

## Observations of Migrating Fish and Their Habitat in the Northshore, Clear Lake Basin Spring 2016

S.Franson

### Summary, Field Monitoring

Monitoring for migrating fish occurred in Spring 2016, from February 27, 2016 until June 17, 2016. The 5 locations that have been monitored since 2013 were checked on a weekly basis for sightings of migrating fish and as time went on, for presence or absence of juveniles.

Clear Lake hitch, *Lavinia exilicauda chi*, was the hoped for sighting this year. This species has been listed as threatened by the California Department of Fish and Wildlife and is currently being considered for listing by the U.S. Fish and Wildlife Service. The 2015-2016 winter ushered in more rain than has been seen during each of the last 4 winters of drought. Water levels in all creeks dropped throughout monitoring, although spring rains briefly replenished them. Since easements and modifications were established in Tulelake, water levels while also receding appeared to have more stability and appeared to follow Clear Lake levels, but levels dropped at the remaining 4 locations with higher elevations, even if differences are slight.

As water receded, fish passage was increasingly compromised, riffles developed into gravel bars, water was channeled in what had been deeper areas of stream beds, and stream width shrank from about 1/2 or less of the width at beginning of monitoring or to 0 if surface flow ceased entirely. By June 17, 2016, water flow was depleted and pooling in some places, blocking fish passage.

Hitch were not seen either as migrating adults headed upstream or as juveniles returning downstream. The first migrating adult Sacramento sucker was observed on February 26, 2016. Juvenile Sacramento suckers were seen first on March 25, 2016 and continued to be observed in most locations on a regular basis including June 17, 2016.

At the Scotts Creek location, where pooled water is murky and visibility into it is minimal, adult carp, *Cyprinus sp.* were observed periodically throughout monitoring. On March 4, 2016, 2 6-cm. deceased threadfin shad, *Dorosoma petenense*, were on a bank. Markings and body styles consistent with juveniles for carp and large- and smallmouth bass, *Micropterus salmoides* and *Micropterus dolomieu*, and juvenile Sacramento suckers were seen in large numbers near water's edge on April 15, 2016, and smaller groups of juveniles were along water's edge until May 27, 2016. Only crayfish were observed after that, however ripples and trails presumably from moving fish were noticed frequently.

On March 25, 2016, several small schools of adult rainbow trout, *Oncorhynchus mykiss*, about 200 individuals in all, were lingering immediately above Rancheria Bridge on Middle Creek. No juveniles were observed during monitoring, although several were observed in earlier years some distance above the bridge, by the Middle Creek CRMP: June 26, 2005, and July 9, 2006. On June 30, 2004, during a greenline survey, a feed ball consisting of a few hundred threadfin shad were seen around 50 feet below Rancheria Bridge.

Field notes, from which the information presented is taken, include more details although most are summarized here.

Field biology including identification is performed in the field. Accurate identification is challenging when fishes are moving in flowing water that distorts features, especially when water is muddy or murky. For this year's and previous years' monitoring, attention was given to adults' heads including opercular plate and snout, large or small eyes and their position, mouth parts inferior or not, body width broader or more narrow, lesser or deeper body depth, less pronounced or more pronounced countershading, lateral line when visible, and tips of caudal fin appearing slightly rounded or not. One rarely sees many of these together, identification can be elusive, and mistakes are easy to make. Imagery might be helpful with questions.

For juveniles, attention was given to smaller eyes and longer or developing snouts and inferior mouth parts, or large eyes and small heads with small mouths, an overall sinuous

appearance and longer TBL of 1 cm or more or appearance of a minnow and shorter TBL of 5 to 6 mm to 1+ cm, more pigmentation when younger or less pigmentation when younger, overall color, less or more translucence, and caudal fins when visible.

Behavior helps (pers.obs.). Adult Sacramento suckers appear to migrate during various weather patterns in water that is cold and later warmer. Migrating adult hitch appear to migrate in water that is not as cool as first winter runoff, and they appear to prefer to gather under riparian vegetation on cloudy or rainy days. Adult Sacramento suckers appear to be comfortable spawning in shallows along creek banks. Adult hitch appear to prefer an area where larval hitch can find extremely shallow water with ample nutrients and with grasses and/or dried, gold to brown vegetation, although historically, with greatly increased populations, this was not necessarily the case (pers.comm. and Garth Murphy, *Notes on the Biology of the Sacramento Hitch (Lavinia exilicauda chi) of Clear Lake, Lake County, California*, The Resources Agency of California, Dept. of Fish and Game online archives, Vol. 34(3), Carlton M. Herman, Editor, pgs.101-110, July 1948).

Very young juvenile Sacramento suckers about 1 cm seem to be able to maneuver some stream flow, although they cluster near shore where it appears their color and pigmentation are camouflage against silted gravel. They seem to move further into the current as they develop. Very young juvenile hitch about 6 mm appear to prefer flooded grassy or weedy areas or edges of creek banks, where their coloring and delicate, slender lines of pigmentation render them nearly invisible and where there is generally little current. Larval hitch appear to require some growth before they incrementally tackle increasingly open spaces.

Spatial and temporal niches appear to coexist to the extent that availability of essential space with prey items allow. As always, individuals of any species can and do overlap temporal and spatial habitat of other species as opportunities for species survival arise.



Juvenile Sacramento suckers  
Middle Creek South location, June 3, 2016



Juvenile hitch  
Adobe Creek, immediately north of Bell Hill Road, April 4, 2012

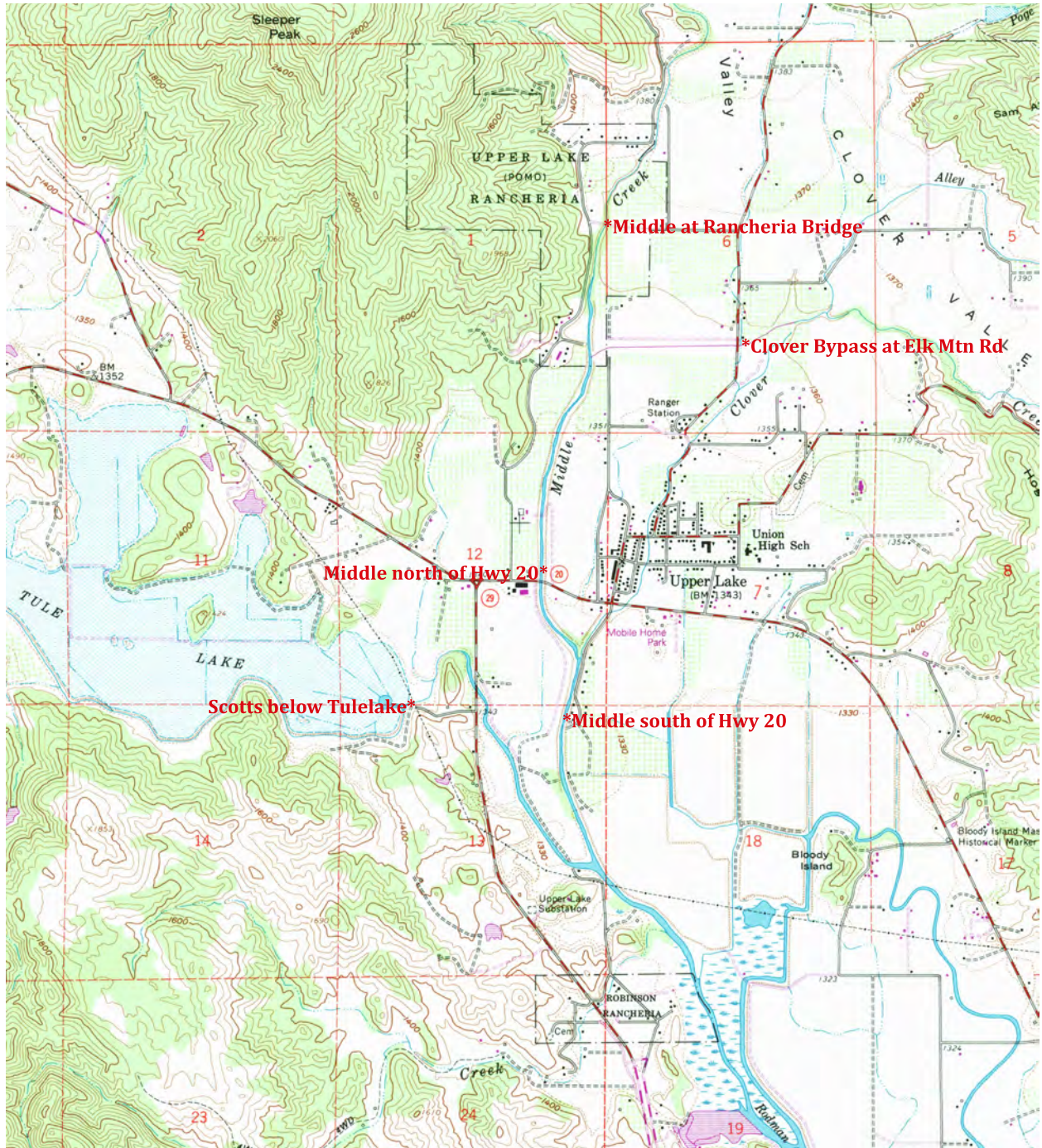
Very young hitch and schools of other species of very young juveniles were observed in 2010 (pers.obs. with team member, Robinson Rancheria Environmental Department) in a pooled rice paddy. When all were disturbed and chased away from edges, hitch were the only juveniles observed to immediately and consistently return to the downstream edge.

There is a risk that any species of very young juveniles could be swept downstream when there is no choice due to heavy rain and runoff affecting young of the year.

Further insight is not backed by adequate observation, notes, study, or data.

## Monitoring Locations and Map

Map derived from a portion of quadrangle map, Upper Lake, CA 39122-B8-TF-024, courtesy of United States Geological Survey, in cooperation with California Department of Water Resources; Control by USGS, NOS.NOAA, and USCE, compiled from imagery taken 1957



## Methods

On the first day monitoring, notes included immediate and peripheral vegetation and stream substrates. After that, changes were noted throughout spring monitoring, for example, creek bank exposure and general appearance of water, clarity, debris, and developing algal growth on surface and substrate.

Notes also included estimates for water depth and flow, cloud cover, and wind speed and direction. Temperatures for ambient air and water were measured. Notes on wildlife were of wildlife heard, seen, in flight, on water, and scat and tracks observed.

Depth was not measured but estimated using permanent reference points. Flow was estimated by timing movement of a leaf or light surface debris. While depth and flow estimates are inexact, indications over time suggest changes and over years, suggest trends.

Length of time for observations was not extensive but consistent, occurring on Friday mornings and requiring about 2 hours to complete. Timing at each location varied depending on what needed to be observed and noted. Fish counts were not based on timed intervals but on careful investigation of the immediate environment.

Digital images were recorded at each location, each week.

Monitoring continued weekly until water flow, except at the Scotts Creek location, was severely reduced and Clover Bypass had been drying and pooling for some weeks. Juvenile Sacramento suckers there were visibly trapped and had been milling about for some weeks.

Equipment included an Olympus digital camera, a DeLorme Earthmate PN-60, and a Cooper handheld air/water digital thermometer. Resources occasionally consulted were Google Earth 7.1.5.1557, a Jepson manual (University of California Press, ©1993), the Guide to the Coastal Marine Fishes of California (Daniel J. Miller and Robert N. Lea, California Fish Bulletin Number 157, Department of Fish and Game, State of California, 1972), the Handbook to the Orders and Families of Living Mammals (Timothy E. Lawlor, 2nd ed., Mad River Press, Rt. 1, Box 151-B, Eureka, CA 95501, 1979), A Field Guide to the Mammals, North America north of Mexico (William H. Burt, and Richard P. Grossenheider, Peterson Field Guides, 3rd Ed., Houghton Mifflin Co., Boston, New York, ©1980), and the Field Guide to the Birds of North America (2nd Ed., National Geographic Society).

## Vegetation

Vegetative cover at most sites included willows, *Salix sp.*, oak, *Quercus sp.*, cottonwood, *Populus sp.* primarily *fremonti*, Himalayan blackberries, *Rubus armeniacus*, poison oak, *Toxicodendron diversilobum*, and various ruderal grasses, herbaceous growth indigenous and invasive, and various sedges, Fam. Cyperaceae, along most creek banks and in Tulelake. Orchards were often within 50 to 60 m. With agricultural easements in place in the Tulelake area, water appeared to generally remain potentially at Clear Lake levels, with fluctuations in level and flow observed. Tules, *Schoenoplectus acutus*, appear to be expanding their territory there.

With warmer temperatures and warming water, various species of algae grew instream in clumps and strands, often forming mats, carpeting substrate and coating water's surface.

## Wildlife

A variety of wildlife exists at all locations. Wildlife was noted as being in the area if it was seen, heard, in flight, on water, on land, or leaving evidence such as scat or tracks.

Species and counts can be reflective of weather patterns or events. Including estimated wind, direction, and presence or absence of gusts, cloud cover, and ambient air and water temperatures at each monitoring was a part of the whole. In general, reduced wildlife populations were seen during precipitation events and during wind  $\geq 8$  mph, with or without accompanying gusts.

Waterfowl and various species of herons and egrets consistently clustered around the Scotts Creek location. American white pelicans, bald eagles, and golden eagles were seen only in that area. Various passerines and woodpeckers were observed or heard at each location. When American cliff swallows arrived to nest, they were at each location. Deer, deer tracks, or deer scat and raccoon tracks were at 4 of 5 locations. Squirrel tracks and/or squirrels were common. In general there was more variety at the Scotts Creek location and less variety at the Rancheria Bridge location, where monitoring took place on Rancheria Bridge, on asphalt.

Fishermen and a photographer were often at the Scotts Creek-Tulelake location. As water levels diminished, ORV enthusiasts used the Middle Creek channel, leaving tire tracks midstream and along banks. Dogs and/or dog tracks were at all locations, horse tracks at 3, domestic cats at 2, coyote tracks at 3, and gopher and/or mole mounds at all except Rancheria Bridge. A common garter snake was noticed at the Clover Bypass location, and a gopher snake at the Middle Creek North location.

Black bear and mountain lion are reported to frequent several of the locations chosen (pers.comm. and previous pers.sightings), although no animals or tracks were observed.

\*Numerous small birds other than Passerines, heard but not seen, were omnipresent and especially prevalent at the Scotts, Middle Creek South, and Middle Creek North locations. They are not listed individually unless they were easily identified.

The following list of wildlife is arranged in no particular order:

White crowned sparrows, *Zonotrichia leucophrys*  
Golden crowned sparrow, *Zonotrichia atricapilla*  
American and lesser goldfinches, *Carduelis tristis* and *Carduelis psaltria*  
American cliff swallows, *Petrochelidon pyrrhonota*  
Red-winged blackbirds, *Agelaius phoeniceus*  
Brewer's blackbirds, *Euphagus cyanocephalus*  
Ringed turtle-doves, *Streptopelia risoria*  
Mourning doves, *Zenaida macroura*  
Quail, *Callipepla californica*  
Wild turkey, *Meleagris gallopavo*  
Northern mockingbird, *Mimus polyglottos*  
Acorn woodpecker, *Melanerpes formicivorus*  
Nuttall's woodpecker, *Picoides nuttallii*  
Northern flicker, *Colaptes auratus*  
Downy woodpecker, *Picoides pubescens*  
Hairy woodpecker, *Leuconotopicus villosus*  
Scrub jay, *Aphelocoma coerulescens*  
Black phoebe, *Sayornis nigricans*  
Rufous sided towhee, *Pipilo erythrophthalmus*  
California towhee, *Meolzone crissalis*  
American robin, *Turdus migratorius*  
Bushtit, *Aegithalos caudatus*  
American crow, *Corvus brachyrhynchos*  
Common raven, *Corvus corax*  
Turkey vulture *Cathartes aura*  
Red-shouldered hawk, *Buteo lineatus*,  
Red-tailed hawk, *Buteo jamaicensis*  
Cooper's hawk, *Accipiter cooperii*  
Sharp-shinned hawk, *Accipiter striatus*  
American kestrel, *Falco sparverius*  
Osprey, *Pandion haliaetus*  
Golden eagle, *Aquila chrysaetos*

Bald eagle, *Haliaeetus leucocephalus*

Waterfowl and herons:

American white pelican, *Pelecanus erythrorhynchos*

Canada goose, *Branta canadensis*

Common merganser, *Mergus merganser*

Mallard, *Anas platyrhynchos*

Greater and lesser scaups, *Aythya marila* and *Aythya affinis*

Gull, Fam. Laridae

Great white egret, *Casmerodius albus*

Snowy egret, *Egretta thula*

Green-backed heron, *Butorides striatus*

Pelagic cormorant, *Phalacrocorax pelagicus*

Black crowned night heron, *Nycticorax nycticorax*

Great blue heron, *Ardea herodias*

Wood duck, *Aix sponsa*

Flying, terrestrial, and aquatic insects

Tadpoles, numerous

California toad, *Bufo boreas*.

Ground squirrel, *Otospermophilus beecheyi*

Raccoon, *Procyon lotor*

Deer, *Odocoileus virginianus*, and tracks, paths, and hollows seen on creek banks and in tall grasses and vetch

Black bear, *Ursus americanus*

Mountain lion, *Puma concolor*

Coyote, *Canis latrans*

Common garter snake, *Thamnophis sirtalis sirtalis*

Gopher snake, *Pituophis catenifer*

Gopher, Fam. Geomyidae

Mole, Fam. Talpidae

Domestic dog, *Canis familiaris*

Domestic cat, *Felis catus*

Domestic horse, *Equus ferus caballus*



Tulelake, May 13, 2016

## Scotts Creek below Tulelake dam

N 39° 9.4076', W 122° 55.5376'

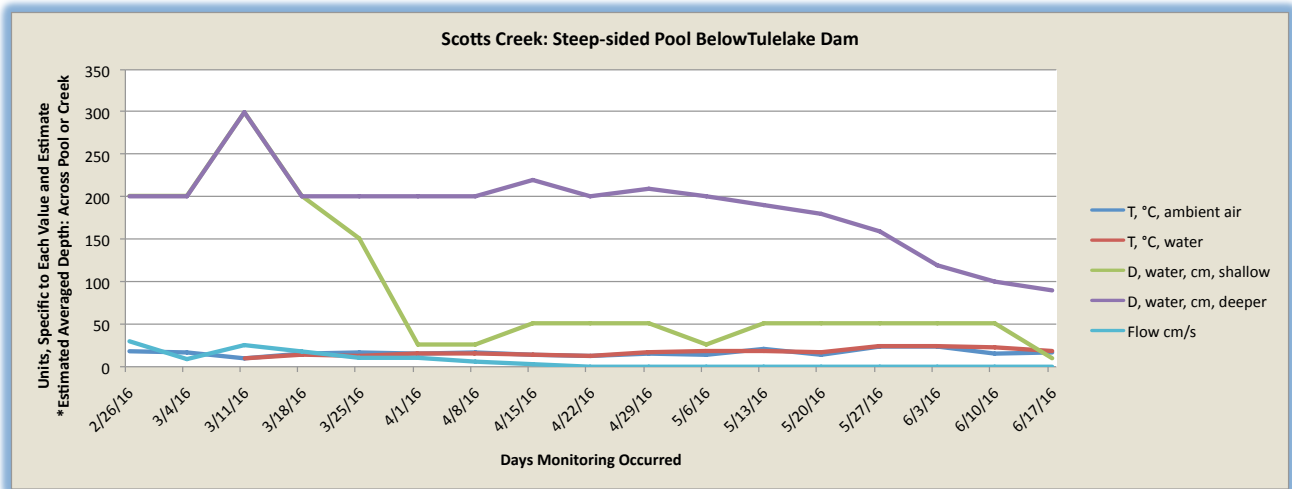
elev 1330 ft, on bank, over time, above water level



February 27, 2016



June 17, 2016, slightly higher elevation



Scotts Date	2/26/16	3/4/16	3/11/16	3/18/16	3/25/16
<b>Count: a brief summary of what is noted with reference to fish count</b>	0; sets of ripples from underwater movement of fish of some size	2 ~6 cm dead threadfin shad on bank	0	1 adult fish, probably carp	0
4/1/16	4/8/16	4/15/16	4/22/16	4/29/16	5/6/16
1 dead juvenile Sacramento sucker; 7 juveniles 1.5-2 cm, markings consistent with large mouth or smallmouth bass, inconsistent with hitch	2 large carp and smaller ripples in ponded area, possibly inland silversides	several hundred juvenile fish, 2-4.5 cm, Sacramento suckers and probably large-and/or smallmouth bass	1 dead juvenile Sacramento sucker; 7 juveniles 1.5-2 cm, markings consistent with large mouth or smallmouth bass, inconsistent with hitch	2 large carp and smaller ripples in ponded area, possibly inland silversides	several hundred juvenile fish, 2-4.5 cm, Sacramento suckers and probably large-and/or smallmouth bass
5/13/16	5/20/16	5/27/16	6/3/16	6/10/16	6/17/16
1 carp ~ 0-.75 m, 1 5-6 cm juvenile bass, 2 juvenile 3-4 cm bass, sp. unknown	0	4 juvenile carp 3-7 cm	1 crayfish	fish, heard but note seen; jumped	0

## Middle Creek South

N 39° 9.4595', W 122° 54.8673'

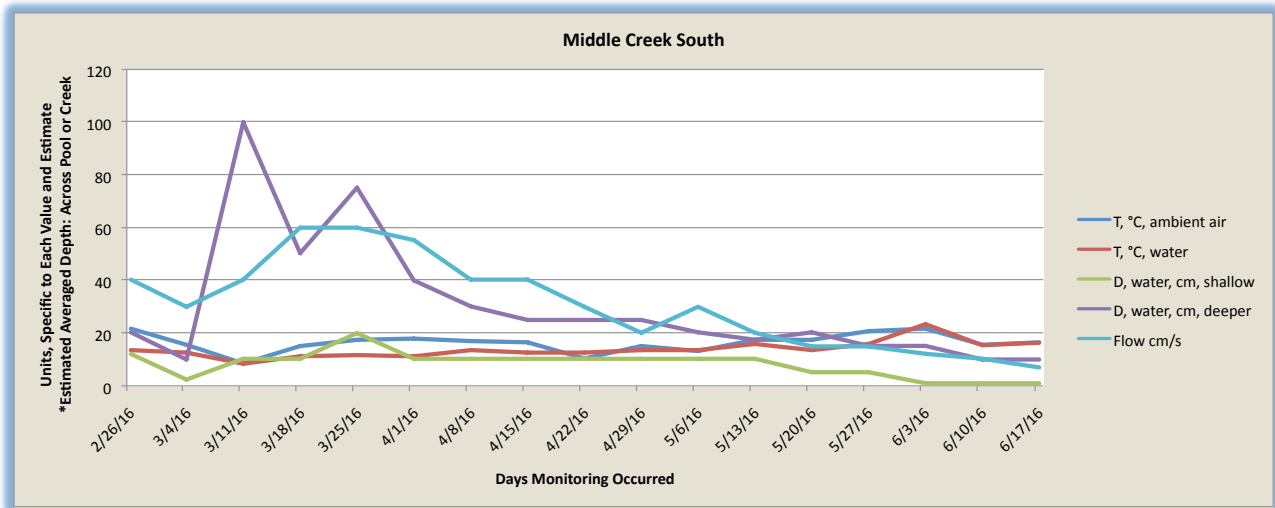
elev 1332 ft, on bank at water level



February 27, 2012



June 17, 2016



Middle S	Date	2/26/16	3/4/16	3/11/16	3/18/16	3/25/16
<b>Count: a brief summary of what is noted with reference to fish count</b>		1 adult fish: size, breadth and water temperature indicate Sacramento sucker	0	0	0	2 juvenile Sacramento suckers, ~1.5 cm
	4/1/16	4/8/16	4/15/16	4/22/16	4/29/16	5/6/16
1 juvenile Sacramento sucker ~2 cm	8 unidentified juveniles, ~2 cm, body elongate, dorsal pigmentation, extended snout, probably Sacramento suckers but do not have color or pigmentation of hitch	0	2 juvenile Sacramento suckers ~1.75 cm	0	8 juvenile Sacramento suckers, 2 to 4.5 cm	
	5/13/16	5/20/16	5/27/16	6/3/16	6/10/16	6/17/16
12 juvenile Sacramento suckers 2 to 4.5 cm	9 juvenile Sacramento suckers, 1-4 cm	0	4 juvenile Sacramento suckers, 2.5 to 3 cm	0	8 juvenile Sacramento suckers, 1 to 1.5 cm	



### Middle Creek at Rancheria Bridge

N 39° 10.9614', W 122° 54.7064'

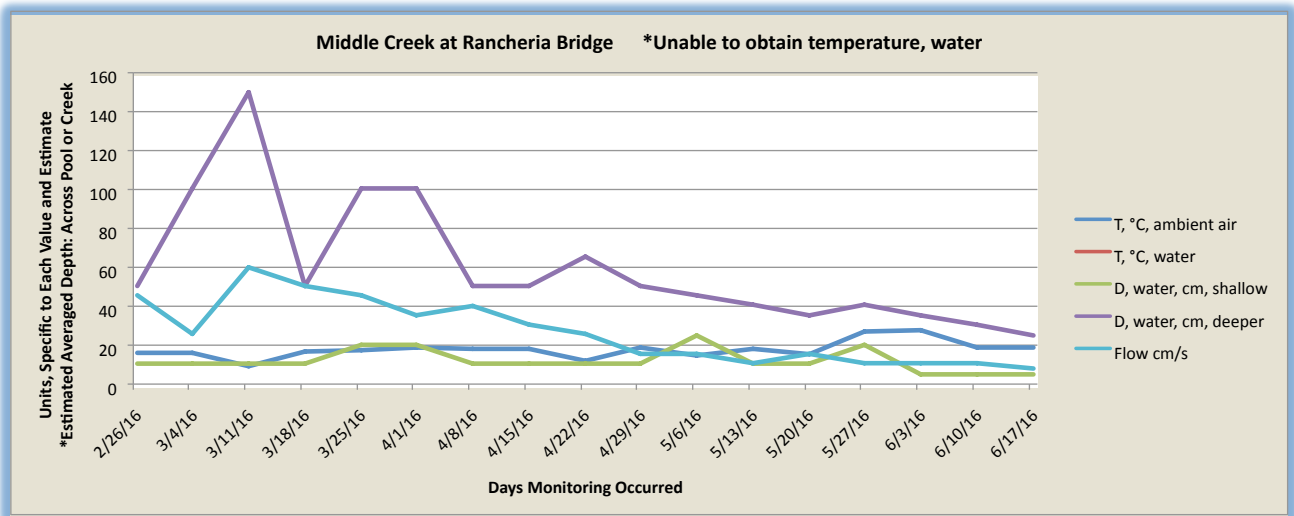
elev 1376 ft, on bridge well above water level



February 27, 2016



June 17, 2016



MC/Ranch. Date	2/26/16	3/4/16	3/11/16	3/18/16	3/25/16
<b>Count: a brief summary of what is noted with reference to fish count</b>	0	0	0	0	several small schools adult rainbow trout, above bridge
<b>4/1/16</b>	<b>4/8/16</b>	<b>4/15/16</b>	<b>4/22/16</b>	<b>4/29/16</b>	<b>5/6/16</b>
0	0	0	0	0	0
<b>5/13/16</b>	<b>5/20/16</b>	<b>5/27/16</b>	<b>6/3/16</b>	<b>6/10/16</b>	<b>6/17/16</b>
0	0	0	0	0	0

### Clover Bypass at Elk Mountain Road

N 39° 10.9616', W 122° 54.1733'

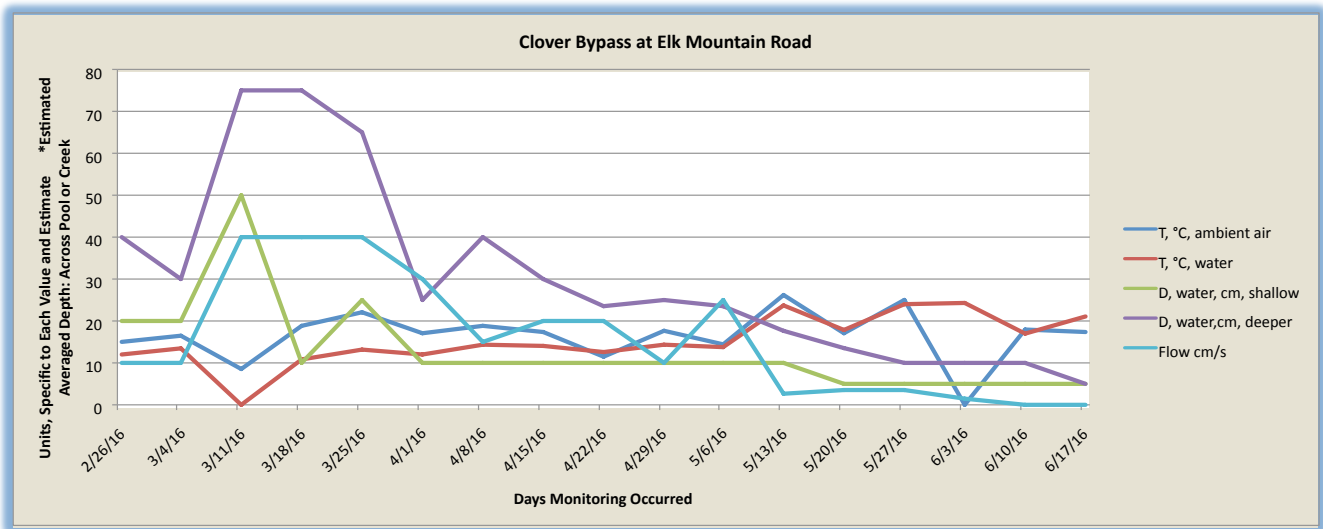
elev 1368 ft, on bank at water level



February 27, 2016



June 17, 2016



Clover Date	2/26/16	3/4/16	3/11/16	3/18/16	3/25/16
<b>Count: a brief summary of what is noted with reference to fish count</b>	0	nearly consumed fish carcass: adult, unidentified	0	0	0
<b>4/1/16</b>	<b>4/8/16</b>	<b>4/15/16</b>	<b>4/22/16</b>	<b>4/29/16</b>	<b>5/6/16</b>
0	30 juveniles about 1.5 cm, believed to be Sacramento suckers: elongated body style and snout, eyes toward side of head, dorsal pigmentation	30 juvenile Sacramento suckers 1.5 to 2 cm; identification based on body style, snout, eyes, and pigmentation	30 juvenile Sacramento suckers, 1.5 to 2.5 cm, identification based on body style, eyes, snout, pigmentation	50 to 60 juvenile Sacramento suckers, identification clear	80 juvenile Sacramento suckers 2 to 4.5 cm, identification clear
<b>5/13/16</b>	<b>5/20/16</b>	<b>5/27/16</b>	<b>6/3/16</b>	<b>6/10/16</b>	<b>6/17/16</b>
12 juvenile Sacramento suckers, 3 to 4 cm	4 juvenile Sacramento suckers, 3 to 4 cm, appear to be trapped	30 juvenile Sacramento suckers, 3 to 4 cm; circular movement	2 juvenile Sacramento suckers, 4 cm	4 juvenile Sacramento suckers, 4 cm	30-40 juvenile Sacramento suckers, 3 to 5 cm, remaining under algae; trapped

### Middle Creek North

N 39° 9.8402', W 122° 54.9652'

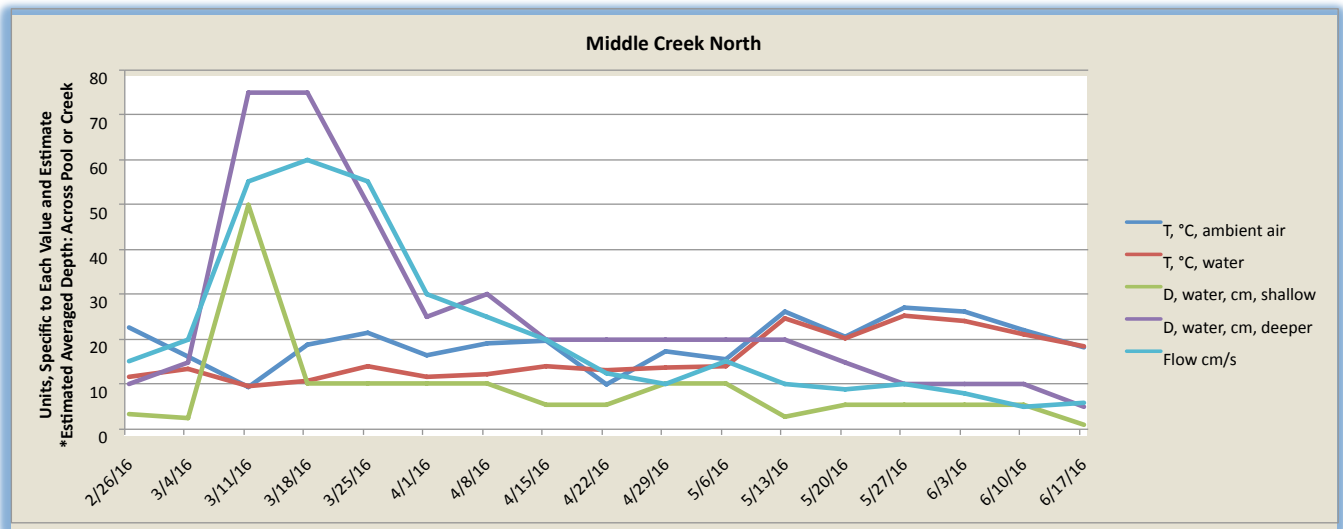
elev 1339 ft, on bank at water level



February 27, 2016



June 17, 2016



Middle N	Date	2/26/16	3/4/16	3/11/16	3/18/16	3/25/16
<b>Count: a brief summary of what is noted with reference to fish count</b>		0	0	0	0	5 juvenile Sacramento suckers, 1.5 cm, about 1 m from bank at edge of current
	4/1/16	4/8/16	4/15/16	4/22/16	4/29/16	5/6/16
	0	0	18 juvenile Sacramento suckers, 1.5 to 3 cm	0	8 juvenile Sacramento suckers	3 juvenile Sacramento suckers, 3 cm
	5/13/16	5/20/16	5/27/16	6/3/16	6/10/16	6/17/16
	juvenile Sacramento suckers: 100, 2 to 4 cm, in flowing channel; 200+, 1.5 to 4.5 cm, in pooling, drying channel; 3, 1.5 to 2 cm, trapped	30 Juvenile Sacramento suckers, 3.5 to 4 cm, moving upstream or in place	200 juvenile Sacramento suckers, 2 to 4 cm	20 juvenile Sacramento suckers, 1.5 to 3 cm	3 juvenile Sacramento suckers, 2 to 4 cm; possibly 1 prickly sculpin, ≤ 1 cm	1 juvenile Sacramento sucker, 4 cm 2, 1 to 1.5 cm

In 2011 a set of culverts into which migrating hitch swam and spawned became dry, leaving as many adults as possible to be rescued by Robinson Rancheria Environmental staff and leaving thousands of larval hitch stranded in a pooled area about 100 feet upstream, where the culvert branches out into what was a grassy field at the time. A Google Earth search indicates that these culverts run into an area of tules off the western arm of Rodman Slough. This area was flooded the previous winter. The exact connection into Rodman Slough was not noted, although lowered elevation along the side of the slough and into it at some point would suffice. Areas of tules along that arm are often flooded in winter (pers.obs.).

An image of a map, courtesy of Google Earth, has possible paths of the 2 culverts. These paths are on private property, the culverts were not followed, so the map is only suggestive at best.

Northernmost: N 39 8.273, W 122 54.320      elev 1326 to 1343 to 1326, to 1329  
To its south: N 39 8.368, W 122 54.615      elev 1330 to 1341 to 1326, to 1329



The results of this spring's observations are that only Sacramento suckers migrated in northshore tributaries, with the exception of Scotts Creek, where a few juveniles were difficult to identify although were probably not hitch, because of pigmentation. Larval hitch might have been present along the edges of former rice paddies in Tulelake, but public access was not permitted near the Scotts Creek monitoring location.

Hitch are late spring, apparently freshet-induced stream spawners whose larvae require time in freshwater tributaries to reach about 2.5 cm before making their way to the littoral zone of Clear Lake (Garth I. Murphy, Notes on the Biology of the Sacramento Hitch, (*Lavinia e. exilicauda*) of Clear Lake, Lake County, California, The Resources Agency of California, Department of Fish and Game online archives, Volume 34(3), Carlton M. Herman, Editor, pgs. 101-110, July 1948). It appears that larval hitch do well in graveled, shallow, warm, low current substrate and grasslands or ovetopped creek banks during spring flows. Embryo development appears to do well in water at or around 62°F, or 16.67°C (G. Murphy, Notes on the Biology of the Sacramento Hitch, (*Lavinia e. exilicauda*) of Clear Lake, Lake County, California, p. 105; Camm Swift, Early Development of the Hitch, *Lavinia exilicauda*, of Clear Lake, California, The Resources Agency of California, Department of Fish and Game online archives, Volume 51(2), Editor-in-Chief John E. Fitch and Editor for Inland Fisheries James H. Ryan; April 1965, p. 75; and pers.study, Observations of Larval Development of Clear Lake Hitch, *Lavinia exilicauda chi*, with Regard to Differences in Temperature in Their Environment, at <http://www.rootlets.com/environment/study-spring2012.pdf>, 2012, p.15).

Marshes and seasonal wetlands that historically existed in the currently leveed northshore watershed are gone (pers. comm., pers. obs., and Att.3, Northshore wetlands, marshlands and flooded grasslands, historic and present, and hitch sightings, Draft Hitch Adaptive Management Plan, Staff, Robinson Rancheria EPA, 2010). Mendenhall Creek that used to flow much or most of the year began to run dry earlier in the year from about the early 1980's on and has become a runoff channel during heavy rain events. It had supported migrating hitch (pers.obs.).

It appears that ecological equilibria with respect to the Clear Lake hitch, *Lavinia exilicauda chi*, are fragile at best. When streams are extremely shallow, dry, pooled, or dry at confluences that eventually lead to Clear Lake, juveniles of any species that are migrating downstream are in jeopardy. When this occurs too early, after hitch have spawned after a late spring rain, survival of developing young of the year would not be possible.

Elevation at the Scotts Creek location is 1330 ft. but is above the actual water level except during heavy rain events. The location at Middle Creek South is 1332 ft. at water level. The other 3 locations are at higher elevations. When the water level decreased at the Scotts Creek location, the other 4 locations had already been impacted. Elevations at the culverts where adults and later, larval hitch were observed in 2011, and along the path to tule beds, are 1326, 1343, 1326, to 1329 at entrance to tules, and 1330, 1341, 1326, to 1329. The culverts would have been impacted.

Drought and global warming jeopardize the hitch survival cycle, as do reduced aquifers from more wells, from water diversion for agriculture and for other purposes difficult to regulate, and from timing of water released from Clear Lake. They lower water levels. Specifics of how and when are not known, although this appears to happen during a time especially critical to hitch reproduction.

Increased habitat such as restoration projects that have at least some year-round water with year-round connections to Clear Lake would be an enormous help to hitch populations.

A sampling of additional resources:

*A Biological Survey of Clear Lake, Lake County*, George A. Coleman, The Resources Agency of California, Department of Fish and Game online archives, Vol. 16(3), pgs.221-227, July 1930

*Aspects of the Ecology of the Hitch, Lavinia exilicauda*(Cyprinidae), a Persistent Native Cyprinid in Clear Lake, California, R. Eugene Geary, and Peter B. Moyle, The Southwestern Naturalist 25 (3): 385-390, November 24, 1980

*Livingston Stone and Fish Culture in California*, Joel Hedgpeth, The Resources Agency of California, Department of Fish and Game online archives, Volume 27(3), pgs.126-148, July 1941 *Climate Change Vulnerability of Native and Alien Freshwater Fishes of California: A Systematic Assessment Approach*, Peter B. Moyle, Joseph D. Kiernan, Patrick K. Crain, Rebecca M. Quiñones, PLOS ONE, May 2013

*Early Development of the Hitch, Lavinia exilicauda, of Clear Lake, California*, Camm Swift, The Resources Agency of California, Department of Fish and Game online archives, Volume 51(2), Editor-in-Chief John E. Fitch and Editor for Inland Fisheries James H. Ryan; pgs. 74-78, April 1965

