Petaluma Watershed Steelhead Monitoring Report—
2013-2014 Spawning Surveys

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NOAA's National Marine Fisheries Service	NMFS
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Central California Coast steelhead	CCC
Distinct population segment	DPS
California Department of Fish and Wildlife	CDFW
Evolutionary Significant Unit	ESU

Acknowledgements

We would like to thank the United Anglers of Casa Grande High School for assisting with surveys and all of the landowners whom granted us access to their land to conduct spawner surveys.

Cover Photo: Adult steelhead in Adobe Creek. Taken by Karen Bobier, NMFS volunteer.

1. INTRODUCTION

1.1 Background

The Petaluma River watershed is located in southern Sonoma County at the boundary with Marin County, California. The watershed consists of several tributaries that drain into the tidally influenced portions of the Petaluma River. These tributaries include: Adobe Creek, Lynch Creek, Washington Creek, Ellis Creek, Willow Brook Creek, Lichau Creek, and San Antonio Creek—the only tributary that drains the west side of the watershed (Figure 1). The Petaluma River watershed is approximately 150 square miles and experiences a Mediterranean climate, characterized by warm summers and mild wet winters with an average yearly rainfall of approximately 26.6 inches. Over 90 percent of annual precipitation occurs during the wet season (between November and April). Stream flows within the watershed are highly variable and can go quickly from low base flow conditions to high flows and then quickly recede again (Figure 2**)**. Many tributaries to the Petaluma River are dry in late summer and in fall. The Petaluma River drains to San Pablo Bay, a sub-embayment in the northern portion of San Francisco Bay. The Petaluma Marsh is the largest remaining tidal brackish marsh in California (CDFW 2007) and is an important rearing area for many aquatic species (Goals Project 1999).

The Petaluma River was historically a narrow, shallow, and difficult to navigate tidal slough. Starting in the 1850's, it has been repeatedly dredged, widened, and straightened in order to facilitate the transport of goods from northern San Francisco Bay to San Francisco. In 1959, the tidal slough was designated a river, which authorized the Army Corps of Engineers to conduct periodic dredging to maintain a navigable channel. Most of the land within the watershed is privately owned and used primarily for agriculture such as cattle ranching, egg and grape production (SSRCD 1999).

NOAA's National Marine Fisheries Service (NMFS) is the federal agency, a division of the Department of Commerce, responsible for the stewardship of the nation's living marine resources and their habitat. Under the Federal Endangered Species Act (FESA) of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*), NMFS recovers protected marine and anadromous[1] species without unnecessarily impeding economic and recreational opportunities. NMFS initiated spawner abundance monitoring to assess the abundance and distribution of steelhead (*Oncorhynchus mykiss*) in the watershed. Steelhead are anadromous forms of rainbow trout. Steelhead that occur in the Petaluma River watershed belong to the Central California Coast (CCC) "distinct population segment" (DPS) and are listed as a threatened species under the, FESA (Figure 3).

[1] Anadromous fish are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn.

Throughout the spawner surveys and other ongoing steelhead monitoring efforts, NMFS has partnered with the United Anglers of Casa Grande High School (United Anglers), a local non-profit group that has been active in the watershed since the late 1980's. The United Anglers mission is to promote environmental awareness and activism through hands-on habitat restoration that supports the survival and recovery of steelhead in the Petaluma River watershed. The United Anglers largely consists of Casa Grande High School students that carry out habitat restoration activities and fish population monitoring. Past efforts of the United Anglers have resulted in the restoration of Adobe Creek from a state of nearly complete degradation to a stream that has consistently supported adult and juvenile steelhead since the early 1990's. The United Anglers operate a small, education-focused hatchery at the Casa Grande High School where they are currently rearing steelhead eggs sourced from the Warm Springs Hatchery in Geyserville, California to smolts that are then returned to the Warm Springs Hatchery to be imprinted and released back into the Russian River watershed. The United Anglers are interested in incorporating a conservation focus into their education-focused program to include the rearing of threatened steelhead from the Petaluma River watershed.

Steelhead observation data from the past 50 years suggests that this population has been reduced significantly from its historical abundance and distribution, largely due to watershed wide habitat destruction. Although, there is no comprehensive data on the population status of steelhead in the watershed, anecdotal information from the United Anglers from 1987 to 2013 indicate a declining population (Figure 4).

In 2013, United Anglers staff and students received training from NMFS to standardize spawning survey efforts in the watershed following the protocols of the American Fisheries Society (AFS) Salmonid Field Protocols Handbook (Gallagher *et al.* 2007). The main objective of the spawner surveys is to estimate the current abundance, productivity, spatial structure, and genetic diversity of CCC steelhead in the Petaluma River watershed; and evaluate steelhead habitat conditions of the Petaluma River watershed. The information obtained from spawner surveys will be used to inform future actions targeting the recovery of steelhead in the watershed. Preliminary observations by NMFS suggest that the population of steelhead in the watershed is at a very high risk of extirpation because of very low abundance and extremely limited distribution of individuals in the watershed. As such, NMFS' immediate objective is to work with the United Anglers to evaluate the necessity for a "conservation" hatchery in the watershed, which would sustain the population until large-scale habitat restoration is achieved.

1.2 Steelhead Life History

Steelhead are anadromous forms of rainbow trout (*O. mykiss*), spending some time in both fresh- and saltwater. The older juvenile and adult life stages occur in the ocean, until the adults ascend freshwater streams to spawn. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapovalov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Eggs (laid in gravel nests called redds), alevins (gravel dwelling hatchlings), fry (juveniles newly emerged from stream gravels), and young juveniles all rear in freshwater until they become large enough to migrate to the ocean to finish rearing and maturing to adults. General reviews for steelhead in California document much variation in life history (Barnhart 1986; Busby *et al.* 1996; McEwan 2001; Shapovalov and Taft 1954). Although variation occurs, in coastal California steelhead usually live in freshwater for 1 to 2 years, then spend 1 or 2 years in the ocean before returning to their natal stream to spawn. Steelhead may spawn one to four times over their life. Adult steelhead typically migrate from the ocean to freshwater between December and April, peaking in January and February (Fukushima and Lesh 1998). Juvenile steelhead migrate as smolts to the ocean from January through May, with peak migration occurring in April and May (Fukushima and Lesh 1998).

Steelhead fry rear in edgewater habitats and move gradually into pools and riffles as they grow larger. Cover is an important habitat component for juvenile steelhead, both as a velocity refuge and as a means of avoiding predation (Meehan and Bjorn 1991; Shirvell 1990). Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Rearing steelhead juveniles prefer water temperatures of 7.2-14.4°C and have an upper lethal limit of about 25°C (Barnhart 1986; Bjornn and Reiser 1991). However, they can survive in water up to 27°C with saturated dissolved oxygen conditions and a plentiful food supply. Fluctuating diurnal water temperatures also aid in survivability of salmonids (Busby *et al*. 1996). Juvenile steelhead emigration from their natal streams occurs episodically during fall, winter, and spring months, and generally occurs during high flow events. Barnhart (1986) reported that steelhead smolts in California typically range in size from 140 to 210 millimeter (mm) (fork length).

Historically, approximately 70 populations[2] of steelhead existed in the CCC steelhead DPS (Spence *et al.* 2008; Spence *et al.* 2012). Many of these populations (about 37) were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts (Bjorkstedt *et al.* 2005). The remaining populations were dependent upon immigration from nearby CCC steelhead DPS populations to ensure their viability (Bjorkstedt *et al.* 2005; McElhany *et al.* 2000).

[2] Population as defined by Bjorkstedt *et al.* 2005 and McElhaney *et al.* 2000 as, in brief summary, a group of fish of the same species that spawns in a particular locality at a particular season and does not interbreed substantially with fish from any other group. Such fish groups may include more than one stream. These authors use this definition as a starting point from which they define four types of populations (not all of which are mentioned here).

1.3 Status of CCC Steelhead and Critical Habitat

Recent viability assessment of CCC steelhead concluded that populations in watersheds that drain to San Francisco Bay are highly unlikely to be viable, and that the limited information available did not indicate that any other CCC steelhead populations could be demonstrated to be viable[3] (Spence *et al.* 2008). Monitoring data from the last ten years of adult CCC steelhead returns in Lagunitas and Scott creeks show steep declines in adults in 2008/2009. In 2011/2012 population levels began to increase, but still remained lower than levels observed over the past ten years (The Nature Conservancy 2013). The most recent status update found that the status of the CCC steelhead DPS remains "likely to become endangered in the foreseeable future" (Williams *et al.* 2011), as new and additional information available since Good *et al.* (2005), does not appear to suggest a change in extinction risk. On December 7, 2011, NMFS chose to maintain the threatened status of the CCC steelhead (76 FR 76386).

Critical habitat was designated for CCC steelhead on September 2, 2005 (70 FR 52488) and includes PCEs essential for the conservation of CCC steelhead. These PCEs include estuarine areas free of obstruction and excessive predation with the following essential features: (1) water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and (3) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation (70 FR 52488).

The condition of CCC steelhead critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat[4]: logging, agricultural and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals, including unscreened diversions for irrigation. Impacts of concern include alteration of streambank and channel morphology, alteration of water temperatures, loss of spawning and rearing habitat, fragmentation of habitat, loss of downstream recruitment of spawning gravels and large woody debris, degradation of water quality, removal of riparian vegetation resulting in increased streambank erosion, loss of shade (higher water temperatures) and loss of nutrient inputs (Busby *et al.* 1996, 70 FR 52488). Water development has drastically altered natural hydrologic cycles in many of the streams in the DPS. Alteration of flows results in migration delays, loss of suitable habitat due to dewatering and blockage; stranding of fish from rapid flow

[3] Viable populations have a high probability of long-term persistence (> 100 years).

[4] Other factors, such as over fishing and artificial propagation have also contributed to the current population status of steelhead. All these human induced factors have exacerbated the adverse effects of natural factors such as drought and poor ocean conditions.

fluctuations; entrainment of juveniles into poorly screened or unscreened diversions, and increased water temperatures harmful to salmonids. Overall, current condition of CCC steelhead critical habitat is degraded, and does not provide the full extent of conservation value necessary for the recovery of the species.

The ESA mandates NMFS to develop and implement plans for the conservation and survival of NMFS listed species, i.e., recovery plans. Recovery is the process by which listed species and their ecosystems are restored and their future safeguarded to the point that protections under the ESA are no longer needed. The recovery plan serves as a road map for species recovery – it lays out where we need to go and how best to get there (NMFS Interim Recovery Plan Guidance 2006). The recovery plan for CCC steelhead is currently in development. It will identify the major threats that impact steelhead and priority actions to be implemented to recover CCC steelhead.

1.4 Status of Steelhead and Critical Habitat in the Petaluma River Watershed

Limited information exists regarding the historic abundance of steelhead in the Petaluma River watershed. The physical attributes of the watershed suggest that populations were likely plentiful. NMFS estimates approximately 59 miles of potential habitat suitable for steelhead is present within the watershed.

Contemporary information suggests that steelhead occur in Adobe, Lichau, Lynch, Willow Brook, and San Antonio creeks. Of these listed tributaries, Adobe and Lynch Creeks have had the highest number of recent steelhead observations (personal communication, Dan Hubacher 2014). A visual survey of Adobe Creek by CDFW in 1968 reported juvenile steelhead abundances at 150 individuals per 30-meters (Skinner 1962). Another 1968 CDFW survey reported juvenile steelhead in Lichau Creek as well (Leidy *et al.* 2005). Steelhead adults have been observed in Adobe Creek, Lynch Creek and Willow Brook Creek by the United Anglers (personal communication, Dan Hubacker 2014). Surveys conducted in 2007 by CDFW confirmed the presence of juvenile steelhead in Adobe Creek, Lichau Creek and Lynch Creek and stated that steelhead may have been present in Willow Brook Creek but the fish observed were not identified (CDFW 2007). The United Anglers have conducted informal visual surveys of adult steelhead in Adobe Creek since 1987 and have observed adult steelhead every year, with numbers ranging from 1 – 60 fish per year (Figure 4). These surveys have shown that Chinook salmon (*Oncorhynchus tshawytscha*) are also present in the watershed, primarily in the tidally influenced portions of tributaries and the mainstem of the Petaluma River. The Chinook salmon occurring in the Petaluma River watershed are believed to be individuals of the Central Valley Fall-run Evolutionary Significant Unit (ESU). This population is not listed as threatened or endangered under the FESA.

Human activities in the watershed have impaired steelhead habitat conditions throughout the watershed. Within the survey area, quality spawning sites were limited. Altered sediment transport from high road densities within the riparian zone has limited spawning gravel recruitment and impacted spawning gravel quality. According to CDFW habitat typing surveys (2007), no streams within the watershed met optimal criteria for embeddedness. Most streams rated fair, and Ellis and Washington Creeks rated poor. Gravel embeddedness affects the survivability of incubating eggs through decreased oxygenation, and the release of metabolic wastes from the redd, and can also inhibit emergence of alevins from the redd. The riparian canopy has been reduced to less than 70 percent in Adobe, Washington and Ellis creeks (CDFW 2007). The majority of the riparian canopy that is present in the watershed does not contain the hardwood species necessary for bank stabilization and future recruitment of large woody debris (LWD). Unrestricted cattle grazing has significantly reduced the riparian canopy along all major creeks in the watershed. There are several passage impediments in the watershed that limit the ability for adult steelhead to migrate at all stream flows. These include culverts, bridges, small dams and farm ponds. Passage barriers are discussed in more detail below. Low stream flow conditions due to the drought restricted movements of adult steelhead in the watershed.

In the draft Recovery Plan for CCC steelhead, NMFS has identified priority recovery actions that should be implemented in this watershed which include: improving riparian and canopy, reducing the input of sand and silt, improving stream flows in tributaries, removing passage barriers, addressing water pollution problems, and increasing population numbers through supplementation efforts following significant habitat restoration to address the above issues. San Antonio Creek, Ellis, Adobe, Lynch, Lichau, and Willow Brook creeks are high priority areas for implementing such recovery actions. The potential for habitat restoration in this rural watershed is higher than other more urbanized watersheds within the CCC steelhead population area, due to its relatively low degree of urban development and lack of large water impoundments.

2. METHODS

2.1 Survey Locations

Because a major portion of the land in the Petaluma River watershed is privately owned (94 percent), the survey area for spawner surveys was largely dictated by landowners granting NMFS and the United Anglers permission to access their property. In the summer of 2013, NMFS and the United Anglers contacted landowners by letter and/or phone to request permission to access their property. NMFS and the United Anglers were granted access to the majority of Adobe Creek (4.5 miles), the lower three miles of Lynch Creek, and a four mile segment of lower San Antonio Creek. Access was granted at other locations throughout the watershed, yet, not in long enough segments to constitute a survey reach.

<u>Adobe Creek</u>

Approximately 4.5 miles of Adobe Creek were surveyed from the point of tidal influence (adjacent to Alman Marsh) upstream to a ranch road crossing 1.6 miles northwest of Manor Lane. This entire stream segment has a gain in elevation of approximately 680 feet. This stream segment was divided into two reaches, with each reach surveyed on different days. Reach 1 started at the tidal influence and ended at the downstream most Casa Grande Road crossing. Reach 2 started at the Casa Grande Road crossing and ended at the ranch road creek crossing approximately 1.6 miles northwest of the Manor Lane bridge over Adobe Creek. Due to field staff constraints, these reaches were combined and surveyed in a single day. Adobe Creek meanders through the city of Petaluma, passing along and under urban streets, through housing developments, a golf course, Petaluma Adobe State Park, and through a privately owned ranch north of the city.

Lynch Creek

Approximately 2.8 miles of Lynch Creek were surveyed from its confluence with the Petaluma River along the Lynch Creek Trail upstream to a point approximately one mile north of Old Adobe Road, skipping over properties immediately adjacent to either side of Old Adobe Road. The entire stream segment has an elevation gain of approximately 220 feet. The Lynch Creek survey reach runs adjacent to walking and biking trails, passes under city streets and US Highway 101, and flows through city parks, housing developments, a golf course, and ranch land in East Petaluma.

San Antonio Creek

Approximately 4.3 miles of San Antonio Creek were surveyed from tidal influence to approximately one mile east of the Point Reyes-Petaluma Road/D-Street Extension crossing. The elevation gain in the entire creek segment is approximately 100 feet. The length of the reach surveyed grew as more property access was granted over the course of the season. For most of the season, we had access to the first 2.7 miles of creek upstream of the tidal influence, but we gained an additional 1.5 miles of creek access for the last survey on April 16, 2014. San Antonio Creek primarily flows through ranch land, passing under US Highway 101 near its mouth.

2.2 Redd, Carcass and Live Adult Fish Surveys

Prior to the first rain of the year, reconnaissance surveys were conducted on Adobe, Lynch and San Antonio creeks. There were extensive portions of the watershed where conditions were dry to the extent that passage into tributaries was blocked. Following the first storm event on February 6-9, NMFS staff, NMFS volunteers, and United Anglers students walked the Adobe, Lynch, and San Antonio creek survey reaches. Surveys were conducted every 7-10 days, or as soon as possible following a storm event (i.e., when stream flows and water visibility were suitable for surveys). Surveys were usually conducted within 2-7 days after a storm on Adobe and Lynch creeks. Water visibility in San Antonio Creek was usually poor for 6-10 days following storm events, so surveys were usually not conducted until 10 days following a storm event. The last survey of the season for each stream was conducted in mid-April, no significant storms occurred after this time. For each survey, teams of 2-4 surveyors walked upstream searching for redds, live fish, and carcasses. Surveys were conducted according to protocols published in the American Fisheries Society (AFS) Salmonid Field Protocols Handbook (Gallagher *et al.* 2007). During all surveys, the presence of live steelhead adults, steelhead carcasses, and redds were recorded. The GPS coordinates or the physical location (in reference to landmarks, road crossings, or properties) of each observation was recorded. Other information collected during surveys included weather, water temperature, water clarity, the sex and length of any fish observed, any mark codes on the carcasses (such as adipose fin clip), type of sample collected (e.g., tissue, scales, otolith, head), the position of each redd in the stream (i.e., right bank, left bank, or midstream), the age of the redd, the species believed to have created the redd (Chinook do occasionally occur in the watershed), if it was a definite or test redd, dimensions of the redd, and the number and species of any fish observed on the redd.

If live fish were encountered, care was taken not to disturb the fish. The location, species and sex of the fish were noted and the size visually estimated. We also recorded spawning behavior or fish interactions. The location of each carcass was recorded and assigned a unique sample ID number. Other information recorded included: the standard length, sex, and the presence of any tags, adipose fin clips or other marks. To help determine the sex of a fish we examined the carcass for any retained eggs or milt (Figure 5A and 5B). A tissue sample was collected from each carcass according to NOAA Southwest Fisheries Science Center (SWFSC) Collection Protocols. Either a 1 cm square clip from the operculum or tail fin, or complete scales were removed and placed in folded over blotter paper in a labeled paper envelope. No otolith samples or heads were collected from carcasses. Tissue samples were allowed to air dry as soon as possible upon leaving the field and later submitted for genetic testing. The tail of the carcass was cut to mark it as “processed” as to avoid double counting. The carcass was left in the stream where it was found.

Each redd was given a unique identification number, which included the date of first observation, and marked with flagging in the field. Flags were positioned in line with the tailspill of the redd. Each flag was marked with the redd ID, the overall length and width of the redd or a note of “not measured”, the location in the stream (right side, left side or midstream), and the species of fish. If a redd did not appear complete, it was classified as a test redd, which was recorded and noted on the flag. If fish were not present on redds or within the immediate area of the redd, the redd was measured. Width and length measurements were taken of each redd’s pot and tailspill. To determine if a redd was created by a steelhead or Chinook salmon we used the size and shape of the redd. Steelhead redds are usually small and round in shape whereas Chinook redds are generally much larger and often have a branching shape.

3. RESULTS

3.1 Live Steelhead, Redds, and Carcasses

A total of 6 live steelhead, 2 steelhead carcasses, and 6 steelhead redds were observed during spawner surveys in Adobe, Lynch, and San Antonio creeks (Table 1). All observations were made during surveys in Adobe Creek. Of the live steelhead observed in Adobe Creek, all were observed in Reach 2 (upstream of the Casa Grande Road crossing). The majority of redds (67 percent) and half of the carcasses were also observed in this reach. The majority of redds observed in Adobe Creek were observed in April, whereas the majority of live steelhead were observed in February. The two carcasses observed retained a significant portion of their eggs, suggesting that they did not successfully spawn. Tissues were collected from both of these carcasses.

3.2 Stream Flows and Correlated Spawning Activity

Adult CCC steelhead in the San Francisco Bay region typically begin their migration to natal streams in December, with migration peaking in January and February. Due to the lack of rain in late 2013 and early 2014, many of the tributaries experienced very low to dry stream flow conditions until February 2014. This resulted in many portions of the watershed becoming inaccessible to adult steelhead. Between February 5 and February 11, 2014, a significant storm event provided 4.8 inches of rain over the Petaluma River watershed (California Department of Water Resources 2014). This storm event increased stream flows throughout the watershed to levels that enabled adult steelhead to migrate into tributaries. The first observations of steelhead in Adobe Creek occurred on February 14, nine days following the February 5 storm event (Figure 6). The final storms of the season occurred over March 25-April 1, which was followed by a peak in redd observations (4) on April 9.

3.3 Habitat Observations

<u>Adobe Creek</u>

There are a few partial barriers on Adobe Creek, such as the silt dam at McDowell Blvd, which may impede the passage of adults and juveniles during low flows. A bridge abutment upstream of Adobe Road is possibly a significant barrier to upstream movement for smaller fish. During low flows, the abutment requires a fish to jump 4 feet vertically through protruding rebar stakes onto a concrete shelf. Adult fish are obviously able to traverse these barriers since we observed adults and redds above the bridge, but juvenile fish are not able to move upstream of this barrier.

<u>Lynch Creek</u>

Stream flows receded quickly in Lynch Creek following storm events. Several reaches had intermittent stream flow within two weeks of storm events. A significant barrier to steelhead movements exists at the confluence of Lynch Creek with the Petaluma River that may impeded fish passage at most stream flows. Fish attempting to enter Lynch Creek at low tide are required to a traverse a steep, 10 foot tall exposed concrete apron to reach the creek bed (Figure 7A). While at high tide, the required jump shrinks to less than a couple feet, low tide may constitute a significant temporal barrier to some individuals (Figure 7B). We were not able to determine if the lack of steelhead observed in the surveyed portion of Lynch Creek was due to this barrier. We also observed numerous illegal campsites in the riparian corridor of Lynch Creek.

San Antonio Creek

There were no obvious fish barriers in our surveyed section of San Antonio Creek. Prior to the first storm in early February, there was a large logjam in the dry creek bed just above San Antonio Road. It mostly blew out during the first rain and opened up more and more with each storm. San Antonio Creek has a much gentler slope than Adobe or Lynch Creek and our surveyed section appeared to have a much greater overall depth than the other two creeks. There is anecdotal information from a long-time resident that San Antonio Creek was heavily gravel mined in the past, which probably explains some of its entrenchment.

In San Antonio Creek, water visibility following storms was poor for at least a week. Baseline water visibility was much lower in San Antonio Creek than Lynch and Adobe creeks. Water depths were much deeper in San Antonio Creek. Surveyors often had to exit the creek due to extreme depths and walk significant distances upstream around dense Himalayan blackberry, *Rubus armeniacus*, covered banks in order to regain access to the creek. Where possible, surveyors would backtrack in the creek to survey skipped sections. Overall, San Antonio Creek was much deeper, had more slack water sections and fewer shallow riffle sections than did Adobe or Lynch creeks.

3.4 Other Aquatic Species Observations

Native Species	**Creek(s) Observed In**
Foothill Yellow-legged Frog *(Rana boylii*)- adults, juveniles, and egg masses	Adobe, Lynch, San Antonio creeks
Pacific Treefrog (*Pseudacris regilla*)- adults, egg mass	Adobe, Lynch, San Antonio creeks
Three spined sticklebacks (*Gasterosteus aculeatus*)	Adobe, Lynch, San Antonio creeks
California roach (*Hesperoleucus symmetricus*)	Adobe, Lynch, San Antonio creeks
Western Toad (*Bufo boreas*)- tadpoles, egg mass	Adobe and San Antonio creeks
California Red-sided Garter Snake (*Thamnophis sirtalis infernalis*)- adult	Adobe and San Antonio creeks
Western Pond Turtle (*Clemmys marmorata*)- 4 live adults, 1 dead adult	San Antonio Creek
Rough- skinned Newt (*Taricha granulosa*)- adults	San Antonio Creek
Non-native Species	**Creek(s) Observed In**
Bullfrog (*Rana catesbiana*)- sub-adult	Adobe and San Antonio creeks

4. DISCUSSION

Because a major portion of the land in the Petaluma River watershed is privately owned (94 percent), the survey area for spawner surveys was largely dictated by landowners granting NMFS and the United Anglers permission to access their property. We were granted access to approximately 11.3 miles of continuous stream miles in 3 different tributaries: 4.5 miles in Adobe Creek, 4 miles in Lynch Creek, and 2.8 miles in San Antonio Creek. Overall, this constituted 19 percent of the total potential habitat in the watershed. Due to such a limited survey area, it is difficult to draw watershed-wide conclusions on the abundance and distribution of steelhead in the watershed. However, anecdotal information suggests that Adobe Creek may contain some of the highest quality habitat in the watershed. We had access to the majority of Adobe Creek and only observed 6 live steelhead, 2 steelhead carcasses, and 6 steelhead redds. These findings corroborate NMFS' preliminary conclusions that the population of steelhead in the Petaluma River watershed is at very low abundance and extremely limited in distribution.

A major factor that likely influenced the low abundance of steelhead present in the watershed this year was the extremely low rainfall and stream flow conditions. The Petaluma River watershed received very little rainfall in the fall of 2013. There was a total of only 1.6 inches of rain from July 1, 2013 (the official start date of the water-year) through December 31, 2013 (California Department of Water Resources 2014). The total 2013/2014 wateryear rainfall amount was 13.4 inches, approximately half the historical average of 26.6 for this area. Many tributaries were dry throughout December 2013 and January 2014, which curtailed the movement of steelhead to natal streams for spawning during this period. It wasn't until early February that stream flows increased in Lynch, Adobe, and San Antonio creeks to the extent that steelhead could migrate into these creeks to access spawning habitat. Unsurprisingly, all live fish, carcasses, and redds were observed following the initial storms of the season (February 2014).

Throughout the surveys we observed significant habitat degradation related to urban infrastructure, cattle grazing, direct human disturbance of the stream bed (e.g., small rock dams and heavy machinery in the creek), illegal camping, poaching, and vegetation removal. As mentioned previously, the rural nature of this watershed makes its restorability more achievable than restoration in more urbanized watersheds. Given the high incidences of poaching, human disturbance of the stream, and illegal camping observed during surveys; education and outreach to residents on ways to conserve and protect steelhead and their habitat in the watershed, and focused enforcement would likely make a significant impact in this watershed. Other priorities we identified are removal of fish passage barriers and restricting cattle access to streams by finding alternative off-stream water sources for cattle.

We plan to continue to conduct spawner surveys during the 2014/2015 spawner season to gain additional information that will be useful in assessing overall trends of the steelhead adult population in the Petaluma River watershed and the habitat conditions over varying wateryear types (e.g. wet, dry, moderate). We hope to expand our survey area in 2014/2015 to include the upper reaches of Lynch, Adobe, and San Antonio creeks, as well as other creeks in the watershed.

5. TABLES AND FIGURES

Table 1. Observations of steelhead, carcasses, and redds in the survey area, spawning season 2013-2014. Adobe Cr

Survey Date	Steelhead in Adobe Creek						Total		
	Reach 1			Reach 2					
	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds
1/16/2014	0	0	0	0	0	0	0	0	0
2/14/2014	0	1	1	-	-	-	0	1	1
2/19/2014	-	-	-	4	0	0	4	0	0
2/21/2014	0	0	1	-	-	-	0	0	1
2/25/2014	-	-	-	2	0	0	2	0	0
3/7/2014	0	0	0	0	1	0	0	1	0
4/9/2014	0	0	0	0	0	4	0	0	4
Subtotal	0	1	2	6	1	4	6	2	6

Survey Date	Steelhead in Lynch Creek			Steelhead in San Antonio Creek			Total		
	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds	Steelhead	Carcasses	Redds
2/5/2014	0	0	0	0	0	0	0	0	0
2/14/2014	0	0	0	0	0	0	0	0	0
2/19/2014	0	0	0	-	-	-	0	0	0
3/14/2014	-	-	-	0	0	0	0	0	0
3/16/2014	0	0	0	-	-	-	0	0	0
4/11/2014	-	-	-	0	0	0	0	0	0
4/16/2014	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0

Live Steelhead, Carcass, and Redd Total	**6**	**2**	**6**

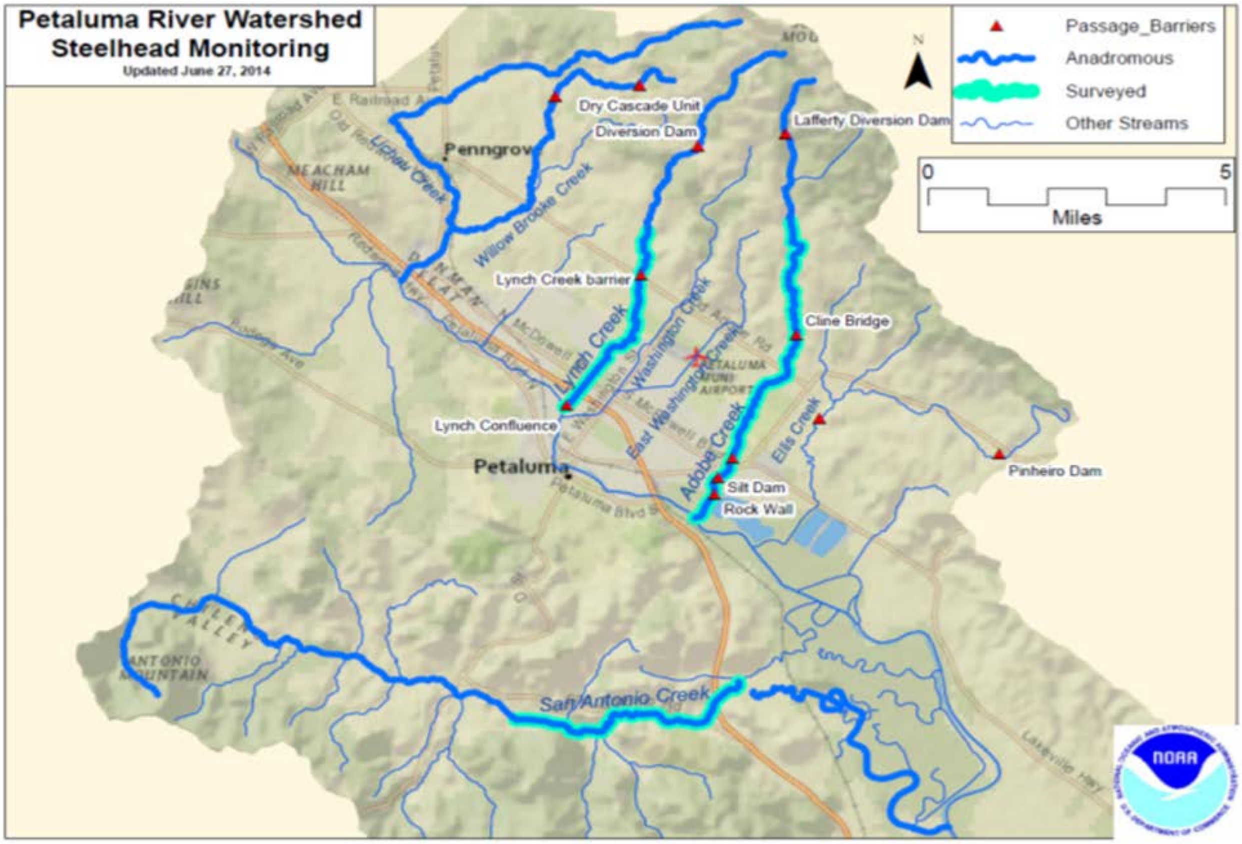

Figure 1 – Map of potential steelhead habitat in the Petaluma River watershed and locations where spawner surveys were conducted.

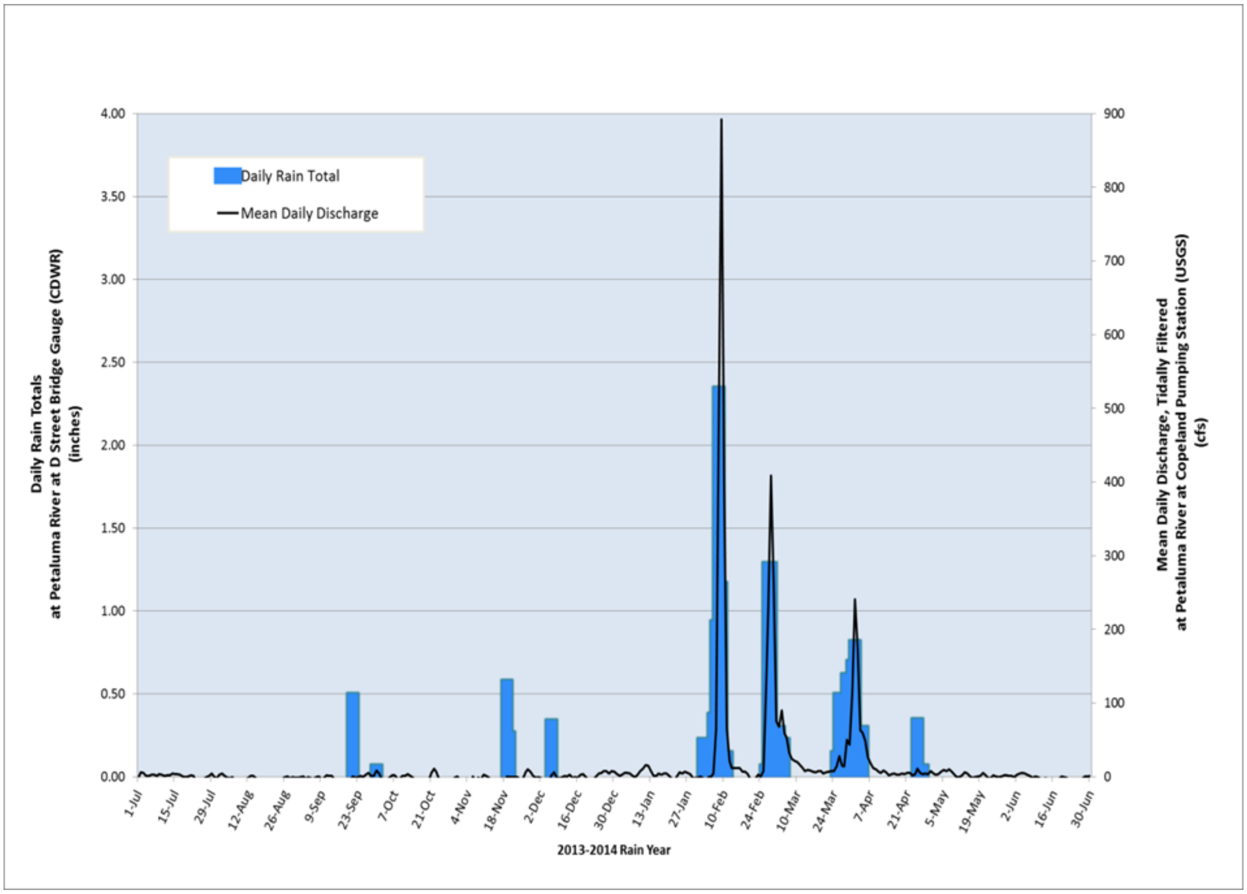

Figure 2 – Total rain and stream discharge for the 2013-2014 rain year, showing that increases in stream flow were correlated with rain events. The chart shows the three significant rain events that occurred during the spawning season.

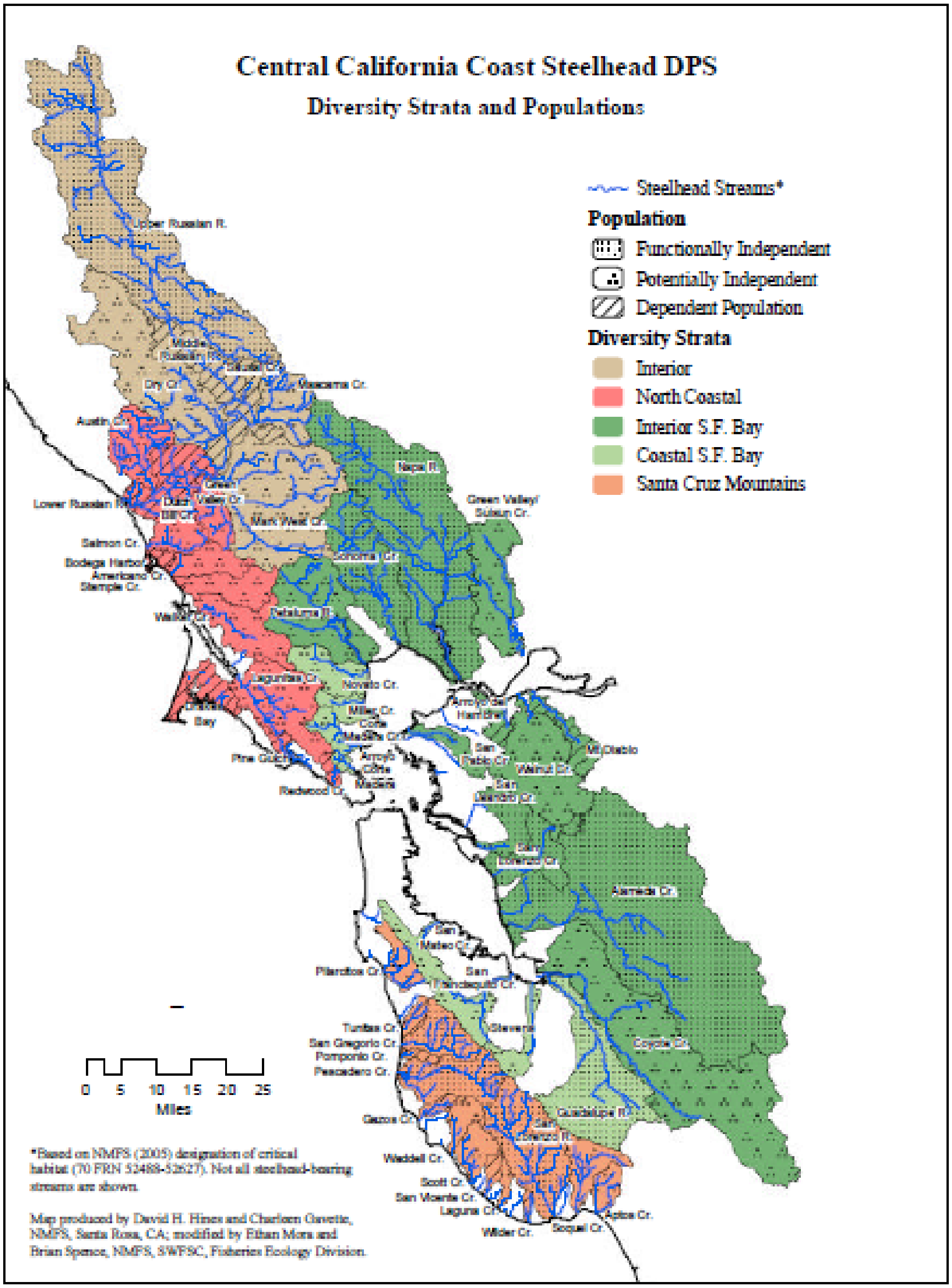

Plate A6. Diversity strata for populations of Central California Coast steelhead. Based on Bjorkstedt et al. (2005) with modifications described in Appendix A.

Figure 3 – Map depicting Central California Coast Distinct Population Segment Diversity Strata from Spence *et al.* 2008.

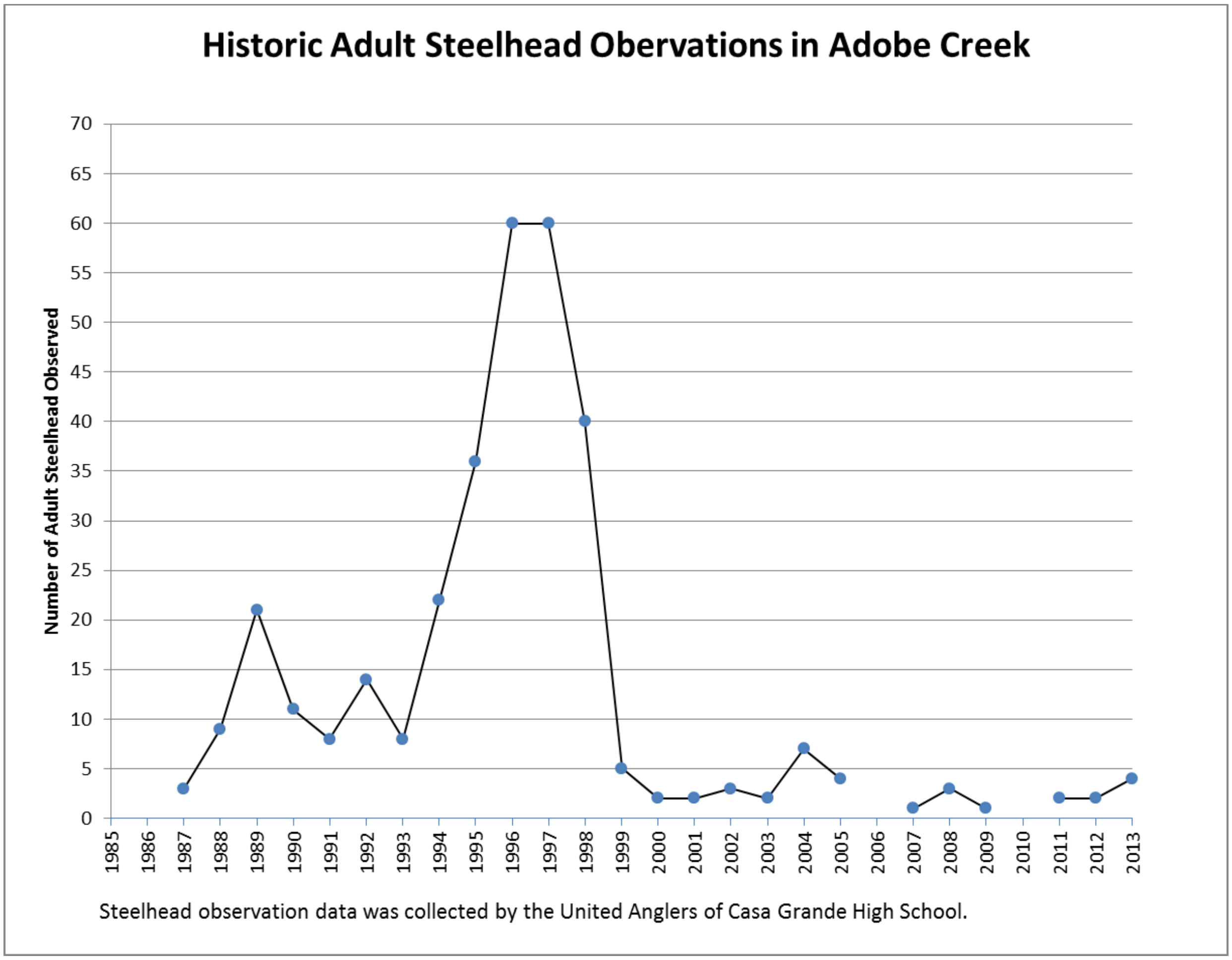

Figure 4 – Historic adult steelhead observations in Adobe Creek.

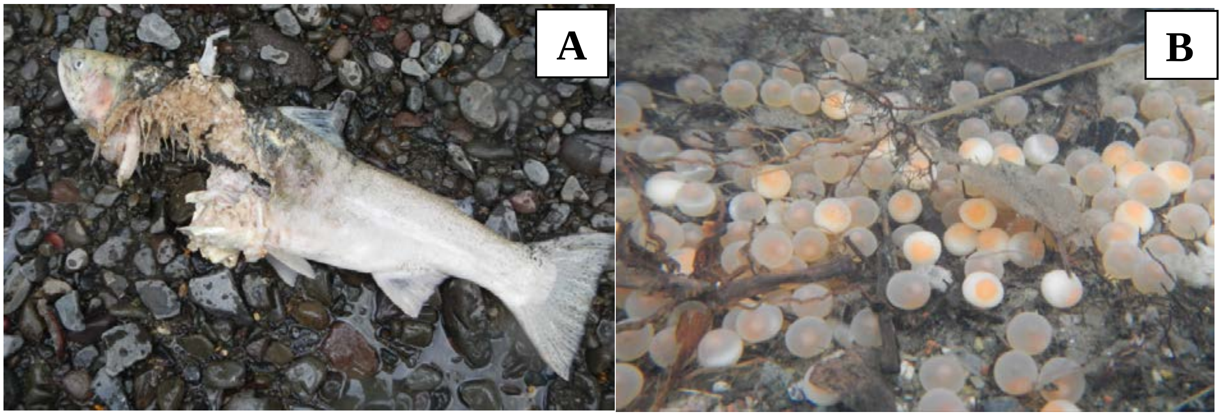

Figure 5 – (A and B). (A) A female steelhead carcass found on February 14. (B) Spilled eggs that had collected along the bank of the creek, observed on February 14, they were the season's first sign of fish in the stream. The eggs were observed 100-200m downstream from where the carcass was found.

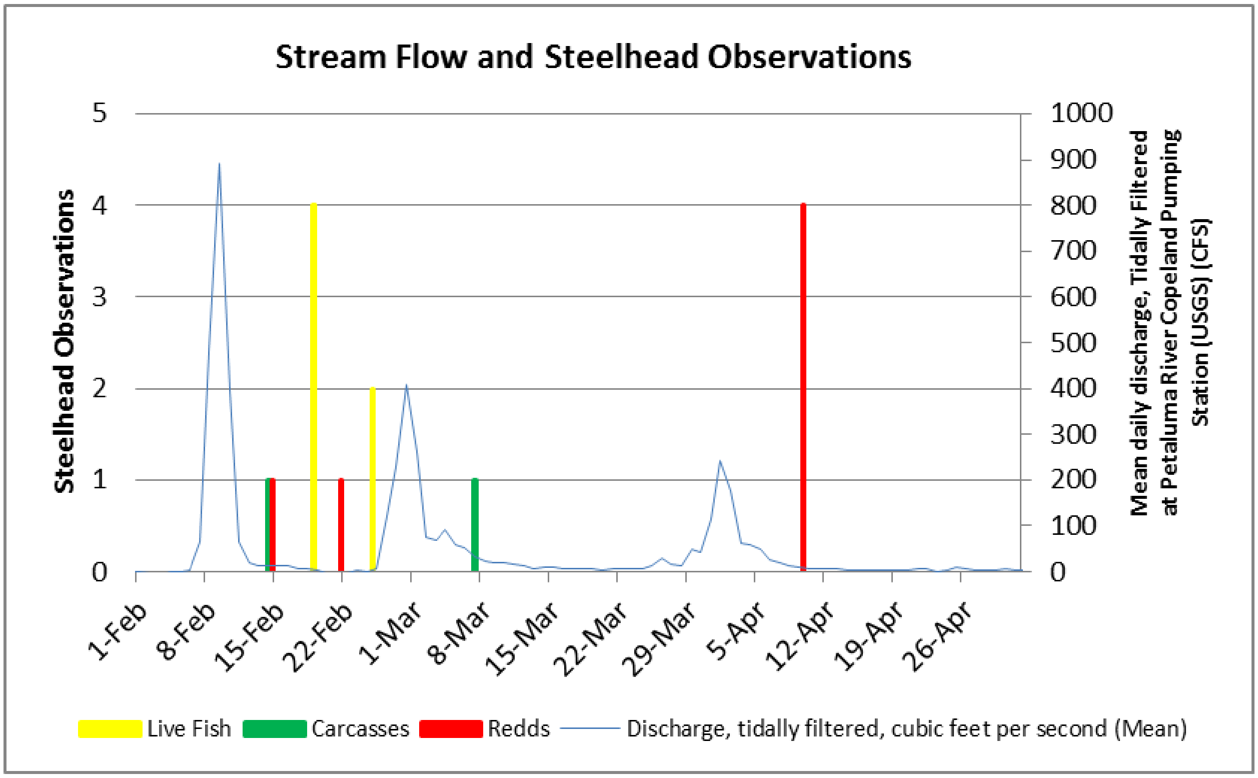

Figure 6 – Stream discharge from February through April shown with survey results. Most of the live steelhead were observed in the two weeks after the large storm in early February and most of the redds were observed after the storm in April.

Figure 7 – (A and B). (A) Lynch Creek at the confluence with the Petaluma River at low tide and low stream flow. (B) Lynch Creek at the confluence with the Petaluma River at high tide and moderate stream flow conditions.

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