater channel. Since nearly all tagged and detected fish in this study were released in the Delta or Sacramento River, it is reasonable to assume that they would remain within or in the vicinity of the main channel during their migration from the North to South Bay. We speculate that if fish from the South Bay had been tagged and released, then results may have been dissimilar. Perhaps those fish would act as the Napa River steelhead behaved, by utilizing off-channel habitat as they were emigrating from their natal streams.

Fish Movement and Utilization throughout the San Francisco Bay

White sturgeon and striped bass were the only species detected travelling to and at receivers within the Napa River, at the DRRB, and within Alviso Slough. One of the two green sturgeon detected in this study was detected within the Napa River and at the DRRB; whereas, many other fish (Chinook salmon, white sturgeon, green sturgeon, striped bass and two unknowns) were detected at the DRRB and within Alviso Slough, but these fish will not be further discussed within this section (Tables 4, 5 and 6).

White Sturgeon

Altogether, eight previously-tagged white sturgeon traversed the Bay from 2010-2013: three white sturgeon traversed the Bay three times, two traversed the Bay twice and three crossed one time (Table 6). Many white sturgeon were detected repeatedly within the South Bay during 2011, 2012 and 2013; and within the Napa River at least once during 2010, 2011 and 2012 (Napa River receivers were removed late summer 2012), indicating bay-wide residency throughout the San Francisco Bay.

Seven of the eight white sturgeon that were detected by North and South Bay receivers were part of a research study being conducted by the UC Davis Biotelemetry Laboratory. Collaboration with the researchers at UCD allowed for the expansion of the dataset and a more comprehensive analysis. This broad-scale overview analysis was conducted, and graphics created to visualize the movement and habitat use by white sturgeon throughout the Delta and greater Bay Area. Maps showing the movement of individual white sturgeon throughout the Bay are provided in Attachment B. Overall, this species seems to be constantly traveling throughout the North and South Bay areas, the San Pablo Bay and associated flats, throughout the Delta channels and sloughs, and up the Sacramento River on a regular basis. Additionally, there did not seem to be a temporal correlation with sturgeon movement throughout the Bay and Delta. In general, white sturgeon were most commonly detected along the route from the Sacramento River down to the Dumbarton Bridge array, and detections were greater around the Benicia Bridge, Carquinez Straight, San Pablo Bay and the Richmond Bridge. In some cases, the number of detections at the Dumbarton Railroad Bridge array was similar in magnitude to those observed at the more northerly receivers (Attachment B).

The following data presented were limited to the South Bay and Napa River receivers that were maintained by ECORP; however, the analysis is supported by the additional data presented in Attachment B. White sturgeon tag numbers 46687, 47835 and 56454 were observed traversing the Bay once during this study. Fish 46687 and 56454 were first detected at the DRRB in 2012 and later within the Napa River Lower Gate (NR-9/10) (Table 6). Fish 47835 was first detected within the Napa River and later detected at DRRB and then within Coyote Creek.

Fish 47867 and 62780 were observed traversing the Bay twice. Fish 47867 was first detected within the Napa River during 2011 before traveling to DRRB, Coyote Creek and back to the Napa River, whereas 62780 was first detected within Coyote Creek and pond A19 before heading through DRRB and into the Napa River. It remained in the Napa River for at least two and a half months before returning to Coyote Creek and ponds A19 and A6 where it remained for roughly 15 days before repeat detection at DRRB.

Three additional white sturgeon (46684, 47821 and 56421) were observed traversing the Bay at least three times during the period that the Napa River receivers were deployed. Fish 46684

and 47821 were first detected at the Napa River Lower Gate and Dutchman Slough before heading south to DRRB where they resided for approximately one to two months before returning to the Napa River, where they were detected briefly before traveling back to DRRB. However, these two fish were not detected within Alviso Slough. White sturgeon 46684 travelled at least 170 miles over 14 months. Since fish 47821 was first detected in December 2010, prior to deployment of the South Bay receivers, it may have traversed the Bay after being detected within the Napa River in December 2010. Despite the possible lack of data, this fish travelled at least 170 miles in 26 months. White sturgeon 56431 traversed the Bay visiting the same locations (DRRB, A62, A63, Coyote Creek, Napa River and Dutchman Slough) repeatedly from September 2011 to February 2013 (Table 6). Based on detections, this fish travelled at least 215 miles over a period of roughly 17 months and had the longest residence time within the Alviso Slough area (2.5 months). This fish was first detected at the Napa River Lower Gate and within Dutchman Slough in September 2011, where it resided for nearly one month. It was detected again almost one month after it left the Napa River at DRRB, then travelled back and forth between Coyote Creek, A62 and DRRB for three months before migrating back to the Napa River where it was detected again on 18 March 2012. It remained there for roughly 2.5 months before migrating back to DRRB and on to A63 where it was detected on 26 January 2013. On 31 January 2013, white sturgeon 56431 was detected again at DRRB.

Green Sturgeon

A green sturgeon (31540) that was released in the Umpqua River, Oregon during September 2011 was first detected at DRRB on 31 March 2012 where it continued to be detected for 20 days before migrating north to the Napa River (Table 6 and Attachment A). Detections at the Napa River Lower Gate and within Dutchman Slough began two months after it had left the DRRB. It continued to be detected within the Napa River for up to one day, and was not detected again. Due to difficulty reaching the researchers who had tagged this fish, additional data were not available in time to be included within this report. In addition, a green sturgeon (46635) that was tagged and released at Tisdale Weir on the Sacramento River in April 2011 was only detected at DRRB, and only for one day.

Striped Bass

During 2011, two striped bass utilized Napa River, DRRB and Alviso Slough habitats (Table 5 and 6). Fish 37706 was first detected at the Napa River Lower Gate in April 2011 and in Dutchman Slough the following day, where it remained for roughly three days before passing back through the Napa River Gate and heading out into the Bay. One month later, it was detected roughly 55 miles away at the DRRB where it resided for approximately two days. This fish was later detected at pond A21 in Alviso Slough (roughly eight miles from DRRB) one year and 15 days later on 1 June 2012. It remained within A21 for one hour and was not detected again. Based on our detections alone, this fish travelled about 17 miles in 417 days since it was first detected at DRRB, indicating site fidelity.

The other striped bass (40175) was first detected at the DRRB on 16 July 2011. Between 16 July and 23 October 2011 this fish traveled extensively throughout the Bay (Table 6). After leaving DRRB on 21 July, it was detected within Coyote Creek the next day for roughly six hours before it travelled back through DRRB 24 hours later on 23 July. Forty-one days later, it was detected at the Napa River Lower Gate, 55 miles from DRRB, where it remained for roughly one day. The next detection was back at DRRB, 25 days later on 27 September 2011, as fish 40175 was traveling to Coyote Creek. It remained in Coyote Creek for roughly 10 minutes, visited pond A19 for 15 minutes, travelled back to Coyote Creek and out to DRRB five hours later where it resided for 13 days before returning to Coyote Creek. It was detected within Coyote Creek for 30 minutes before returning to A19 where it resided from 17 to 23 October 2011. Altogether, this striped bass travelled at least 154 miles in roughly 93 days.

Napa River Steelhead

Detections of the Napa River Steelhead tagged as part of the Napa River *Fish Acoustic Tagging and Monitoring Study* (ECORP 2013) were queried from Hydra. A chronological list and tracking maps of steelhead detection locations, number of detections, and the date and time they were first detected at a given location are included in Attachments C, D and E. Additionally, data for wild Napa River Steelhead that emigrated to Point Reyes are included in Attachment F.

Since the Golden Gate, Point Reyes and many North Bay receivers/arrays (San Pablo, Richmond Bridge, Bay Bridge, Vallejo Marina, Alcatraz, Benicia Bridge and Emeryville) were not maintained by ECORP; the data had to be shared through Hydra and was dependent on other researchers uploading those receivers' detections into the database. Therefore, the data presented here for the Napa River steelhead are reflective of what is currently in the Hydra database and are not necessarily complete. A list of receivers and the date/time individual steelhead were first detected at the receivers is provided in Attachment C.

Twenty-six of the wild Napa River (CC) steelhead that were tagged and released during the companion study were detected by receiver arrays throughout the San Francisco and San Pablo Bays. Steelhead tended to emigrate directly from their natal Napa River into the Bay and out toward the California coast. Hence, none of the steelhead were detected south of the Bay Bridge, but movement throughout the North Bay was extensive nonetheless. Attachment D provides the cumulative residency and number of detections maps of all of the steelhead detected in the Bay. For simplification, individual receivers in an array were mapped as aggregated receiver locations. In general, after leaving the Napa River Lower Gate steelhead had the longest residency (up to one day) within the San Pablo Bay and at the Richmond Bridge. Maps showing the outmigration and bay movements of individual steelhead are included in Attachment E.

Of the 26 steelhead, nine were detected by the offshore Point Reyes array. These nine fish were detected crossing the array eight to 102 days after arriving at the Napa River Lower Gate (Attachment F). On average, steelhead smolts arrived at Point Reyes within 31 days (\pm SE, 11 days). The fish that took the longest time to immigrate (#40882, 102 days), an outlier in this dataset, was detected back at the Bay Bridge five days after visiting Point Reyes.

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Table 1. South Bay Receiver Locations

Location	Receiver ID	Serial Number	Lat. N	Long. W
Alviso Slough				
Alviso Slough	A19	112777	37° 27.831	121° 57.691
Alviso Slough	A21	112772	37° 27.773	121° 59.110
Alviso Slough	A61	112773	37° 27.424	122° 01.307
Alviso Slough	A62	112776	37° 27.046	122° 01.277
Guadalupe Slough	A63	112774	37° 27.242	122° 01.999
Alviso Slough	ASM	missing	37° 27.739	122° 01.355
Coyote Creek	CC1	112780	37° 27.953	121° 59.634
Dumbarton Railroad Bridge				
Dumbarton Bridge	DRRB 4	109111	37° 29.771	122° 06.717
Dumbarton Bridge	DRRB 1	107218	37° 29.973	122° 06.418
Dumbarton Bridge	DRRB 2	112781	37° 29.895	122° 06.568
Dumbarton Bridge	DRRB 3	112779	37° 29.881	122° 06.607
Dumbarton Bridge	DRRB 5	112783	37° 29.699	122° 06.824
Dumbarton Bridge	DRRB 6	112782	37° 29.619	122° 06.945
Dumbarton Bridge	DRRB 7	112784	37° 29.538	122° 07.066
Dumbarton Bridge	DRRB 8	112786	37° 29.456	122° 07.187
Dumbarton Bridge	DRRB 9	112785	37° 29.381	122° 07.293
Eden Landing				
Alameda Creek	AC1	109110	37° 35.605	122° 08.414
Alameda Creek	AC2	109117	37° 35.594	122° 08.021
Alameda Creek	AC3	109112	37° 35.626	122° 07.834
Alameda Creek	AC4	112780	37° 35.807	122° 07.294
Coyote Hills Slough	E1	109116	37° 33.801	122° 07.894
Coyote Hills Slough	E2	119974	37° 34.189	122° 07.546
Eden Landing	E3	119973	37° 35.071	122° 08.509
Mt. Eden Creek	E4	109118	37° 36.455	122° 08.744
Mt. Eden Creek	E5	109119	37° 36.424	122° 08.525

Table 2. Number of Individual Fish Per Species Detected by South Bay Receivers in 2011 (14 January - 31 December), 2012 (1 January - 31 December), and 2013 (1 January - 27 March).

Year	Receiver location	Total Number of Chinook Salmon	Total Number of Striped Bass	Total Number of White Sturgeon	Total Number of Green Sturgeon	Total Number of Unknowns	Total Number of Individuals
2011	A19		1	1			2
	CC1		2	3			5
	DRRB 1		2	1			3
	DRRB 2		6	7	1		14
	DRRB 3		6	8	1		15
	DRRB 4		7	4	1		12
	DRRB 5		5	4	1		10
	DRRB 6		4	4			8
	DRRB 7			1			1
	DRRB 8		1	2			3
	DRRB 9		2	2			4
	NR-8		1	1			2
	NR-9/10		2	3			5
2012	A19			1			1
	A21		1	1			2
	A62			1			1
	A63			1			1
	CC1	1		6		1	8
	DRRB 2	1	1	13	1	10	26
	DRRB 3	1	1	14	1	11	28
	DRRB 5			7		5	12
	DRRB 6	1		6	1	2	10
	DRRB 7			1		1	2
	DRRB 8			2		1	3
	DRRB 9	1		3		1	5
NR-8			2	1		3	
NR-9/10			7	1		8	
2013	A63			1			1
	DRRB 2			5		2	7
	DRRB 3			5		4	9
	DRRB 4			4		4	8
	DRRB 5			4		3	7
	DRRB 8					1	1

Table 3. Tracking (Date and Time, UTC) of Tagged Fish by Alviso Slough and Coyote Creek Receivers in 2011 (14 January - 31 December), 2012 (1 January - 31 December) and 2013 (1 January - 27 March).

Year	Fish ID	Species	A19		A21		A62		A63		CC1	
			First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect
2011	37738	Striped Bass									3/20/11 7:49	3/20/11 7:49
	40175	Striped Bass	9/28/11 10:06	10/23/11 16:29							7/22/11 17:34	10/16/11 17:52
	47867	White Sturgeon									11/19/11 13:15	11/19/11 16:46
	56431	White Sturgeon									11/14/11 10:29	11/26/11 10:53
	62780	White Sturgeon	2/16/11 16:15	2/16/11 16:15							2/11/11 5:18	3/2/11 18:26
2012	62917	Chinook Salmon									8/9/12 6:40	8/9/12 6:51
	37706	Striped Bass			6/1/12 18:13	6/1/12 19:05						
	56484	Unknown									4/29/12 11:37	5/7/12 14:17
	2843	White Sturgeon									5/4/12 5:34	5/4/12 6:13
	47835	White Sturgeon									12/27/12 17:58	12/27/12 19:46
	56431	White Sturgeon					1/22/12 17:34	1/22/12 18:17			2/3/12 8:36	2/3/12 19:09
	62780	White Sturgeon	12/15/12 9:14	12/15/12 9:28					12/30/12 20:21	12/30/12 21:50	12/12/12 14:29	12/22/12 16:59
	63047	White Sturgeon									5/7/12 6:56	5/7/12 8:49
2013	63055	White Sturgeon			5/14/12 12:09	12/11/12 17:13					5/3/12 14:57	12/24/12 15:26
	56431	White Sturgeon							1/26/13 16:40	1/26/13 16:40		

Table 4. Tracking (Date and Time, UTC) of Tagged Fish by Dumbarton Railroad Bridge Receivers in 2011 (14 January - 31 December), 2012 (1 January - 31 December), and 2013 (1 January - 27 March); and by Napa River Receivers in 2011 (1 January - 31 December) and 2012 (1 January - 1 August).

Year	Fish ID	Species	DRRB 1		DRRB 2		DRRB 3		DRRB 4		DRRB 5		DRRB 6		DRRB 7		DRRB 8		DRRB 9		NR-8		NR-9/10		
			First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect	Last Detect	First Detect
2011	46635	Green Sturgeon			8/12/11 2:56	8/12/2011	8/12/11 3:24	8/12/2011	8/12/11 3:30	8/12/11 12:56	8/12/11 3:23	8/12/11 13:11													
	791	Striped Bass			7/19/11 20:29	7/19/11 20:34	7/19/11 20:29	7/20/11 0:24	7/20/11 0:15	9/28/11 8:12	9/28/11 7:37	9/28/11 8:59	9/28/11 8:25	9/28/11 8:25											
	806	Striped Bass							6/21/11 22:57	6/21/11 23:02	6/21/11 23:02														
	37706	Striped Bass			5/14/11 2:29	5/14/11 7:12	5/14/11 2:25	5/14/11 7:11	5/12/11 1:54	5/13/11 0:31	5/13/11 0:19	5/13/11 0:19													
	37724	Striped Bass			4/18/11 17:53	4/18/11 17:53	4/18/11 17:56	4/18/11 17:56	4/18/11 23:52	4/18/11 23:52												4/13/11 6:06	4/13/11 20:16	4/12/11 0:37	4/17/11 0:03
	37738	Striped Bass			4/13/11 9:23	4/13/11 9:23	3/22/11 9:14	4/13/11 9:27	3/19/11 17:44	4/13/11 12:17	3/22/11 8:45	4/5/11 17:37													
	37749	Striped Bass	3/28/11 4:47	3/28/11 4:47	5/19/11 23:38	6/24/11 12:51	5/19/11 23:36	6/24/11 12:51	5/19/11 22:36	6/26/11 22:53	6/23/11 10:41	6/26/11 22:57	6/25/11 22:31	6/25/11 22:31	3/22/11 7:49	4/5/11 18:08	3/22/11 7:37	3/22/11 7:37							
	40175	Striped Bass	5/20/11 10:18	5/20/11 10:30	7/16/11 19:27	10/15/11 18:02	7/16/11 19:24	10/15/11 18:02	10/3/11 4:08	10/14/11 8:04	10/2/11 7:18	10/14/11 11:53	10/3/11 3:51	10/3/11 3:56											
	46610	White Sturgeon			5/15/11 4:31	11/27/11 21:59	5/14/11 3:56	12/23/11 18:36	5/16/11 3:36	11/27/11 21:39	5/16/11 8:37	11/27/11 22:00													
	46631	White Sturgeon			12/20/11 14:04	12/31/11 15:27	12/20/11 14:03	12/31/11 23:59					12/20/11 14:26	12/25/11 21:19											
	46684	White Sturgeon			12/17/11 7:22	12/31/11 15:53	12/17/11 6:58	12/31/11 16:00					12/19/11 12:33	12/30/11 22:54											
	47821	White Sturgeon			12/27/11 7:19	12/31/11 15:14	12/27/11 7:14	12/31/11 15:13																	
	47835	White Sturgeon	4/20/11 9:04	4/20/11 10:34	3/28/11 22:54	5/17/11 23:04	3/28/11 22:40	5/17/11 23:12	3/30/11 23:52	5/17/11 23:03	4/15/11 8:26	5/17/11 23:13	4/1/11 13:57	4/19/11 2:23	4/15/11 8:11	4/15/11 8:14	4/15/11 8:06	4/15/11 8:10							
	47855	White Sturgeon					4/7/11 23:01	4/7/11 23:01																	
47867	White Sturgeon			11/19/11 7:13	11/20/11 0:12	11/19/11 7:09	11/19/11 22:25	11/19/11 22:07	11/19/11 22:20	11/19/11 7:26	11/19/11 22:07	3/4/11 5:24	3/4/11 7:37												
62780	White Sturgeon			3/3/11 23:11	3/4/11 7:43	3/3/11 23:11	3/4/11 7:26	3/4/11 5:24	3/4/11 7:38	3/4/11 5:24	3/4/11 7:37	3/4/11 5:31	3/4/11 7:24	3/4/11 7:02	3/4/11 7:02	3/4/11 6:32	3/4/11 7:19	3/4/11 6:07	3/4/11 7:00						
2012	62917	Chinook Salmon			8/6/12 20:15	8/10/12 3:00	8/6/12 19:49	8/10/12 3:20																	
	31540	Green Sturgeon			3/31/12 18:29	4/20/12 8:37	3/31/12 18:29	4/20/12 8:43																	
	791	Striped Bass			5/22/12 10:37	5/22/12 10:38	5/22/12 10:37	5/22/12 10:38																	
	2871	Unknown			7/4/12 18:55	7/4/12 22:21	7/4/12 18:55	7/4/12 22:21																	
	2872	Unknown			5/12/12 11:03	5/12/12 15:21	5/12/12 11:05	5/12/12 15:25																	
	2886	Unknown			5/2/12 0:13	5/2/12 4:23	5/2/12 0:12	5/2/12 3:56																	
	17889	Unknown			9/21/12 19:34	9/21/12 19:37	9/21/12 19:29	9/22/12 7:45																	
	31485	Unknown			9/12/12 3:40	9/14/12 6:29	9/12/12 3:40	9/14/12 6:18																	
	44221	Unknown			2/7/12 8:01	2/7/12 8:01																			
	54311	Unknown					1/7/12 19:46	1/7/12 19:46																	
	56241	Unknown					11/18/12 16:58	11/18/12 16:58																	
	56473	Unknown			8/20/12 9:01	10/18/12 12:17	7/29/12 17:26	10/18/12 12:19																	
	56481	Unknown			10/18/12 6:54	12/30/12 12:04	10/18/12 6:36	12/30/12 12:19																	
	56484	Unknown			4/29/12 2:01	12/30/12 22:05	4/29/12 1:59	12/30/12 21:29																	
	56486	Unknown			9/7/12 22:09	11/11/12 7:56	9/7/12 22:08	11/11/12 8:01																	
	2843	White Sturgeon			12/25/12 23:33	12/26/12 3:03	5/3/12 0:10	12/26/12 3:15																	
	46610	White Sturgeon			2/11/12 9:21	7/10/12 2:19	2/11/12 9:37	8/24/12 1:15																	
	46631	White Sturgeon			1/1/12 0:11	1/14/12 14:11	1/1/12 0:02	1/14/12 14:14																	
	46684	White Sturgeon			1/2/12 0:17	12/7/12 16:52	1/2/12 0:01	12/7/12 16:55																	
	46687	White Sturgeon			6/4/12 18:36	6/4/12 23:17	6/4/12 18:34	6/4/12 23:19																	
	47821	White Sturgeon			1/2/12 7:01	12/30/12 22:15	1/2/12 7:41	12/30/12 22:05																	
	47835	White Sturgeon			12/27/12 6:17	12/30/12 20:59	12/27/12 6:17	12/30/12 21:22																	
	47836	White Sturgeon					12/4/12 17:41	12/4/12 17:41																	
	47867	White Sturgeon																							
47883	White Sturgeon			10/10/12 3:48	10/10/12 16:11	10/10/12 3:32	10/10/12 17:05																		
56431	White Sturgeon			2/28/12 17:18	12/11/12 15:05	2/12/12 18:51	12/12/12 0:11																		
56454	White Sturgeon			5/5/12 6:16	5/5/12 7:23	5/5/12 6:17	5/5/12 7:07																		
56466	White Sturgeon			11/11/12 12:02	12/7/12 7:47	11/6/12 16:20	12/21/12 12:42																		
62780	White Sturgeon			12/12/12 3:40	12/29/12 0:38	12/12/12 3:42	12/29/12 3:08																		
63047	White Sturgeon			5/3/12 15:09	12/30/12 17:02	5/3/12 15:09	12/30/12 16:53																		
63055	White Sturgeon			4/30/12 2:38	12/8/12 22:49	4/30/12 2:38	12/8/12 22:45																		
2013	56473	Unknown			2/27/13 6:10	2/27/13 10:40	2/27/13 6:10	2/27/13 10:04																	
	56481	Unknown			1/1/13 0:01	1/10/13 19:53	1/1/13 0:01	2/10/13 10:45																	
	56484	Unknown			1/4/13 19:50	1/24/13 7:16	1/19/13 18:33	2/1/13 0:09	1/26/13 12:28	1/31/13 23:58	1/13/13 3:05	2/10/13 10:44	2/1/13 0:03												
	56499	Unknown																							
	47821	White Sturgeon			1/1/13 12:51	1/25/13 17:42	1/1/13 0:01	1/27/13 15:12																	
	47835	White Sturgeon			1/1/13 13:22	1/25/13 15:10	1/1/13 2:14	3/18/13 16:25																	
	47836	White Sturgeon			1/19/13 15:45	1/24/13 2:57																			
	56431	White Sturgeon					2/11/13 3:52	2/18/13 14:55																	
	62780	White Sturgeon			1/1/13 6:16	1/25/13 17:39	1/1/13 5:05	2/7/13 7:24																	
	63047	White Sturgeon			1/1/13 6:13																				

Table 5. Number of Detections of Tagged Fish by South Bay receivers in 2011 (1 January - 31 December), 2012 (1 January - 31 December), and 2013 (1 January - 27 March); and by Napa River Receivers in 2010 (1 November - 31 December 2010), 2011 (1 January - 31 December), and 2012 (1 January - 1 August). Date and Time is in UTC.

Year	Fish ID	Species	Release Location	Release Date	A19	A21	A62	A63	CC1	DRRB 1	DRRB 2	DRRB 3	DRRB 4	DRRB 5	DRRB 6	DRRB 7	DRRB 8	DRRB 9	NR-8	NR-9/10	Totals	
2010	47821	White Sturgeon	Suisun Bay	2010	--	--	--	--	--	--	--	--	--	--	--	--	--	--	72	1,688	1,760	
	47835	White Sturgeon	Suisun Bay	2010	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		70	70
Totals	2 individuals	1 Species			--	--	--	--	--	--	--	--	--	--	--	--	--	--	72	1,758	1,830	
2011	46635	Green Sturgeon	Tisdale Bypass	4/14/2011							42	34	12	25							113	
	791	Striped Bass	King Island	5/19/2011							3	5	6	28	1						43	
	806	Striped Bass	King Island	6/2/2011									6								6	
	37706	Striped Bass	(Antioch) San Joaquin	7/6/2010							6	4	10	2					64	1,264	1,350	
	37724	Striped Bass	(Antioch) San Joaquin	7/6/2010							2	2	2								6	
	37738	Striped Bass	(Antioch) San Joaquin	7/7/2010					2	2	2	12	30	20	21		4	2			95	
	37749	Striped Bass	(Antioch) Sacramento River	7/6/2010						4	40	35	30	3	1						113	
	40175	Striped Bass	Below the American River	6/8/2011	95				26		38	52	4	9	2				3		13	242
	46610	White Sturgeon	Freemont Weir	4/12/2011							148	206	48	62								464
	46631	White Sturgeon	Tisdale Bypass	4/14/2011							509	778				2						1,289
	46684	White Sturgeon	Freemont Weir	5/11/2011							550	894				33			23	50	1,550	
	47821	White Sturgeon	Suisun Bay	2010							228	472									4	704
	47835	White Sturgeon	Suisun Bay	2010						18	64	66	230	66	48		6	8				506
	47855	White Sturgeon	Suisun Bay	2010								2										2
	47867	White Sturgeon	Suisun Bay	2010					13		35	55	7	15							133	258
	56431	White Sturgeon	NA	NA					756		136	217	47	82					23	682	1,943	
	62780	White Sturgeon	NA	NA		2			568		20	26	26	40	26	2	8	26				744
Totals	17 individuals	3 Species			97	0	0	0	1,365	24	1,823	2,860	458	352	134	2	18	39	110	2,146	9,428	

LIST OF FIGURES

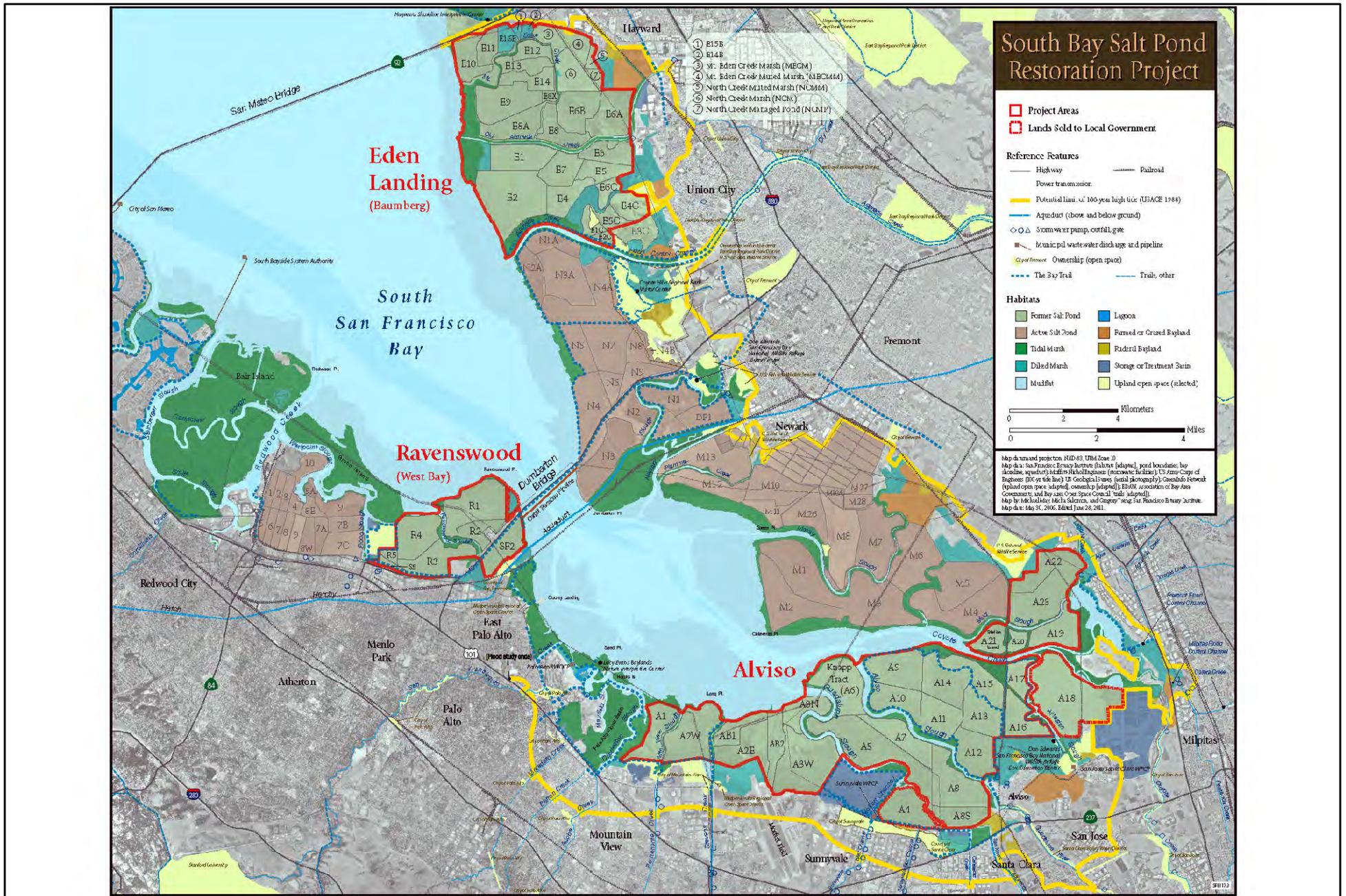
Figure 1. South San Francisco Bay Restoration Areas

Figure 2. Alviso Slough, Coyote Creek and Island Pond Receiver Locations

Figure 3. South San Francisco Bay Receiver Locations along Dumbarton Railroad Bridge

Figure 4. Eden Landing and Alameda Creek Receiver Locations

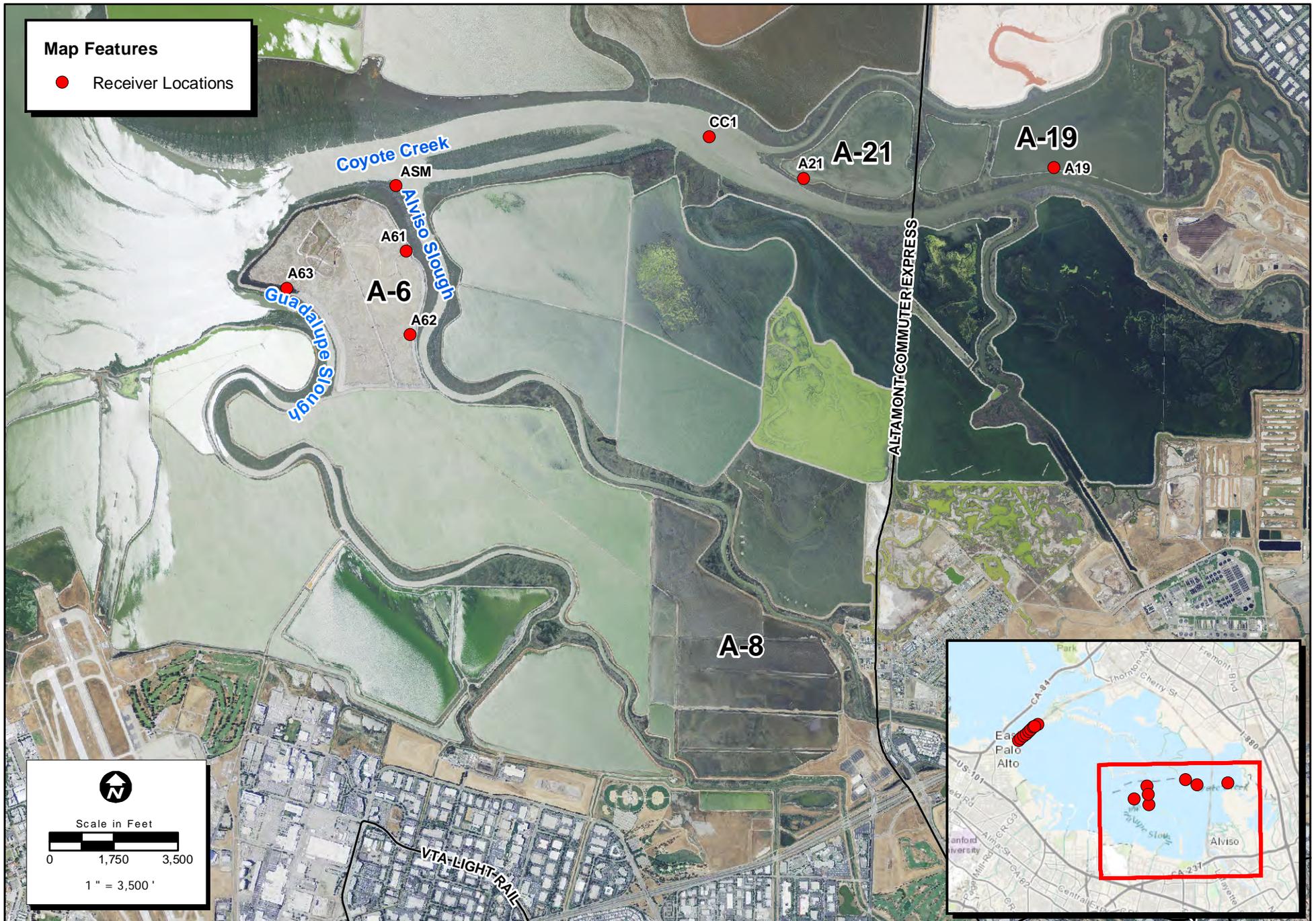
Figure 5. Napa River Receiver Locations



Location: N:\2011\2011-014 South Bay Fish Tagging Project\MAPS\SSS_Survey_and_Mapping\Fish Tagging\Maps\lv1SE_Estuary_NotECORP.mxd (DWagnon, 2/13/2013) - dwagnon

Figure 1. South San Francisco Bay Restoration Areas

2011-014 South Bay Fish Tagging



Map Date: 2/13/2013
 Photo/Base Sources: World Imagery (ESRI Online),
 World Topo Map (ESRI Online)

Location: N:\2011\2011-014 South Bay Fish Tagging Project\MAPS\SSS_Survey_and_Mapping\FishTagging\Maps\v1\AlvisoReceivers_v2.mxd (KBelden, KOrtega, DWagnon, 2/13/2013) - dwagnon

Figure 2. Alviso Slough, Coyote Creek and Island Pond Receiver Locations



Figure 3. South San Francisco Bay Receiver Locations along Dumbarton Railroad Bridge

2011-014 South Bay Fish Tagging

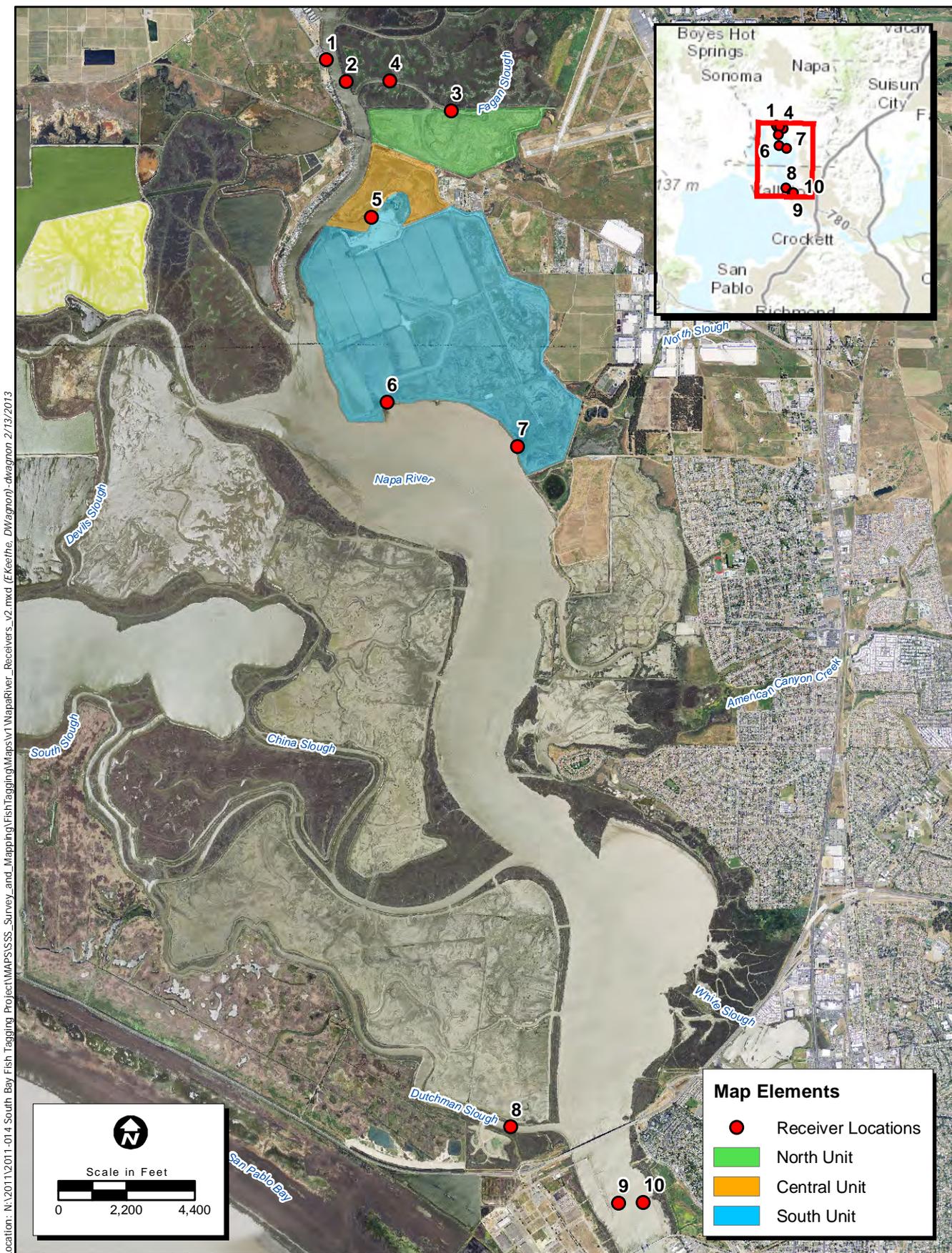


Map Date: 2/13/2013
 Photo/Base Sources: NAIP 2012
 World Topo Map (ESRI Online)

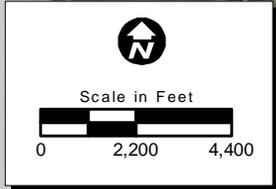
Location: N:\2011\2011-014 South Bay Fish Tagging Project\MAPS\SSS_Survey_and_Mapping\FishTagging\Maps\v1\EdenLanding_Receiver_v2.mxd (EKeethe, DWagnon, 2/13/2013) - dwagnon

Figure 4. Eden Landing & Alameda Creek Receiver Locations

2011-014 South Bay Fish Tagging



Location: N:\2011\2011-014_South_Bay_Fish_Tagging_Project\MAPS\SSSS_Survey_and_Mapping\FishTagging\Maps\1\NapaRiver_Receivers_v2.mxd (EKeefe, D\Wagnon)-dwagnon 2/13/2013



Map Elements	
●	Receiver Locations
	North Unit
	Central Unit
	South Unit

Map Date: 2/13/2013
 Photo Source: NAIP 2012
 World Topo Map (ESRI Online)



Figure 5. Napa River Receiver Locations

2011-014 South Bay Fish Tagging

LIST OF ATTACHMENTS

Attachment A – Comprehensive List of Fish Detected From 1 November 2010 through 11 March 2013

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Attachment F – Wild Napa River Steelhead (CC) Immigration to Point Reyes

ATTACHMENT A

Comprehensive List of Fish Detected From 1 November 2010 through 11 March 2013

Code Space	Tag ID	Species	Release Location	Release Date (UTC)	Years Detected
A69-1303	62917	Chinook Salmon	Adult tagged at sea and released near Bodega Bay	7/25/2012	2012
A69-9001	31540	Green Sturgeon	Umpqua River	9/7/2011	2012
A69-1303	46635	Green Sturgeon	Tisdale Bypass	4/14/2011	2011
A69-1601	791	Striped Bass	King Island	5/19/2011	2011, 2012
A69-1601	806	Striped Bass	King Island	6/2/2011	2011
A69-1303	37706	Striped Bass	San Joaquin (Antioch)	7/6/2010	2011, 2012
A69-1303	37724	Striped Bass	San Joaquin (Antioch)	7/6/2010	2011
A69-1303	37738	Striped Bass	San Joaquin (Antioch)	7/7/2010	2011
A69-1303	37749	Striped Bass	San Joaquin (Antioch)	7/6/2010	2011
A69-1303	40175	Striped Bass	Sacramento Below the American	6/8/2011	2011
A69-1206	2871	Unknown			2012
A69-1206	2872	Unknown			2012
A69-1206	2886	Unknown			2012
A69-1303	17889	Unknown			2012
A69-9001	31485	Unknown			2012
A69-1303	44221	Unknown			2012
A69-1303	54311	Unknown			2012
A69-1303	56241	Unknown			2012
A69-1303	56473	Unknown			2012, 2013
A69-1303	56481	Unknown			2012, 2013
A69-1303	56484	Unknown			2012, 2013
A69-1303	56486	Unknown			2012
A69-1303	56499	Unknown			2013
A69-1206	2843	White Sturgeon			2012
A69-1303	46610	White Sturgeon	Freemont Weir	4/12/2011	2011, 2012
A69-1303	46631	White Sturgeon	Tisdale Bypass	4/14/2011	2011, 2012
A69-1303	46684	White Sturgeon	Fremont Weir	5/11/2011	2011, 2012
A69-1303	46687	White Sturgeon	Fremont Weir	5/11/2011	2012
A69-1303	47821	White Sturgeon	Suisun Bay	2010	2010, 2011, 2012, 2013
A69-1303	47835	White Sturgeon	Suisun Bay	2010	2010, 2011, 2012, 2013
A69-1303	47836	White Sturgeon	Suisun Bay	2010	2012, 2013
A69-1303	47855	White Sturgeon	Suisun Bay	2010	2011
A69-1303	47867	White Sturgeon	Suisun Bay	2010	2011, 2012
A69-1303	47883	White Sturgeon	San Pablo Bay	2011	2012
A69-1303	56431	White Sturgeon	NA	NA	2011, 2012, 2013
A69-1303	56454	White Sturgeon	Suisun Bay	2011	2012
A69-1303	56466	White Sturgeon	Suisun Bay	2011	2012
A69-1303	62780	White Sturgeon	NA	NA	2011, 2012, 2013
A69-1303	63047	White Sturgeon	NA	NA	2012, 2013
A69-1303	63055	White Sturgeon	NA	NA	2012

ATTACHMENT B

Movement of White Sturgeon and Detection Summary Patterns throughout the
San Francisco Bay and Delta

San Francisco Bay & Delta White Sturgeon Detections Fish Tag ID: A69-1303-46684

Map Features

- Aggregated Receiver Location (No Detection)

Fish Transit by Year

- 2011
- 2012
- 2013

Cumulative Detections by Receiver

- 2 - 50
- 51 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 5,000
- > 5,000

*Receivers were aggregated with others in the same array or vicinity for simplicity and clarity. All Bay arrays, Delta and river receivers were aggregated into single representative points. The Sacramento River, Mokelumne River and San Joaquin River receiver aggregates represent all the detections at and upstream of those locations. Tracking lines are separated by year, and provide a rough visual representation of fish transit between detections at receiver aggregates. Receivers points are scaled by the cumulative number of detections that occurred across all three years.



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-46684.mxd (ECK) ekeche 7/15/2013

Pacific Ocean



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 7/15/2013

San Francisco Bay & Delta White Sturgeon Detections Fish Tag ID: A69-1303-46687

Map Features

- Aggregated Receiver Location (No Detection)

Fish Transit by Year

- 2011
- 2012
- 2013

Cumulative Detections by Receiver

- 2 - 50
- 51 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 5,000
- > 5,000

*Receivers were aggregated with others in the same array or vicinity for simplicity and clarity. All Bay arrays, Delta and river receivers were aggregated into single representative points. The Sacramento River, Mokelumne River and San Joaquin River receiver aggregates represent all the detections at and upstream of those locations. Tracking lines are separated by year, and provide a rough visual representation of fish transit between detections at receiver aggregates. Receivers points are scaled by the cumulative number of detections that occurred across all three years.



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-46687.mxd (ECX) akeethe 7/15/2013

Pacific Ocean



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 7/15/2013

San Francisco Bay & Delta White Sturgeon Detections Fish Tag ID: A69-1303-47821

Map Features

- Aggregated Receiver Location (No Detection)

Fish Transit by Year

- 2011
- 2012

Cumulative Detections by Receiver

- 2 - 50
- 51 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 5,000
- > 5,000

*Receivers were aggregated with others in the same array or vicinity for simplicity and clarity. All Bay arrays, Delta and river receivers were aggregated into single representative points. The Sacramento River, Mokelumne River and San Joaquin River receiver aggregates represent all the detections at and upstream of those locations. Tracking lines are separated by year, and provide a rough visual representation of fish transit between detections at receiver aggregates. Receivers points are scaled by the cumulative number of detections that occurred across all three years.



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-47821.mxd (ECK) eke@ecorp 7/15/2013



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 7/15/2013



Pacific Ocean

San Francisco Bay & Delta White Sturgeon Detections Fish Tag ID: A69-1303-47835

Map Features

- Aggregated Receiver Location (No Detection)

Fish Transit by Year

- 2011
- 2012

Cumulative Detections by Receiver

- 2 - 50
- 51 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 5,000
- > 5,000

*Receivers were aggregated with others in the same array or vicinity for simplicity and clarity. All Bay arrays, Delta and river receivers were aggregated into single representative points. The Sacramento River, Mokelumne River and San Joaquin River receiver aggregates represent all the detections at and upstream of those locations. Tracking lines are separated by year, and provide a rough visual representation of fish transit between detections at receiver aggregates. Receivers points are scaled by the cumulative number of detections that occurred across all three years.



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-47835.mxd (ECK) ekeche 7/15/2013



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 7/15/2013

San Francisco Bay & Delta White Sturgeon Detections Fish Tag ID: A69-1303-47867

Map Features

- Aggregated Receiver Location (No Detection)

Fish Transit by Year

- 2011
- 2012

Cumulative Detections by Receiver

- 2 - 50
- 51 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 5,000
- > 5,000

*Receivers were aggregated with others in the same array or vicinity for simplicity and clarity. All Bay arrays, Delta and river receivers were aggregated into single representative points. The Sacramento River, Mokelumne River and San Joaquin River receiver aggregates represent all the detections at and upstream of those locations. Tracking lines are separated by year, and provide a rough visual representation of fish transit between detections at receiver aggregates. Receivers points are scaled by the cumulative number of detections that occurred across all three years.



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-47867.mxd (ECX) ekethe 7/15/2013

Pacific Ocean



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community



Map Date: 7/15/2013

San Francisco Bay & Delta White Sturgeon Detections Fish Tag ID: A69-1303-56454

Map Features

- Aggregated Receiver Location (No Detection)

Fish Transit by Year

- 2011
- 2012
- 2013

Cumulative Detections by Receiver

- 2 - 50
- 51 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 5,000
- > 5,000

*Receivers were aggregated with others in the same array or vicinity for simplicity and clarity. All Bay arrays, Delta and river receivers were aggregated into single representative points. The Sacramento River, Mokelumne River and San Joaquin River receiver aggregates represent all the detections at and upstream of those locations. Tracking lines are separated by year, and provide a rough visual representation of fish transit between detections at receiver aggregates. Receivers points are scaled by the cumulative number of detections that occurred across all three years.



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-56454.mxd (ECK) eke@che 7/15/2013

Pacific Ocean



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 7/15/2013

San Francisco Bay & Delta White Sturgeon Detections Fish Tag ID: A69-1303-62780

Map Features

- Aggregated Receiver Location (No Detection)

Fish Transit by Year

- 2011
- 2012
- 2013

Cumulative Detections by Receiver

- 2 - 50
- 51 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 5,000
- > 5,000

*Receivers were aggregated with others in the same array or vicinity for simplicity and clarity. All Bay arrays, Delta and river receivers were aggregated into single representative points. The Sacramento River, Mokelumne River and San Joaquin River receiver aggregates represent all the detections at and upstream of those locations. Tracking lines are separated by year, and provide a rough visual representation of fish transit between detections at receiver aggregates. Receivers points are scaled by the cumulative number of detections that occurred across all three years.



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-62780.mxd (ECK) ekeche 7/15/2013

Pacific Ocean



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 7/15/2013

ATTACHMENT C

Wild Napa River Steelhead (CC) San Francisco Bay Detections

Tag ID	Detected At	First Detection Date/Time (UTC)	Total Number of Detections at this Location
A69-1303-29795	Napa River RST	4/22/10 21:55	2
A69-1303-29795	Napa River - 1	4/25/10 13:11	2
A69-1303-29795	Napa River - 2	4/25/10 13:15	4
A69-1303-29795	Napa River - 10	4/26/10 1:33	12
A69-1303-29795	Napa River - 9	4/26/10 2:00	2
A69-1303-29795	Mar_Is22	4/26/10 11:15	36
A69-1303-29795	Mar_Is23	4/26/10 11:15	24
A69-1303-29795	SP_Buoy_10	4/26/10 15:06	2
A69-1303-29795	SP_Buoy_9	4/26/10 15:13	15
A69-1303-29795	SP_Array_2A	4/26/10 23:01	10
A69-1303-29795	SP_Array_2B	4/26/10 23:10	1
A69-1303-29795	SP_Array_2C	4/26/10 23:13	1
A69-1303-29795	SF_Control_NE	4/27/10 23:36	1
A69-1303-29795	BayBr16A	4/28/10 4:18	2
A69-1303-29795	BayBr14B	4/28/10 7:43	1
A69-1303-29795	BayBr12A	4/28/10 7:45	2
A69-1303-29796	Napa River - 1	4/23/10 20:56	40
A69-1303-29796	Napa River - 2	4/23/10 21:02	10
A69-1303-29796	Mar_Is23	4/24/10 22:13	12
A69-1303-29796	Mar_Is22	4/24/10 22:14	6
A69-1303-29796	Napa River - 9	4/24/10 22:20	4
A69-1303-29796	CarSt01	4/25/10 0:14	6
A69-1303-29797	Vallejo_Marina	4/25/10 20:49	1
A69-1303-29797	Mar_Is23	4/25/10 21:22	6
A69-1303-29797	Mar_Is22	4/25/10 21:23	6
A69-1303-29797	Napa River - 9	4/25/10 21:42	2
A69-1303-29797	SP_Control_4	4/26/10 0:14	2
A69-1303-29797	SP_Control_3	4/26/10 0:14	4
A69-1303-29797	SP_Control_2	4/26/10 0:20	1
A69-1303-29797	SP_Array_1A	4/26/10 0:38	9
A69-1303-29797	SP_Array_1B	4/26/10 0:39	1
A69-1303-29797	SP_Array_1F	4/26/10 1:43	1
A69-1303-29797	SP_Array_1H	4/26/10 1:48	4
A69-1303-29797	SP_Array_1G	4/26/10 1:50	3
A69-1303-29797	SP_Control_6	4/26/10 9:55	1
A69-1303-29797	SP_Control_7	4/26/10 9:56	1
A69-1303-29797	SP_Array_1E	4/26/10 10:09	1
A69-1303-29797	SP_Array_2E	4/26/10 10:19	2
A69-1303-29797	RichBr_11_2009	4/26/10 12:02	4
A69-1303-29797	RichBr_12_2009	4/26/10 12:05	5

A69-1303-29797	BayBr07.1	4/28/10 4:01	14
A69-1303-29797	BayBr06.1	4/28/10 4:11	5
A69-1303-29797	BayBr08.1	4/28/10 4:17	1
A69-1303-29797	BayBr08.5	4/28/10 6:39	10
A69-1303-29797	Pt_Reyes_07	5/30/10 14:01	1
<hr/>			
A69-1303-29798	Napa River RST	4/21/10 15:34	2
A69-1303-29798	Napa River - 2	4/25/10 0:10	14
A69-1303-29798	Napa River - 1	4/25/10 1:12	12
A69-1303-29798	Napa River - 10	4/26/10 14:03	6
A69-1303-29798	Napa River - 9	4/26/10 14:53	12
A69-1303-29798	Mar_Is23	4/26/10 21:32	3
A69-1303-29798	SP_Buoy_8	4/26/10 23:46	3
A69-1303-29798	SP_Control_5	4/27/10 0:22	5
A69-1303-29798	SP_Control_6	4/27/10 0:24	1
A69-1303-29798	SP_Array_1C	4/27/10 0:45	1
A69-1303-29798	SP_Array_1D	4/27/10 0:47	2
A69-1303-29798	SP_Array_1E	4/27/10 0:48	4
A69-1303-29798	SP_Array_1F	4/27/10 0:49	1
A69-1303-29798	RichBr_19_2009	4/27/10 16:52	1
A69-1303-29798	RichBr_14_2009	4/27/10 20:54	12
A69-1303-29798	RichBr_W_Channel_2009	4/27/10 20:56	36
A69-1303-29798	RichBr_13_2009	4/27/10 20:58	5
A69-1303-29798	BayBr12B	4/28/10 8:04	3
<hr/>			
A69-1303-29800	Napa River - 1	4/23/10 22:25	36
A69-1303-29800	Napa River - 2	4/23/10 22:34	36
A69-1303-29800	Napa River - 9	4/24/10 23:14	4
A69-1303-29800	Vallejo_Marina	4/25/10 7:34	1
A69-1303-29800	Mar_Is22	4/25/10 8:11	9
A69-1303-29800	Mar_Is23	4/25/10 8:11	6
A69-1303-29800	SP_Control_5	4/25/10 14:17	1
A69-1303-29800	SP_Control_4	4/25/10 14:18	20
A69-1303-29800	SP_Control_3	4/25/10 14:18	13
A69-1303-29800	SP_Control_2	4/25/10 14:27	18
A69-1303-29800	SP_Control_1	4/25/10 14:35	6
A69-1303-29800	SP_Buoy_8	4/25/10 19:16	6
A69-1303-29800	SP_Array_1A	4/25/10 20:24	2
A69-1303-29800	SP_Array_2B	4/25/10 20:40	1
A69-1303-29800	SP_Array_2C	4/25/10 20:40	2
A69-1303-29800	SP_Array_2D	4/25/10 20:41	1
A69-1303-29800	RichBr_19_2009	4/25/10 21:55	3
A69-1303-29800	RichBr_18_2009	4/25/10 21:55	1
A69-1303-29800	Pt_Reyes_09	5/9/10 6:43	10
A69-1303-29800	Pt_Reyes_07	5/23/10 4:45	11
A69-1303-29800	Pt_Reyes_08	6/2/10 8:38	30

A69-1303-29801	Napa River - 1	4/27/10 11:06	4
A69-1303-29801	Napa River - 2	4/27/10 11:08	4
A69-1303-29801	Napa River - 10	4/27/10 14:47	16
A69-1303-29801	Napa River - 9	4/27/10 15:42	26
A69-1303-29801	Vallejo_Marina	4/28/10 12:13	3
A69-1303-29801	Mar_Is23	4/28/10 12:55	6
A69-1303-29801	CarSt01	4/28/10 14:01	9
A69-1303-29801	RichBr_21_2009	4/29/10 9:45	3
A69-1303-29801	RichBr_20_2009	4/29/10 9:49	3
A69-1303-29801	Pt_Reyes_07	5/18/10 19:54	10
<hr/>			
A69-1303-29804	Napa River - 1	4/22/10 18:24	4
A69-1303-29804	Napa River - 2	4/22/10 18:31	6
A69-1303-29804	Vallejo_Marina	4/24/10 19:01	1
A69-1303-29804	Mar_Is22	4/24/10 19:33	3
A69-1303-29804	SP_Control_1	4/24/10 22:01	1
A69-1303-29804	SP_Control_2	4/24/10 22:03	1
A69-1303-29804	SP_Array_1E	4/24/10 22:20	5
A69-1303-29804	SP_Array_2H	4/24/10 22:36	3
A69-1303-29804	SP_Array_1F	4/25/10 2:29	1
A69-1303-29804	SP_Control_6	4/25/10 2:50	6
A69-1303-29804	SP_Control_5	4/25/10 2:51	2
A69-1303-29804	CarSt01	4/25/10 6:03	12
A69-1303-29804	RichBr_18_2009	4/25/10 20:29	2
A69-1303-29804	RichBr_6_2009	4/26/10 12:03	2
A69-1303-29804	RichBr_7_2009	4/26/10 12:05	1
A69-1303-29804	RichBr_17_2009	4/26/10 17:13	4
A69-1303-29804	RichBr_26_2009	4/26/10 18:05	1
A69-1303-29804	RichBr_27_2009	4/26/10 18:09	2
A69-1303-29804	RichBr_29_2009	4/26/10 18:09	8
A69-1303-29804	RichBr_28_2009	4/26/10 18:10	4
A69-1303-29804	RichBr_E_Channel_2009	4/27/10 2:25	5
A69-1303-29804	RichBr_5_2009	4/27/10 2:28	3
A69-1303-29804	SP_Array_1C	4/27/10 7:17	6
A69-1303-29804	SP_Array_1B	4/27/10 7:20	1
A69-1303-29804	SP_Array_2C	4/27/10 9:26	1
<hr/>			
A69-1303-29805	Napa River RST	4/20/10 19:35	6
A69-1303-29805	Napa River - 2	4/23/10 1:36	14
A69-1303-29805	Napa River - 1	4/23/10 1:52	10
A69-1303-29805	Vallejo_Marina	4/23/10 21:13	5
A69-1303-29805	Napa River - 9	4/24/10 10:37	2
A69-1303-29805	Mar_Is23	4/24/10 10:40	33
A69-1303-29805	Mar_Is22	4/24/10 10:41	45
A69-1303-29805	SP_Control_3	4/24/10 23:15	2
A69-1303-29805	SP_Control_4	4/24/10 23:17	2
A69-1303-29805	SP_Array_1C	4/24/10 23:39	4

A69-1303-29805	SP_Array_1A	4/24/10 23:40	1
A69-1303-29805	SP_Array_2A	4/25/10 7:51	1
A69-1303-29805	RichBr_10_2009	4/25/10 9:19	1
A69-1303-29805	BayBr12A	4/26/10 7:37	1
A69-1303-29805	Pt_Reyes_08	5/2/10 7:53	1
A69-1303-29805	Pt_Reyes_03	5/10/10 0:48	7
A69-1303-29805	Pt_Reyes_06	5/10/10 12:01	4
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A69-1303-29806	Napa River RST	4/20/10 19:52	2
A69-1303-29806	Napa River - 2	4/25/10 0:59	16
A69-1303-29806	Napa River - 1	4/25/10 1:23	6
A69-1303-29806	Mar_Is23	4/26/10 12:26	6
A69-1303-29806	RichBr_5_2009	4/27/10 22:37	1
A69-1303-29806	RichBr_W_Channel_2009	4/28/10 4:00	9
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A69-1303-29807	Napa River - 1	4/12/10 1:52	14
A69-1303-29807	Vallejo_Marina	4/13/10 12:54	2
A69-1303-29807	Mar_Is22	4/13/10 13:36	138
A69-1303-29807	Mar_Is23	4/13/10 13:37	72
A69-1303-29807	Napa River - 9	4/13/10 13:44	14
A69-1303-29807	Napa River - 10	4/13/10 18:17	2
A69-1303-29807	Napa River - 8	4/14/10 13:00	6
A69-1303-29807	SP_Buoy_8	4/14/10 23:36	1
A69-1303-29807	SP_Control_6	4/15/10 0:09	1
A69-1303-29807	SP_Control_7	4/15/10 0:10	2
A69-1303-29807	SP_Array_1E	4/15/10 0:27	2
A69-1303-29807	SP_Array_2G	4/15/10 0:45	1
A69-1303-29807	SP_Array_2H	4/15/10 0:46	2
A69-1303-29807	RichBr_10_2009	4/15/10 2:27	45
A69-1303-29807	RichBr_9_2009	4/15/10 3:20	1
A69-1303-29807	RichBr_20_2009	4/15/10 10:33	5
A69-1303-29807	BayBr17	4/15/10 16:51	1
A69-1303-29807	BayBr14B	4/15/10 22:12	4
A69-1303-29807	SF_Control_SW	4/16/10 2:50	3
A69-1303-29807	SF_Control_NE	4/16/10 2:58	2
A69-1303-29807	BayBr14A	4/16/10 8:12	12
A69-1303-29807	Pt_Reyes_09	5/6/10 0:45	3
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A69-1303-29808	SR_RV127L	3/10/09 6:31	1
A69-1303-29808	Napa River - 1	4/12/10 14:01	80
A69-1303-29808	Napa River - 2	4/12/10 14:09	34
A69-1303-29808	Napa River - 8	4/13/10 2:46	2
A69-1303-29808	Vallejo_Marina	4/13/10 11:12	1
A69-1303-29808	Mar_Is22	4/13/10 11:55	3
A69-1303-29808	Mar_Is23	4/13/10 12:01	9
A69-1303-29808	Napa River - 10	4/13/10 12:04	6
A69-1303-29808	SP_Control_6	4/13/10 22:43	5

A69-1303-29808	SP_Control_7	4/13/10 22:45	4
A69-1303-29808	SP_Control_8	4/13/10 22:46	1
A69-1303-29808	SP_Array_1F	4/13/10 23:02	6
A69-1303-29808	SP_Array_1E	4/13/10 23:04	2
A69-1303-29808	SP_Array_2G	4/13/10 23:32	4
A69-1303-29808	SP_Array_2F	4/13/10 23:33	1
A69-1303-29808	SP_Array_2H	4/13/10 23:34	1
A69-1303-29808	RichBr_W_Channel_2009	4/14/10 1:14	3
A69-1303-29808	RichBr_14_2009	4/14/10 1:24	3
A69-1303-29808	RichBr_13_2009	4/14/10 1:25	8
A69-1303-29808	RichBr_9_2009	4/14/10 5:33	8
A69-1303-29808	RichBr_10_2009	4/14/10 5:34	2
A69-1303-29808	RichBr_5_2009	4/14/10 9:06	2
A69-1303-29808	RichBr_E_Channel_2009	4/14/10 9:09	3
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A69-1303-29809	Napa River - 1	4/28/10 1:29	30
A69-1303-29809	Napa River - 2	4/28/10 1:40	12
A69-1303-29809	Napa River - 9	4/29/10 14:47	76
A69-1303-29809	Mar_Is23	4/29/10 14:48	78
A69-1303-29809	Mar_Is22	4/29/10 17:05	123
A69-1303-29809	Vallejo_Marina	4/29/10 18:35	6
A69-1303-29809	Napa River - 10	4/30/10 16:02	8
A69-1303-29809	SP_Control_6	5/1/10 12:17	2
A69-1303-29809	SP_Control_7	5/1/10 12:17	2
A69-1303-29809	SP_Array_1C	5/1/10 12:33	1
A69-1303-29809	SP_Array_2C	5/1/10 12:48	1
A69-1303-29809	SP_Array_2D	5/1/10 12:48	1
A69-1303-29809	BayBr11	5/1/10 23:25	9
A69-1303-29809	Raccoon01_2009	5/2/10 5:51	9
A69-1303-29809	Pt_Reyes_15	5/27/10 5:30	40
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A69-1303-29811	Napa River - 1	4/13/10 0:28	58
A69-1303-29811	Napa River - 2	4/13/10 0:53	44
A69-1303-29811	Napa River - 8	4/13/10 15:23	4
A69-1303-29811	Vallejo_Marina	4/13/10 23:17	1
A69-1303-29811	Mar_Is22	4/13/10 23:57	42
A69-1303-29811	Mar_Is23	4/14/10 0:01	30
A69-1303-29811	Napa River - 10	4/14/10 0:05	6
A69-1303-29811	CarSt01	4/14/10 5:50	3
A69-1303-29811	SP_Control_1	4/14/10 15:27	15
A69-1303-29811	SP_Control_3	4/14/10 15:33	6
A69-1303-29811	SP_Control_2	4/14/10 15:34	7
A69-1303-29811	SP_Control_4	4/14/10 15:36	8
A69-1303-29811	SP_Control_6	4/14/10 15:42	7
A69-1303-29811	SP_Array_1B	4/14/10 16:25	1
A69-1303-29811	SP_Array_1C	4/14/10 16:25	1
A69-1303-29811	SP_Array_1A	4/14/10 16:26	1

A69-1303-29811	SP_Buoy_8	4/14/10 18:21	3
A69-1303-29811	RichBr_17_2009	4/15/10 13:28	1
A69-1303-29811	RichBr_28_2009	4/15/10 17:47	8
A69-1303-29811	RichBr_27_2009	4/15/10 17:48	15
A69-1303-29811	RichBr_26_2009	4/15/10 17:48	2
A69-1303-29811	BayBr11	4/16/10 4:32	1
A69-1303-29811	Alcatraz_SE	4/16/10 15:00	2
A69-1303-29811	BayBr18	4/16/10 18:42	27
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A69-1303-29814	Napa River - 1	4/11/10 14:02	166
A69-1303-29814	Napa River - 2	4/11/10 14:14	50
A69-1303-29814	Vallejo_Marina	4/15/10 14:04	4
A69-1303-29814	Napa River - 10	4/15/10 14:54	38
A69-1303-29814	Napa River - 9	4/15/10 14:54	58
A69-1303-29814	Mar_Is22	4/15/10 14:56	111
A69-1303-29814	Mar_Is23	4/15/10 14:56	93
A69-1303-29814	Napa River - 8	4/18/10 15:11	4
A69-1303-29814	CarSt01	4/18/10 16:52	3
A69-1303-29814	SP_Buoy_9	4/18/10 23:52	6
A69-1303-29814	SP_Buoy_8	4/19/10 2:51	3
A69-1303-29814	SP_Flats_Array_7	4/19/10 6:34	5
A69-1303-29814	SP_Flats_Array_6	4/19/10 6:40	8
A69-1303-29814	SP_Flats_Array_5	4/19/10 6:47	1
A69-1303-29814	SP_Control_3	4/19/10 13:18	6
A69-1303-29814	SP_Control_4	4/19/10 13:20	1
A69-1303-29814	SP_Control_2	4/19/10 13:24	1
A69-1303-29814	SP_Array_1C	4/19/10 13:39	4
A69-1303-29814	SP_Array_2E	4/19/10 13:49	2
A69-1303-29814	SP_Array_2D	4/19/10 13:53	2
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A69-1303-37321	Napa River - 1	4/10/11 18:53	12
A69-1303-37321	Napa River - 10	4/11/11 21:13	210
A69-1303-37321	Napa River - 9	4/12/11 2:11	44
A69-1303-37321	SF9_SE	4/12/11 20:35	2
A69-1303-37321	SP_Buoy_8	4/12/11 21:58	1
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A69-1303-37325	Napa River - 1	4/9/11 16:42	12
A69-1303-37325	Napa River - 2	4/9/11 16:48	8
A69-1303-37325	Napa River - 4	4/9/11 16:48	2
A69-1303-37325	Napa River - 10	4/10/11 17:34	18
A69-1303-37325	Napa River - 9	4/10/11 17:39	2
A69-1303-37325	SF9_SE	4/10/11 18:19	3
A69-1303-37325	SF9_SW	4/10/11 18:24	3
A69-1303-37325	SP_Buoy_8	4/10/11 19:29	1
A69-1303-37325	SP_Array_1C	4/10/11 20:01	2
A69-1303-37325	SP_Array_2H	4/10/11 20:25	2
A69-1303-37325	RichBr_14_2009	4/11/11 15:32	1

A69-1303-37327	Napa River - 1	4/9/11 18:55	192
A69-1303-37327	Napa River - 2	4/9/11 19:08	26
A69-1303-37327	Napa River - 4	4/10/11 5:17	4
A69-1303-37327	Napa River - 10	4/11/11 19:27	42
A69-1303-37327	Napa River - 9	4/11/11 19:35	28
A69-1303-37327	SF9_SE	4/14/11 22:39	2
A69-1303-37327	SF9_SW	4/14/11 22:45	3
A69-1303-37327	SP_Array_1E	4/15/11 0:50	4
A69-1303-37327	SP_Array_1H	4/15/11 9:47	1
A69-1303-37327	RichBr_20_2009	4/15/11 19:21	5
A69-1303-37327	RichBr_21_2009	4/15/11 19:21	6
A69-1303-37327	RichBr_22_2009	4/15/11 19:22	1
A69-1303-37327	RichBr_19_2009	4/15/11 19:23	3
A69-1303-37327	Alcatraz_NE	4/15/11 23:27	5
A69-1303-37327	Alcatraz_NW	4/15/11 23:35	5
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A69-1303-37328	Napa River - 1	4/10/11 20:57	150
A69-1303-37328	Napa River - 4	4/11/11 2:18	26
A69-1303-37328	Napa River - 2	4/11/11 2:23	26
A69-1303-37328	RichBr_19_2009	4/13/11 17:56	3
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A69-1303-37329	Napa River - 1	4/11/11 20:34	306
A69-1303-37329	Napa River - 2	4/11/11 20:58	136
A69-1303-37329	Napa River - 4	4/11/11 21:28	2
A69-1303-37329	Napa River - 10	4/12/11 21:33	42
A69-1303-37329	Napa River - 9	4/12/11 23:52	14
A69-1303-37329	CarBr01	4/16/11 0:43	40
A69-1303-37329	Carq_East	4/16/11 0:55	23
A69-1303-37329	CarBr02	4/16/11 1:16	12
A69-1303-37329	BenBrCenter	4/16/11 4:46	2
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A69-1303-37330	Napa River - 1	4/9/11 18:54	4
A69-1303-37330	Napa River - 2	4/9/11 19:02	2
A69-1303-37330	Vallejo_Marina	4/10/11 16:49	1
A69-1303-37330	Napa River - 10	4/10/11 17:42	6
A69-1303-37330	SP_Array_1G	4/10/11 21:07	5
A69-1303-37330	SP_Array_1H	4/10/11 21:08	4
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A69-1303-37333	Napa River - 1	4/11/11 20:22	220
A69-1303-37333	Napa River - 2	4/12/11 8:41	88
A69-1303-37333	Napa River - 4	4/12/11 14:16	180
A69-1303-37333	Napa River - 10	4/12/11 21:02	178
A69-1303-37333	Napa River - 9	4/12/11 21:14	74
A69-1303-37333	Vallejo_Marina	4/12/11 23:12	6
A69-1303-37333	SF9_SE	4/16/11 11:31	2
A69-1303-37333	SF9_SW	4/16/11 11:36	1

A69-1303-37333	SP_Buoy_10	4/16/11 12:44	4
A69-1303-37333	SP_Buoy_8	4/16/11 13:18	1
A69-1303-37333	SP_Buoy_7	4/16/11 13:23	13
A69-1303-37333	SP_Flats_Array_7	4/16/11 15:57	54
A69-1303-37333	SP_Flats_Array_6	4/16/11 15:57	69
A69-1303-37333	SP_Flats_Array_5	4/16/11 16:02	96
A69-1303-37333	SP_Flats_Array_4	4/16/11 16:04	128
A69-1303-37333	SP_Flats_Array_3	4/16/11 16:11	49
A69-1303-37333	SP_Flats_Array_2	4/16/11 16:16	15
A69-1303-37333	SP_Flats_Array_8	4/16/11 17:41	16
A69-1303-37333	RichBr_12_2009	4/16/11 23:04	2
A69-1303-37333	RichBr_W_Channel_2009	4/16/11 23:08	2
A69-1303-37333	RichBr_14_2009	4/17/11 5:23	4
A69-1303-37333	RichBr_19_2009	4/17/11 8:50	1
A69-1303-37333	RichBr_21_2009	4/17/11 8:50	2
A69-1303-37333	RichBr_20_2009	4/17/11 8:52	2
A69-1303-37333	BayBr18	4/17/11 14:55	1
A69-1303-37333	Pt_Reyes_15	5/3/11 21:13	93
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A69-1303-40881	Napa River - 1	5/20/11 17:01	16
A69-1303-40881	Napa River - 2	5/20/11 17:05	2
A69-1303-40881	SP_Array_2B	5/25/11 6:20	3
A69-1303-40881	SP_Array_2A	5/25/11 6:20	2
A69-1303-40881	SP_Array_2C	5/25/11 6:25	1
A69-1303-40881	RichBr_15_2009	5/25/11 17:09	1
A69-1303-40881	Alcatraz_SE	5/26/11 14:05	5
A69-1303-40881	Pt_Reyes_02	8/9/11 2:27	3
A69-1303-40881	Pt_Reyes_09	8/9/11 17:39	13
A69-1303-40881	Pt_Reyes_03	8/14/11 21:48	19
A69-1303-40881	Pt_Reyes_04	8/17/11 2:48	56
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A69-1303-40882	Napa River - 1	5/21/11 18:08	86
A69-1303-40882	Napa River - 2	5/21/11 21:50	4
A69-1303-40882	Napa River - 6	5/22/11 15:59	2
A69-1303-40882	Napa River - 9	5/22/11 18:14	18
A69-1303-40882	Napa River - 10	5/22/11 18:27	10
A69-1303-40882	SF9_NE	5/23/11 7:44	4
A69-1303-40882	SF9_NW	5/23/11 7:57	1
A69-1303-40882	SP_Flats_Array_6	5/23/11 14:28	4
A69-1303-40882	SP_Flats_Array_7	5/23/11 14:29	5
A69-1303-40882	RichBr_17_2009	5/23/11 17:00	3
A69-1303-40882	RichBr_18_2009	5/23/11 17:03	3
A69-1303-40882	RichBr_16_2009	5/23/11 17:06	1
A69-1303-40882	BayBr15	5/23/11 21:21	1
A69-1303-40882	Alcatraz_NW	5/24/11 15:36	1
A69-1303-40882	Pt_Reyes_11.5	9/2/11 3:46	11
A69-1303-40882	BayBr11	9/7/11 1:52	2

A69-1303-40882	BayBr12B	9/7/11 2:06	6
A69-1303-40882	Emeryville_Marina_A_Out	9/7/11 17:34	1
A69-1303-40882	BenBr04	9/10/11 6:50	2
A69-1303-40913	Napa River - 1	3/24/12 3:03	192
A69-1303-40913	Napa River - 2	3/24/12 3:17	8
A69-1303-40913	Napa River - 4	3/24/12 6:22	46
A69-1303-40913	Napa River - 10	3/26/12 16:43	100
A69-1303-40913	GG1	3/28/12 15:42	2
A69-1303-40913	GG2	3/28/12 15:43	1
A69-1303-40916	Napa River - 1	4/9/12 16:16	68
A69-1303-40916	Napa River - 10	4/10/12 17:55	34
A69-1303-40916	GG1	4/12/12 18:45	2
A69-1303-40916	GG9	4/12/12 21:22	2
A69-1303-40916	GG2	4/13/12 5:24	4
A69-1303-40924	Napa River - 1	4/22/12 0:49	120
A69-1303-40924	Napa River - 8	4/22/12 16:21	14
A69-1303-40924	Napa River - 10	4/22/12 16:55	42
A69-1303-40924	Napa River - 4	4/23/12 20:52	2
A69-1303-40924	GG1	4/27/12 12:10	5
A69-1303-40925	Napa River - 1	3/26/12 15:37	18
A69-1303-40925	Napa River - 10	3/27/12 15:14	6
A69-1303-40925	GG2	3/29/12 1:26	6
A69-1303-40927	Napa River - 1	3/26/12 16:15	42
A69-1303-40927	Napa River - 10	3/28/12 15:16	16
A69-1303-40927	GG1	3/29/12 19:02	4
A69-1303-40927	GG9	3/30/12 1:37	10
A69-1303-40927	GG5	3/30/12 2:05	14
A69-1303-40927	GG4	3/30/12 2:13	3

ATTACHMENT D

Overview of Wild Napa River Steelhead Detection Summary Patterns at each Receiver
(or Receiver Aggregate) within the San Francisco Bay and Delta Region

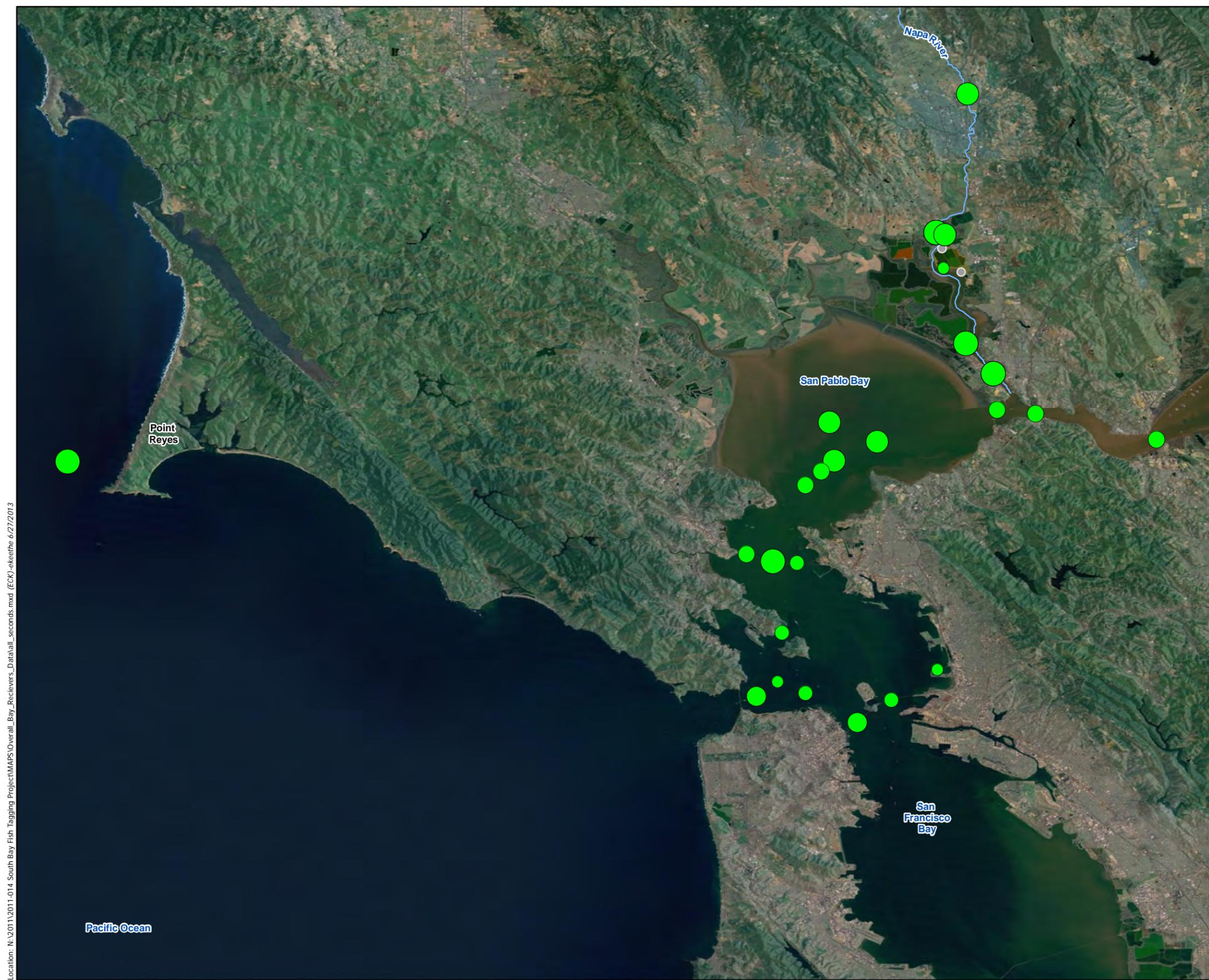
Napa River Steelhead San Francisco Bay Detections

Map Features

● Aggregated Receiver Location (No Detection)

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\all_seconds.mxd (ECK) - kseeffe 6/27/2013

Pacific Ocean

San Pablo Bay

San Francisco Bay

Napa River

Point Reyes



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community



Map Date: 6/27/2013

ATTACHMENT E

Movement of Wild Napa River Steelhead throughout the San Francisco Bay and Delta

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29795**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/22/2010
- 4/25/2010
- 4/26/2010
- 4/27/2010
- 4/28/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-29795.mxd (ECK) - created 6/27/2013



1 inch = 6 miles





**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29797**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/20/2010
- 4/25/2010
- 4/26/2010
- 4/28/2010
- 5/30/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recievers_Data\A69-1303-29797.mxd (ECK) eke@ecorp.com 6/27/2013

Pacific Ocean



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 6/27/2013

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29798**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/21/2010
- 4/25/2010
- 4/26/2010
- 4/27/2010
- 4/28/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



1 inch = 6 miles



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-29798.mxd (ECK) - eke@ecorp.com 6/27/2013

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29800**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/23/2010
- 4/24/2010
- 4/25/2010
- 4/26/2010
- 5/23/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recievers_Data\A29800.mxd (ECK) ekeatfe 6/27/2013



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29801**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/27/2010
- 4/28/2010
- 4/29/2010
- 5/18/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\29801.mxd (ECK) ekeatfe 6/27/2013



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29804**

Map Features

- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/22/2010
- 4/24/2010
- 4/25/2010
- 4/26/2010
- 4/27/2010
- 4/28/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\29804.mxd (ECK) - ekeafte 6/27/2013



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29805**

Map Features

- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/20/2010
- 4/23/2010
- 4/24/2010
- 4/25/2010
- 4/26/2010
- 5/2/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\29805.mxd (ECK) ekeatfe 6/27/2013



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29807**

Map Features

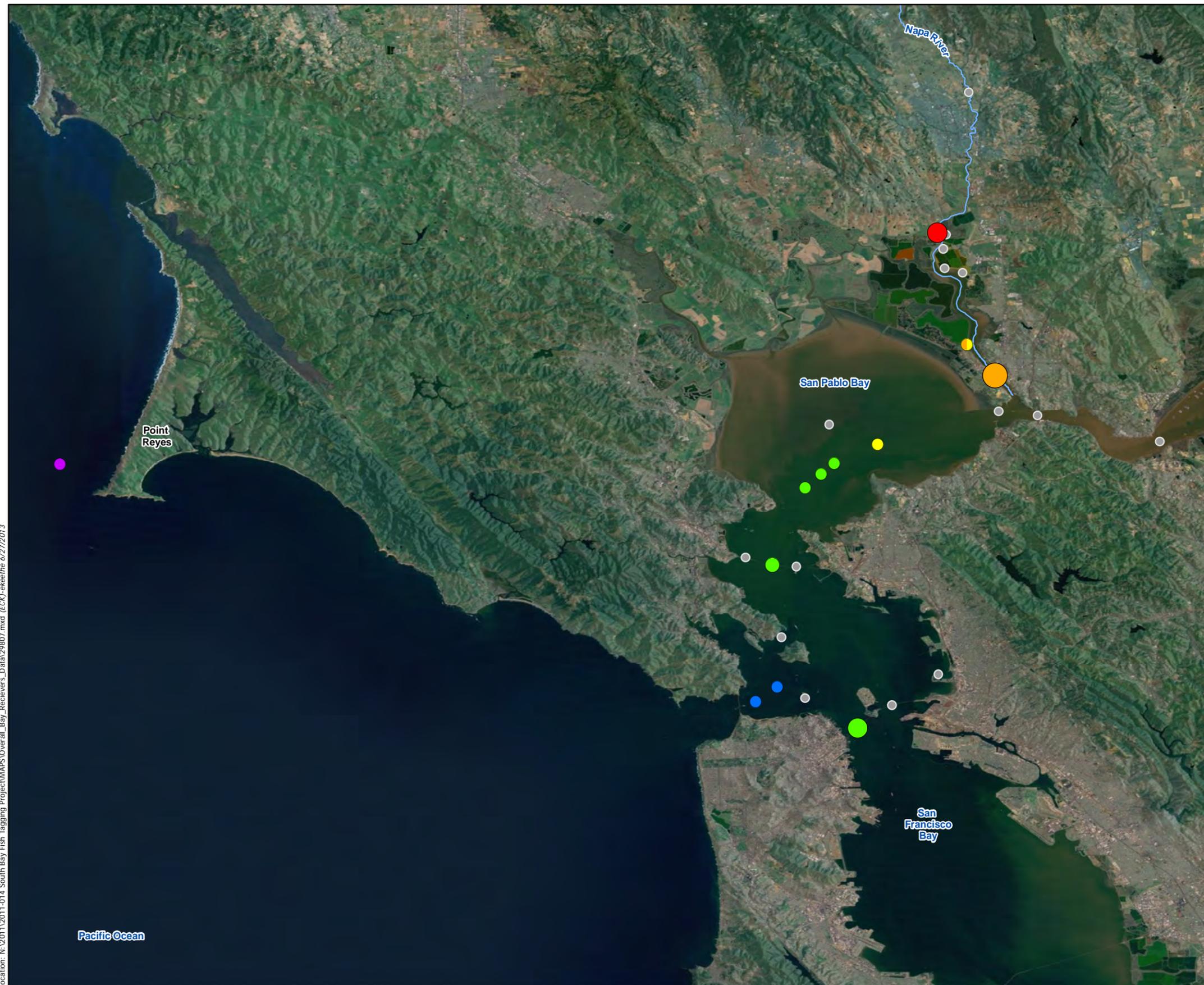
- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/12/2010
- 4/13/2010
- 4/14/2010
- 4/15/2010
- 4/16/2010
- 5/6/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recivers_Data\A69-1303-29807.mxd (ECK) eke@ecorp.com 6/27/2013

Pacific Ocean

San Pablo Bay

San Francisco Bay

Napa River

Point Reyes



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29808**

Map Features

- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/12/2010
- 4/13/2010
- 4/14/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\29808.mxd (ECK) ekeatfe 6/27/2013



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29809**

Map Features

- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/28/2010
- 4/29/2010
- 5/1/2010
- 5/2/2010
- 5/27/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A29809.mxd (ECK) ekeatfe 6/27/2013



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29811**

Map Features

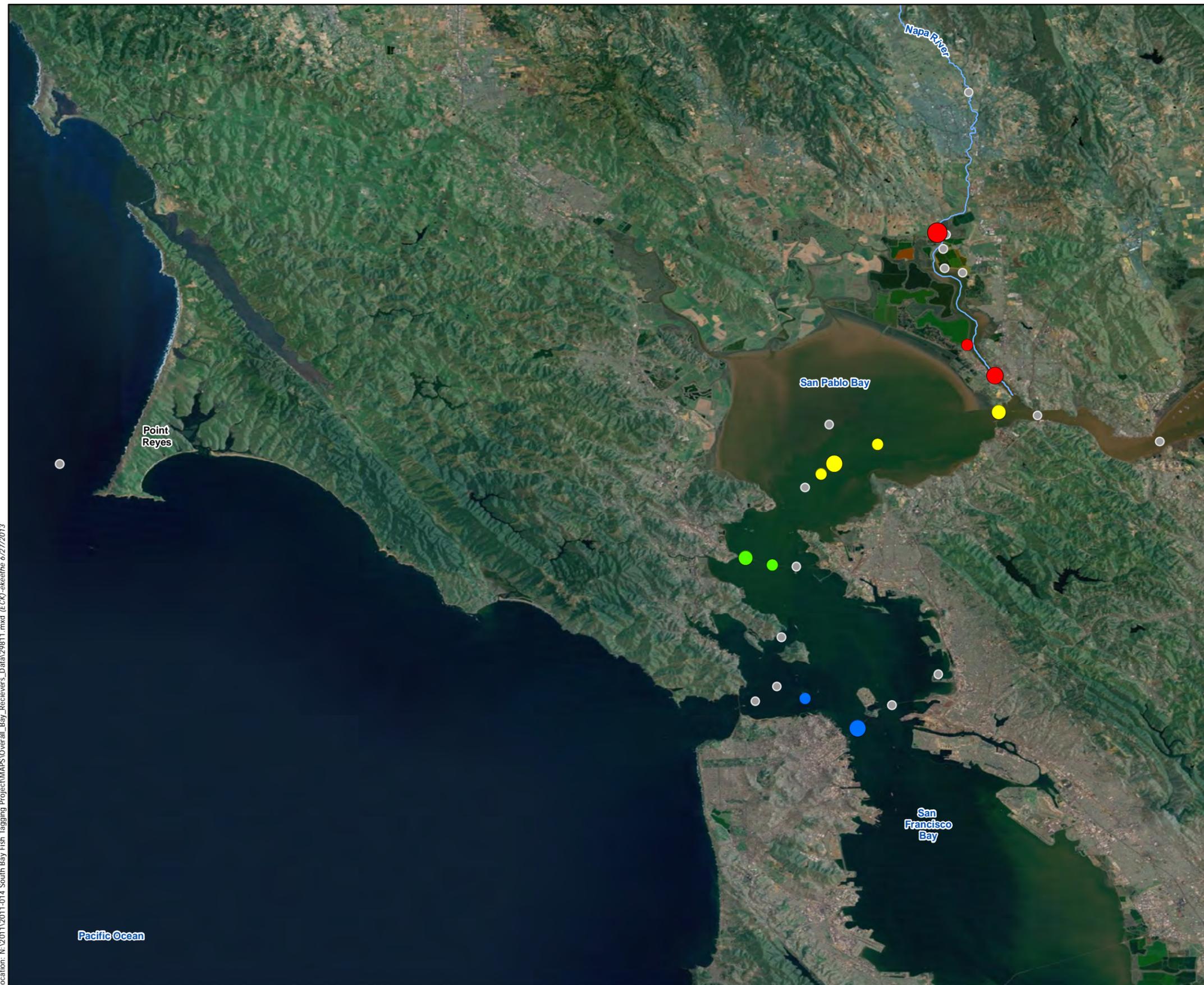
● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/13/2010
- 4/14/2010
- 4/15/2010
- 4/16/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



1 inch = 6 miles



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recivers_Data\29811.mxd (ECK) ekeatfe 6/27/2013

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-29814**

Map Features

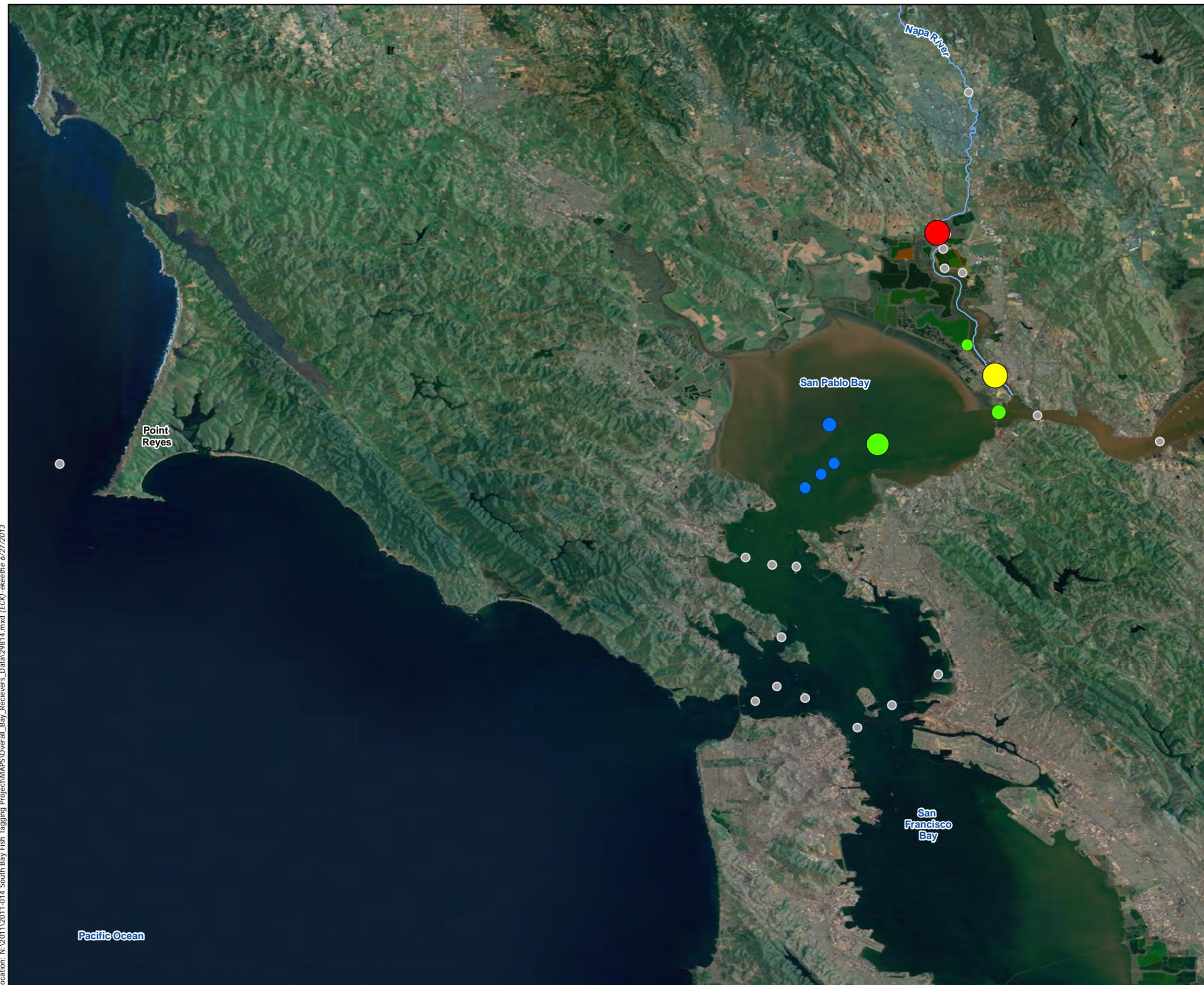
● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/11/2010
- 4/15/2010
- 4/18/2010
- 4/19/2010

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recivers_Data\29814.mxd (ECK) - ekeafte 6/27/2013



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-37321**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

● 4/10/2011

● 4/11/2011

● 4/12/2011

Residency Time at Receiver

○ 0-5 minutes

○ 5 minutes - 1 hour

○ 1 hour - 6 hours

○ 6 hours - 12 hours

○ 12 hours - 1 day

○ 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recievers_Data\37321.mxd (ECK) - created 6/27/2013



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-37325**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

● 4/9/2011

● 4/10/2011

● 4/11/2011

Residency Time at Receiver

○ 0-5 minutes

○ 5 minutes - 1 hour

○ 1 hour - 6 hours

○ 6 hours - 12 hours

○ 12 hours - 1 day

○ 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recievers_Data\A69-1303-37325.mxd (ECK) - created 6/27/2013

Pacific Ocean

San Pablo Bay

San Francisco Bay

Point Reyes



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-37327**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/9/2011
- 4/10/2011
- 4/11/2011
- 4/14/2011
- 4/15/2011

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recievers_Data\A69-1303-37327.mxd (ECK) eke@fhe 6/27/2013



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-37328**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/10/2011
- 4/11/2011
- 4/13/2011
- 4/14/2011

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recievers_Data\37328.mxd (ECK) ekeatfe 6/27/2013

Pacific Ocean



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-37329**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

● 4/11/2011

● 4/12/2011

● 4/16/2011

Residency Time at Receiver

○ 0-5 minutes

○ 5 minutes - 1 hour

○ 1 hour - 6 hours

○ 6 hours - 12 hours

○ 12 hours - 1 day

○ 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recivers_Data\37329.mxd (ECK) ekeatfe 6/27/2013



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-37330**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

● 4/9/2011

● 4/10/2011

● 4/12/2011

Residency Time at Receiver

○ 0-5 minutes

○ 5 minutes - 1 hour

○ 1 hour - 6 hours

○ 6 hours - 12 hours

○ 12 hours - 1 day

○ 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recievers_Data\37330.mxd (ECK) - created 6/27/2013

Pacific Ocean

San Pablo Bay

San Francisco Bay

Napa River

Point Reyes



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-37333**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/11/2011
- 4/12/2011
- 4/16/2011
- 4/17/2011
- 5/3/2011

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A69-1303-37333.mxd (ECK) - created 6/27/2013



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-40881**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 5/20/2011
- 5/25/2011
- 5/26/2011
- 8/9/2011

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\40881.mxd (ECK) ekeatfe 6/27/2013



1 inch = 6 miles



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-40882**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

- 5/21/2011
- 5/22/2011
- 5/23/2011
- 5/24/2011
- 9/2/2011
- 9/7/2011
- 9/10/2011

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\40882.mxd (ECK) eke@ecorp.com 6/27/2013

Pacific Ocean



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 6/27/2013

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-40913**

Map Features

- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 3/24/2012
- 3/26/2012
- 3/28/2012
- 4/8/2012

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A6913.mxd (ECK) - eke@the 6/27/2013



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-40916**

Map Features

- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/9/2012
- 4/10/2012
- 4/12/2012
- 4/22/2012

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A6916.mxd (ECK) - eke@ecorp.com 6/27/2013



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community



**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-40924**

Map Features

- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 4/22/2012
- 4/23/2012
- 4/27/2012

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Recievers_Data\40924.mxd (ECK) - ekeafte 6/27/2013

Pacific Ocean



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Map Date: 6/27/2013

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-40925**

Map Features

- Aggregated Receiver Location (No Detection)

Initial Detection Date

- 3/26/2012
- 3/27/2012
- 3/29/2012
- 4/13/2012

Residency Time at Receiver

- 0-5 minutes
- 5 minutes - 1 hour
- 1 hour - 6 hours
- 6 hours - 12 hours
- 12 hours - 1 day
- 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A6925.mxd (ECK) - 6/27/2013

Pacific Ocean



1 inch = 6 miles



Image Source: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

**Napa River Steelhead
San Francisco Bay Detections
Fish Tag ID: A69-1303-40927**

Map Features

● Aggregated Receiver Location (No Detection)

Initial Detection Date

● 3/26/2012

● 3/28/2012

● 3/29/2012

Residency Time at Receiver

○ 0-5 minutes

○ 5 minutes - 1 hour

○ 1 hour - 6 hours

○ 6 hours - 12 hours

○ 12 hours - 1 day

○ 1 Day +



Location: N:\2011\2011-014_South Bay Fish Tagging Project\MAPS\Overall_Bay_Receivers_Data\A6927.mxd (ECK) eke@e 6/27/2013



1 inch = 6 miles



ATTACHMENT F

Wild Napa River Steelhead (CC) Immigration to Point Reyes

Tag ID	First Detection at Napa River Upper Gate Date/Time (UTC)	First Detection at Napa River Lower Gate Date/Time (UTC)	First Detection at Point Reyes Array Date/Time (UTC)	Time Between First Detection at the Napa River Lower Gate and Point Reyes (Days)
A69-1303-29797	N/A	4/25/10 21:42	5/30/10 14:01	35
A69-1303-29800	4/23/10 22:25	4/24/10 23:14	5/9/10 6:43	14
A69-1303-29801	4/27/10 11:06	4/27/10 14:47	5/18/10 19:54	21
A69-1303-29805	4/23/10 1:36	4/24/10 10:37	5/2/10 7:53	8
A69-1303-29807	4/12/10 1:52	4/13/10 13:44	5/6/10 0:45	22
A69-1303-29809	4/28/10 1:29	4/29/10 14:47	5/27/10 5:30	28
A69-1303-37333	4/11/11 20:22	4/12/11 21:02	5/3/11 21:13	21
A69-1303-40881	5/20/11 17:01	N/A	8/9/11 2:27	
A69-1303-40882	5/21/11 18:08	5/22/11 18:14	9/2/11 3:46	102
<i>Average Time (days):</i>				31
<i>Standard Error:</i>				11