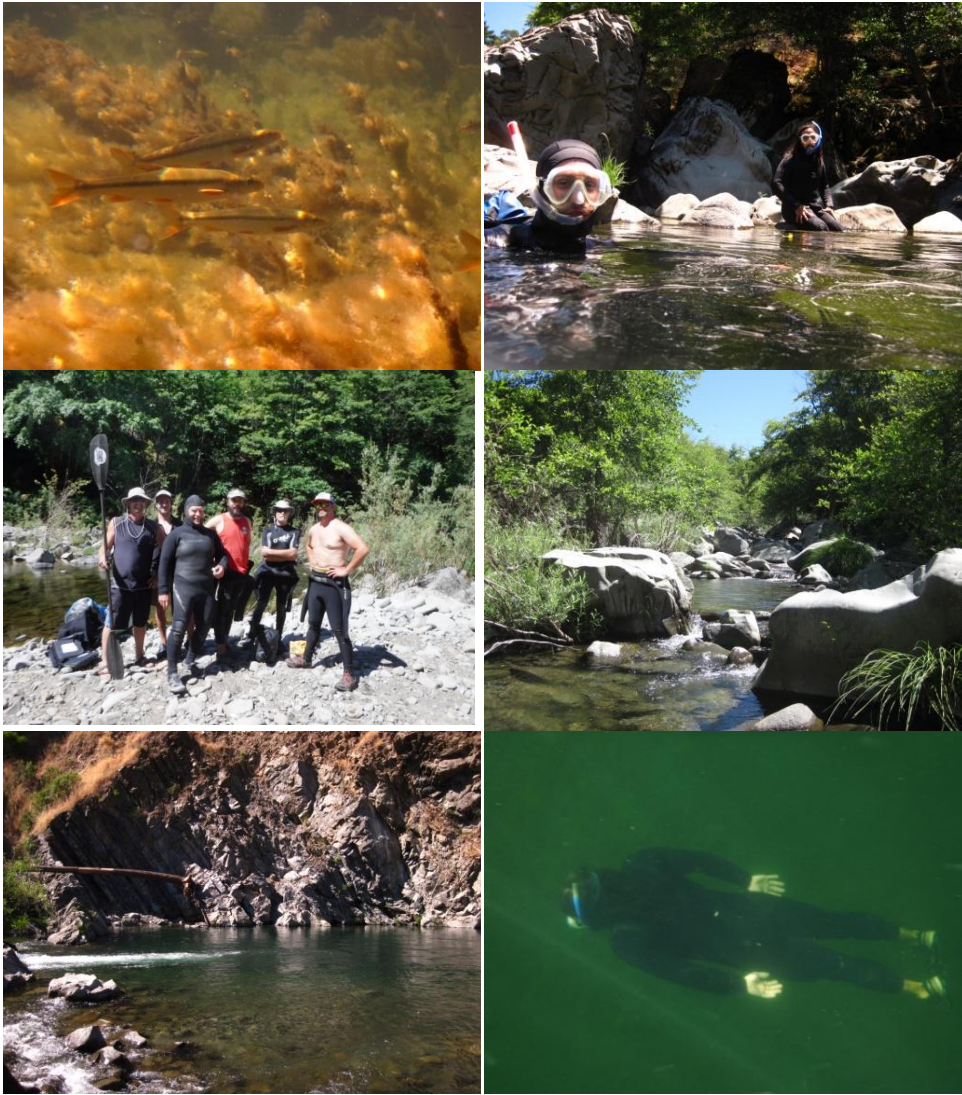


# Monitoring Sacramento Pikeminnow in the Eel River: Summer 2016



By: Patrick Higgins, ERRP Managing Director

*Funding From:*



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## Acknowledgements

The Eel River Recovery Project thanks the Salmon Restoration Association (SRA) for funding our work on the non-native Sacramento pikeminnow. In addition to supporting our Chinook salmon and pikeminnow monitoring in the Mendocino County portions of the Eel River, SRA also funds salmon habitat restoration projects in coastal streams and the Mendocino High School SONAR program. SRA raises these funds by hosting the World's Largest Salmon Barbeque on Fourth of July weekend each year in Fort Bragg, which is a tremendous community event.

Dr. Bret Harvey of the U.S. Forest Service Redwood Sciences Laboratory collected extensive baseline data on Sacramento pikeminnow of the Eel River. We are thankful for his oversight of our study and for training divers to differentiate between California roach and pikeminnow. His presentation at Standish Hickey State Park on the night prior to the June 27-28 dives was also appreciated by campers who attended the talk. Thanks also to the Standish Hickey State Park Interpretive Association for providing a beautiful campsite for two nights for divers.

The success of the pikeminnow dive, however, was largely owing to a very high quality dive team comprised of motivated volunteers and ERRP contractors. Phil Georgakakos and Noah Israel from the University of California Berkeley provided a lot of energy and expertise and their participation is greatly appreciated. ERRP volunteers. Willie Grover and Dave Sopjes also had considerable experience from participating in many previous ERRP fall Chinook dives. Fisheries professional Tim Salamunovich of Normandeau Associates joined the team on the second day – thanks Tim! Pat Higgins, ERRP Managing Director has years of experience and kept the team on task. Although Barbara Sopjes did not join in the dives, her help with spotting vehicles helped the team a lot. ERRP also wishes to thank volunteer Mickey Bailey, who assisted with a 2 ½ mile pikeminnow census of the main Eel River survey above Woodman Creek. Sal Steinberg pulled together the More Kids in the Woods project that involved Van Duzen River 4<sup>th</sup> grade students in supervised dive observations; his efforts are much appreciated. We wish to also thank North Fork Eel volunteer Brett Lovelace for access and monitoring participation.

Eric Stockwell deserves special thanks for being the water Sherpa, dragging and floating a kayak with dry bags that contained note books, equipment and lunches. He did a great job photo-documenting the trip and taking GPS waypoints to establish the location of large groups of pikeminnow.



**Eric Stockwell readies his camera as he cruises through a SF Eel River pool**

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## Introduction/Background

Since its formation in 2011, the Eel River Recovery Project (ERRP) has been concerned with the potential impacts of the introduced Sacramento pikeminnow (*Ptychocheilus grandis*) on the Eel River's native fish community (Smalley and Higgins 2011). Residents of the Eel River watershed are worried about predation by the pikeminnow on salmon and steelhead juveniles and would like to see action taken to control this invasive, non-native species.

Formerly known as squawfish, the pikeminnow is one of the larger members of the minnow family, *Cyprinidae*, with voracious pike-like feeding habits (Figure 1). Their native range is the Sacramento-San Joaquin, Pajaro-Salinas River, Russian River, and Clear Lake drainages in California. They have been introduced into the Eel River, Morro Bay tributaries, and southern California streams. Moyle et al. (2008) summarized the problem in the Eel River basin:

“In the Eel River, Sacramento pikeminnow were introduced illegally in 1979 and they quickly spread throughout much of the watershed (Brown and Moyle 1997). They are now one of the most abundant fish in the river and it is highly likely that they are suppressing Chinook salmon populations through predation on emigrating juveniles.... Pikeminnow not only prey directly on juvenile steelhead but they displace them from pool habitat into less desirable riffle habitat, presumably resulting in reduced growth and survival.”

Genetic analysis indicates the Eel River population came from upper Cache Creek or Clear Lake (Kinziger et al. 2014). They were likely introduced by fishermen who imported small fish as bait to fish for bass in Lake Pillsbury. High flows in 1983 and 1986 allowed rapid spread of the population downstream to the estuary. By the 1990s, the pikeminnow had colonized the entire Eel River stream network (Brown and Moyle 1991, 1997) up to waterfalls that prevented further migration. The growth of the population was exponential when first introduced (Clancy 1993), because the fish found little competition and optimal habitat in the main Eel River channels that had been profoundly changed by the 1964 flood. Harvey and Nakamoto (1999) found that adult pikeminnow in the Eel River occupy the same pools year after year. Substantial predation by pikeminnow on steelhead juveniles in the upper South Fork Eel River was documented by Nakamoto and Harvey (2003), and it was greatest during fall when water clarity was high. White and Harvey (2001) noted that predation by pikeminnow had substantially reduced native sculpin populations in the Eel River. Native Sacramento suckers also appears to be at low levels and patchy in distribution (Higgins 2013, 2015). Surveys since 2012 by ERRP suggest that pikeminnow have declined, possibly as a result of intensive otter predation (Higgins 2015).

Eel River pikeminnow surveys are necessary to gauge the potential level of predation on salmonids (Harvey and Nakamoto 1999, Harvey et al. 2002) and other native fishes. Nakamoto and Harvey (2003) noted that strategically cropping the largest adult pikeminnow in reaches of the river where there is high production of juvenile salmonids may be necessary to limit predation. There have been extensive plans for pikeminnow eradication or management in the past (Upper Eel Task Force 1992; NMFS 2002), and some actions to remove them (Downie 1992a, 1992b; PGE 2007), but none since the National Marine Fisheries Service (2008) halted PG&E control efforts within and immediately below the Potter Valley Project.



**Figure 1. Sacramento pikeminnow in the 10-14 inch size class in an algae covered run. 6/27/16**

## **Time, Location and Conditions of Surveys**

The June 27-28 dive survey of the South Fork Eel River was approximately 12 miles in length and extended from the U.S. Bureau of Land Management access at the Hermitage at the mouth of Rattlesnake Creek to Standish Hickey State Park (Figure 2). The halfway point of the survey was the Gomde Monastery at the mouth of Cedar Creek, where the team took out at the end of Monday and began the second day of the survey on Tuesday morning.

The survey was scheduled to take advantage of low flows for better observation of pikeminnow, but also to be sufficiently early in the season to avoid risk of swimmer's itch for divers. The U.S. Geologic Survey flow gauge at Leggett registered a flow of 55 cubic feet per second (cfs) at the beginning of the survey and 50 cfs near the end (Figure 3). A significant part of the reach from Rattlesnake Creek to Cedar Creek is high gradient riffles or cascades and very difficult to float in any kind of water craft at low flow. Consequently, only one person used a kayak to portage gear and food. In addition to navigating white water and falls, some of the riffles and cascades had dense willow growth encroaching on the channel (Figure 4).

Conditions were ideal for dive observations with visibility of 30 feet underwater, although divers sometimes disturbed algae in runs above pools and slightly lowered visibility. Cladophora growth was not excessive and concentrations of cyanobacteria were noted only in a few short reaches. The water temperature measured at the beginning of the dive survey was 64 F on the morning of June 27 and had risen to 68 F at the end of the survey on the afternoon of June 28.



Figure 2 Map of June 27-28 ERRP Sacramento pikeminnow survey.

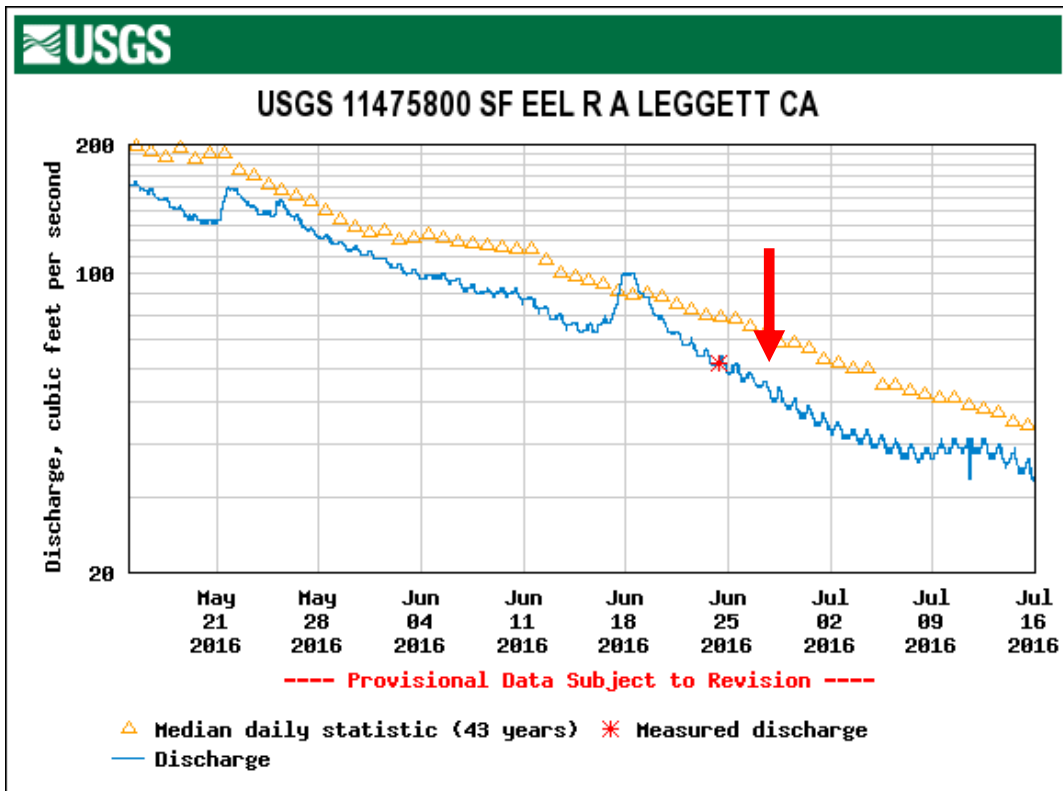


Figure 3 Flow of the South Fork Eel River at Leggett gauge during survey (red arrow). Data from the USGS



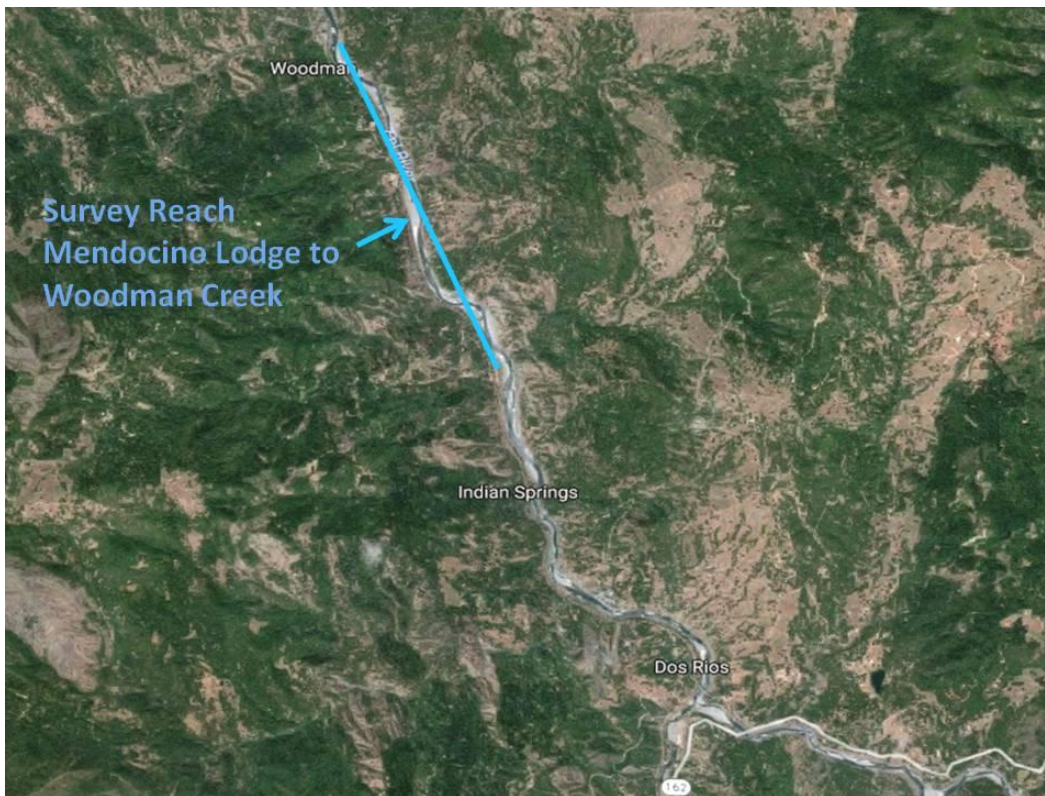
**Figure 4 Top of SF Eel high gradient riffle with dense willow growth between the put in below Camp St Michael and Rattlesnake Creek. 6/27/16.**

On June 6, the North Fork Eel River at the None of the Above Ranch between Mina Bridge and Hulls Creek had visibility of greater than 25 feet and the water temperature was 72 F. There was very little algae and no sign of cyanobacteria. No pools deeper than 20 feet were noted.

On July 3, 2016, two divers surveyed a 2 ½ mile reach of the main Eel River below Dos Rios from the former location of the Mendocino Lodge to Woodman Creek. (Figure 5). The flow according to the USGS gauge at Ft Seward downstream of Woodman Creek was 100 cfs. Water clarity was 25 feet or greater. Cladophora was flourishing in some pools, but the amount of algae was not indicative of nutrient pollution. Very little algae coated the rocks in riffle environments and there were almost no patches of cyanobacteria. An over-supply of fine sediment in the form of very small gravel caused problems with embeddedness in riffles and was also compromising the depth of pools.

The Eel River above Bear Creek near Shively was surveyed on July 4 and August 1. Visibility was 20 feet on the earlier date, but dropped to under 15 feet by August 1, apparently due to phytoplankton growth. Water temperatures were 74 F on July 4 and 78 F on August 1. Blooms by the latter date caused large amounts of suspended algae and potentially toxic cyanobacteria were flourishing in the shallows. Visibility was greater than 20 feet at the Alderpoint community swimming hole on July 14, flow was 94 cfs, the water temperature was 74 F, and algal growth was moderate, with some cyanobacteria present.

The Van Duzen River at Shakefork Farm on June 24 had visibility of 20 feet, the water temperature was 71 F, algae was fairly light and no cyanobacteria were noted. The largest pool at Swimmers Delight on July 13 also had visibility of 20 feet and no floating algae.



**Figure 5 Map of main Eel from Dos Rios (bottom left) downstream to Woodman Creek with pikeminnow survey reach highlighted in blue.**

## **Methods**

On June 27-28, standard direct observation dive techniques were used, similar to ERRP lower Eel River fall Chinook dives (Higgins 2016), U.S. Forest Service summer steelhead surveys in the Trinity River basin (Everest 1997), and the California Department of Fish and Wildlife Butte Creek spring Chinook counts in the Central Valley (Garmin 2012).

Five experienced divers swam in a line through pools maintaining proper spacing so that fish could be counted as they passed the team (Figures 6 and 7). If fish milled in front of the team without passing, they were not counted, and fish passing back downstream were subtracted from the count. Divers conferred after each pool census. Leaders had wrist slates for recording the number of pikeminnow, and data were transferred to notebooks periodically. Size classes adopted are the same as those used previously (CDFG 1996): 0-4" in length, 4-8", 8-14", 14-18" and greater than 18". The location of pools containing large numbers of adult pikeminnow was recorded using a GPS device. No effort was expended to discern between California roach (*Hesperoleucus symmetricus*) and juvenile pikeminnow less than four inches that schooled together in shallow, warm edge waters. There wasn't time to make this distinction and it was thought unnecessary since pikeminnow of this small size do not predate on salmonids.

Solo dives and those utilizing inexperienced volunteers and elementary school students were for the purpose of determining presence or absence of pikeminnow and relative abundance, not for precise counts.





**Figure 6** Second day dive team (l to r): Willie Grover, Tim Salamunovich, Pat Higgins, Eric Stockwell, Noah Israel, and Phil Georgakakos. 6/28/16. Photo by Barbara Sopjes.



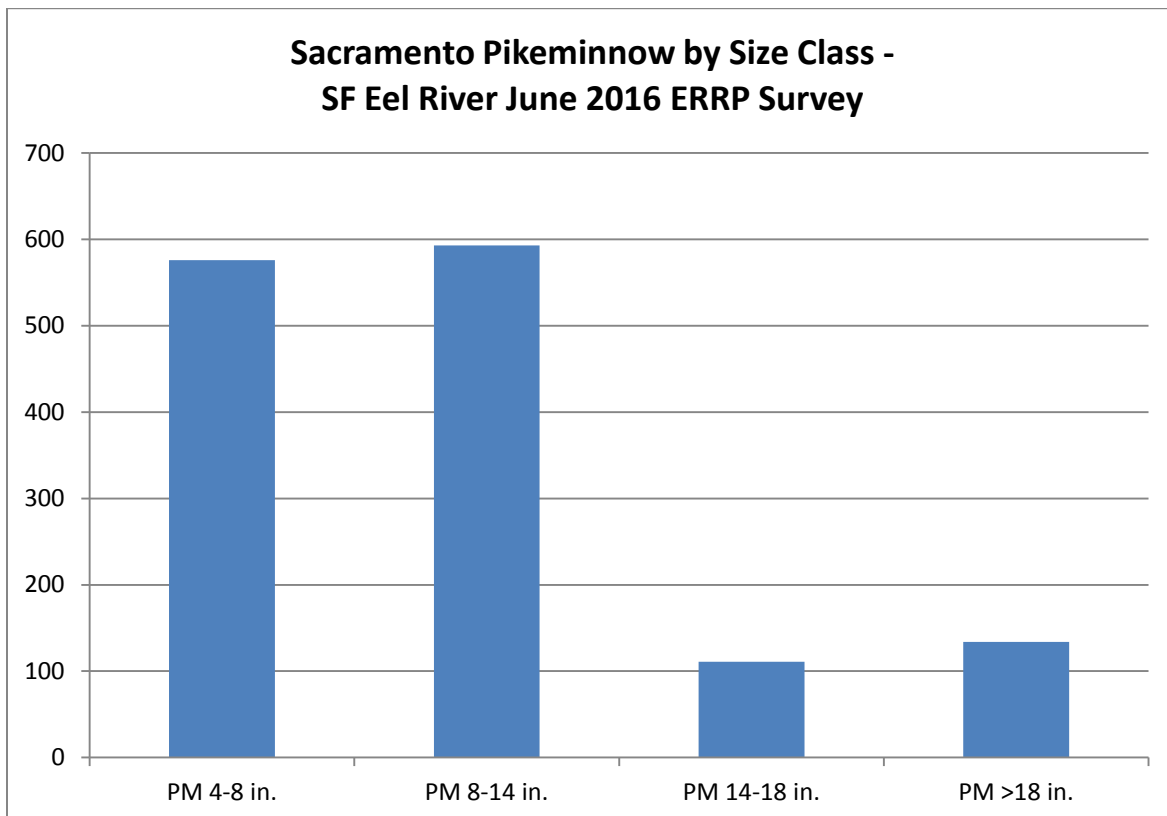
**Figure 7** Dive team advancing in formation through SF Eel River pool on day 1 of pikeminnow survey.

## Results

South Fork Eel Rattlesnake Creek to Standish Hickey: A total of 41 pools and three deep runs were surveyed on June 27-28 in the 12 mile South Fork Eel River reach from Rattlesnake Creek to Standish Hickey State Park. The total number of Sacramento pikeminnow greater than 4 inches in length was 1,414 with 576 fish from 4-8 inches, 593 from 8-14 inches, 111 from 14-18 inches, and 134 pikeminnow greater than 18 inches in length (Figure 8). The complete table of results by habitat unit is available as Appendix 1. The number of Cyprinids less than 4 inches in length was 3445, but the vast majority of these fish were California roach, not pikeminnow (Figure 9).

The upper reach of the survey above Cedar Creek had far more juvenile steelhead (*Oncorhynchus mykiss*) than pikeminnow. This included a large number of yearlings (4" in length), two year olds (6" in length) and some steelhead up to 18" in length. Only five young of the year native Sacramento suckers (*Catostomus occidentalis*) were noted in the entire survey reach and no sculpin (*Cottus sp.*) were observed. Groups of three-spine stickleback (*Gasterosteus aculeatus*) were seen occasionally in the stream margins, but they were not abundant.

There were hundreds of Pacific lamprey redds at riffle crests and in gravels of appropriate size in pool tails and runs along the entire length of the South Fork survey. Spawned out dead lamprey were frequently seen and one live adult was also observed in a pool.



**Figure 8** The number of Sacramento pikeminnow by size class counted in the two day dive survey of the South Fork Eel River from Rattlesnake Creek to Standish Hickey State Park on June 27-28, 2016.



**Figure 9** California roach schooling in a South Fork Eel River cove with dense algae growth. Note the lack of a strong purple stripe along the lateral line, the wide body, and lack of down-turned mouth.



**Figure 10** Two year old steelhead trout feeding in the SF Eel River below Cedar Creek.



**Figure 11 Three spine stickleback in the margin of the South Fork Eel River**

Main Eel River Above Woodman Creek: There were very few fish in the main Eel River between the site of the old Mendocino Lodge and Woodman Creek, with no steelhead trout and only five adult pikeminnow over 18 inches in length (Figure 12). The reach was riffle dominated and there were no pools deeper than 20 feet. Three of the five adult pikeminnow were seen holding in runs. Schools of a few dozen roach and small juvenile pikeminnow tended to be in side water areas with emergent vegetation, which were rare features. Unlike on the South Fork Eel survey, juvenile young suckers of approximately two inches in length were common in riffles and used interstitial spaces between cobbles for shelter (Figure 13). Pacific lamprey redds were as numerous as on the South Fork, but there also appeared to be a number of false redds. Some dry redds were seen on gravel terraces adjacent to the stream that were made before flows receded.

Lower Main Eel at Shively: An old growth redwood tree with its root ball intact lodged in the main Eel River approximately 100 yards upstream of Bear Creek during the winter of 2015-2016. The water was 12-15 feet deep and the root ball extended from the bottom of the pool to the surface and had extensive algae growth that served as ideal cover for adult and juvenile pikeminnow. Dozens of adult pikeminnow over 18" in length held at depth and they moved into the cover of the log when approached. Pikeminnow of intermediate size also numbered in the dozens while those under 10" numbered in the hundreds and schooled nearer the surface (Figure 14). On August 1, one dozen adult pikeminnow greater than 18" held in a school off the mouth of Bear Creek.

Main Eel River at Alderpoint: There were no pikeminnow in run or shallow pool habitats for 600 feet extending upstream from the Alderpoint community swimming hole or in the pool itself. However, two to three dozen pikeminnow ranging from 8-14" in length held in a bedrock run just above the pool.



**Figure 12** Adult pikeminnow approximately 24 inches in a run on the main Eel River above Woodman Creek.



**Figure 13** Juvenile Sacramento sucker holding in the main Eel River in a riffle upstream of Woodman Creek.



**Figure 14** Large adult pikeminnow holding deep and dozens of 8-12” fish holding in the top of the water column near a submerged old growth redwood log just upstream of Bear Creek at Shively on the lower Eel River.

Van Duzen River Locations: A Van Duzen River reach approximately 1500 feet long was surveyed at Shakefork Farm in Carlotta. A shallow glide less than 2 feet deep comprised the lowest 1000 feet of the survey and the only fish were tiny Cyprinids in the shallow margins. Several hundred roach were present in the 300 foot long run just upstream, which was three feet deep with emergent aquatic vegetation, but no pikeminnow juveniles were evident. The top 200 feet of the survey was a pool with a maximum depth of 5 feet and extensive cover provided by large woody debris and overhanging vegetation on the west bank. A dozen pikeminnow 12-18” long were intermixed with several dozen 4-12” long and hundreds of roach and juvenile pikeminnow less than 4”.

The survey of the largest and furthest upstream pool at Swimmers Delight Humboldt County Park found no pikeminnow in the deepest part of the pool, which was greater than 20 feet deep. However, there was a school that included three 14-18” pikeminnow and nine pikeminnow greater than 18” clustered around a large wood jam in an alcove at the upstream extent of the pool. Algae were draped off the limbs within the wood jam and schools of dozens of roach were making use of the cover.

North Fork Eel River: The dive observations on the North Fork Eel in early June were primarily to determine abundance of steelhead juveniles, but a single 18 inch long Sacramento pikeminnow was seen and video documented.

Other Salmonids Observed: Coho salmon juveniles (*Oncorhynchus kisutch*) were noted feeding in lower Rattlesnake Creek and a juvenile Chinook (*Oncorhynchus tshawytscha*) was observed migrating downstream above Standish Hickey State Park.

Other Aquatic and Avian Life: Other aquatic animals noted in summer 2016 surveys were western pond turtles (*Actinemys marmorata*), yellow-legged frogs (*Rana boylei*) and rough-skinned newts (*Taricha granulose*). Scat of the north American river Otter (*Lontra canadensis*) was commonly seen on rocks near the edge or in the middle of the river, although no live otters were observed. Birds noted included blue herons (*Ardea herodias*), green herons (*Butorides virescens*), osprey (*Pandion haliaetus*), mergansers (*Mergus merganser*), and dippers (*Cinclus mexicanus*).

## **Discussion**

The first ERRP population estimate of Sacramento pikeminnow on June 27-28, 2016 proved feasible and a precise estimate of pikeminnow over 4" in length was attained for a 12 mile reach of the South Fork Eel River. ERRP was able to put together an extremely competent dive team and to get very high quality data. The flow of 50-55 cfs according to the USGS gauges at Leggett made navigation with a kayak challenging, but set up perfect conditions for dive counts in terms of current and visibility. It is imperative that dive team members be in very good condition because six miles per day of walking and swimming is arduous and near the maximum feasible survey length.

With several drought years preceding the dive, there was concern that the pikeminnow population would be high. Instead there were only 117 Sacramento pikeminnow over 4" in length per mile, far fewer than the number of juvenile steelhead observed. Of the 134 adult pikeminnow over 18 inches, 111 or 83% resided in the four deepest pools in the reach, confirming the hypothesis advanced by Higgins (2015). Of the total, 43 of the largest adult pikeminnow were in the Highway 1 Pool at Leggett.

The Alderpoint community swimming hole had hundreds of pikeminnow up to 16" in length when surveyed in September 2010, then very small numbers in most subsequent samples, including in 2016. This pool experienced substantial filling in December 2012 and may have become less suitable habitat because of diminished depth and ability of pikeminnow to avoid otters. An exception was on November 11, 2014 when there were once again hundreds of pikeminnow of varying lengths, including at least a dozen adults greater than 18". Suitability at that time may have been owing to a proliferation of macroalgae during the prolonged drought that provided cover.

The North Fork Eel River observation between Mina Bridge and Hulls Creek indicates that pikeminnow have been able to jump water falls in the lower river that block salmon migrations.

In all 2016 ERRP surveys, large adult pikeminnow were found only in the deepest pools and adjacent large wood jams, similar to previous findings by ERRP (Higgins 2013, 2015). Otter scat was seen frequently on rocks during the South Fork survey, at Shakefork Farm on the Van Duzen and on the main Eel above Woodman Creek. This evidence tends to uphold the ERRP hypothesis that predation by otters is controlling the distribution and abundance of the largest of the largest pikeminnow.

The relatively low number of Sacramento pikeminnow might suggest that there is no need to remove them or suppress their population since they are being naturally controlled by otters. However, the fact that there are very few suckers in the South Fork Eel and that sculpin are extremely rare throughout the Eel River watershed indicates that the native fish community has not recovered from pikeminnow predation impacts. Consequently, removal of large adults may be necessary to allow these non-game fish species to increase in numbers and fill their historic niche, as well as to minimize predation on native salmon and steelhead juveniles.

Although pikeminnow over 10 inches are known to consume juvenile salmonids, those greater than 16 inches have the greatest predatory impact (Rieman and Beamesderfer 1990). Therefore, removal of fish greater than 16 inches would have the greatest beneficial impact on predation reduction. Larger adults also tend to be females (Rieman and Beamesderfer 1990), and the larger the fish the more eggs they lay. Consequently, removing large fish may also change the demographics of the population and decrease reproductive capacity.

Previous efforts to control pikeminnow such as removal with explosives (Downie 1992a, 1992b), and derbies that only lasted a year or two, were temporary impacts that would be categorized by Glasby and Underwood (1996) as a “pulse disturbance”. Since various events such as floods have caused rapid population declines historically, pikeminnow and many other fishes have the ability to increase reproduction in response (Rieman and Beamesderfer 1990). Therefore, previous short term efforts may have temporarily decreased the pikeminnow population, but may also have triggered a rebound to an equal or higher level. For a removal program to be effective in resetting the Sacramento pikeminnow population at a lower level it should be ten years in duration. This is one year beyond the maximum age of pikeminnow (Taft and Murphy 1950), and such an extended management effort would create a “press disturbance” (Glasby and Underwood 1996).

According to the FishBase (2016) on-line database of fishes, Sacramento pikeminnow have very low resilience to fishing pressure with a minimum population doubling time of 14 years. This means that, if fully depleted by a ten year removal effort, the species would take more than a decade to rebound. FishBase (2016) also noted that Sacramento pikeminnow have potentially high vulnerability. Consequently, we could make pikeminnow rare in the Eel River if we are able to create a press disturbance.

Some have questioned whether pikeminnow removal would cause a decline in otters because of a decreased prey base. However, suckers, sculpins, salmonids, Pacific lamprey and other native species would increase in response to reduced pikeminnow predation and would serve as food for otters, as these species matured and/or returned to spawn. Recruitment of juvenile pikeminnow into the adult population could also be increased, if larger adults were cannibals and their predation was reduced or eliminated. Since Nakamoto and Harvey (2003) found cannibalism by pikeminnow in the Eel River to be rare, the likelihood of such a population response is low. Additionally, Gard (2005) suggested that niche partitioning by juvenile pikeminnow in the presence of large adults tends to naturally suppress intraspecific competition and predation.

ERRP would like to begin to experimentally remove large adult pikeminnow in the upper South Fork in 2018. Because of the known patterns of distribution of large adult pikeminnow and the discrete number of locations where they reside, subsequent basin-wide removal efforts may be feasible.



## Recommendations

- Continue Sacramento pikeminnow trend data collection in 2017 on the South Fork Eel River from Rattlesnake Creek to Standish-Hickey State Park.
- Expand volunteer surveys to other Eel River reaches and encourage volunteers to collect data and supply photo and video documentation of the distribution and abundance of pikeminnow.
- Begin a dialog with CDFW and NMFS about the possibility of organized, strategic removal of large adult pikeminnow as a pilot project on the upper South Fork Eel River in 2018.
- Work with Humboldt State University to study Eel River otters and to explore how they exploit non-native Sacramento pikeminnow and other food resources.
- Work with the University of California Berkeley and Davis to study population trends of non-game native fish, such as the Sacramento sucker and sculpin species, as a means of gauging ecological recovery from pikeminnow impacts.

## Conclusion

Although ERRP observations indicate a downturn in the Sacramento pikeminnow population relative to the 1990s (Clancy 1993), there is always the potential for the population to re-expand in the future unless they are managed. Intervention is imperative, because prior human activities, like building a reservoir suitable for pikeminnow proliferation and introducing them, have put the native fish community of the Eel River at risk. There is greater risk of harm to salmonid and native fish populations from inaction than from possible side-effects of pikeminnow removal and management of the species.

The words of Julian Huxley pertain:

“It is as if man had been suddenly appointed managing director of the biggest business of all, the business of evolution – appointed without being asked if he wanted it, and without preparation. What is more, he can’t refuse the job. Whether he wants to or not, whether he is conscious of what he is doing or not, he is in fact determining the future direction of evolution on this earth. That is his inescapable destiny, and the sooner he realizes it and starts believing in it, the better off for all.”

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**Appendix 1. Sacramento pikeminnow data from ERRP June 27-28 South Fork Eel River Survey – Rattlesnake Creek to Standish Hickey State Park.**

<b>Pool</b>	<b>_0_4*</b>	<b>_4_8</b>	<b>8_14</b>	<b>14_18</b>	<b>_18_Over</b>
Pool 1	85	2	2	0	0
Pool 2	2	3	3	0	2
Pool 3	0	0	0	0	0
Pool 4	0	0	0	0	0
Pool 5	0	0	0	0	0
Pool 6	0	6	14	5	1
Pool 7	0	0	0	1	1
Pool 8	400	60	40	30	26
Pool 9	0	0	4	0	0
Pool 10	200	8	0	0	0
Run	0	0	0	2	0
Pool 11	4	7			
Pool 12	0	0	0	0	0
Pool 13	600	30	30	10	24
Pool 14	25	10	10	0	0
Pool 15		2	5	5	4
Pool 16	0	0	0	0	0
Pool 17	60	0	0	0	0
Pool 18	200	0	0	0	0
Pool 19	0	0	0	0	0
Pool 20	600	0	0	1	0
Pool 21	150	50	0	0	2
Run	0	25	25	0	0
Pool 22	500	12	40	0	18
Pool 23	200	0	0	0	0
Pool 24	0	6	80	6	0
Pool 25	200	0	0	1	1
Pool 26	0	1	0	0	1
Pool 27	0	0	0	0	0
Pool 28	0	0	0	0	0
Pool 29	0	0	0	0	1
Pool 30	20	70	130	23	43
Pool 31	0	2	0	0	0
Pool 32	0	20	10	1	0
Pool 33	0	4	6	0	0
Pool 34	4	0	0	1	0
Pool 35	200	15	6	0	0
Pool 36	15	0	18	0	0

<b>Pool</b>	<b>_0_4*</b>	<b>_4_8</b>	<b>8_14</b>	<b>14_18</b>	<b>_18_Over</b>
Pool 37	50	150	50	5	2
Pool 38	30	8	8	0	0
Pool 39	50	20	20	8	2
Pool 40	0	5	92	12	6
Pool 41	0	60	0	0	0
<b>Totals</b>	<b>3595*</b>	<b>576</b>	<b>593</b>	<b>111</b>	<b>134</b>

\* The 0-4 inch category is likely comprised of predominantly California roach with some juvenile pikeminnow mixed in. Therefore, this size class is not included in the total population Sacramento pikeminnow calculation for the reach.