State of California
Department of Fish and Wildlife

2023 Clear Lake General Fish Survey

Ben Ewing
North Central Region
Sierra Fisheries

February 2024

Fish Evaluation Summary

In an effort to assist the California Department of Fish and Wildlife (CDFW) find more information on the Clear Lake fishery, a boat-based electrofishing survey was conducted on June 12, 13, and 27, 2023. The 18 selected shoreline transects were the same as those sampled in June 2015. The sites were randomly selected in 2015 and will be the basis for comparison with the 2023 survey. In 2023, native fish species made up two of the seven fish species collected at Clear Lake.

Introduction

In September 2012, The Center for Biological Diversity submitted a petition to the United States Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW) to list the Clear Lake Hitch (*Lavinia exilicauda chi*) (HCH-C) as a threatened or endangered species pursuant to the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA) (Fish and Game Code, 2050). On August 6, 2014, a decision to list the species as threatened under CESA was made by the California Fish and Game Commission. On December 3, 2020, a decision not to list the species as threatened or endangered under the ESA was made by the USFWS.

The objectives of this survey were to determine:

- Fish species composition
- Fish age class distribution
- Body condition of each species
- Fish species relative abundance

Methods and Materials

In June 2015, eighteen randomly selected transects of the shoreline at Clear Lake were sampled. These same 18 transects were selected in June 2023 for comparison (**Figure 1**). Each transect was sampled for 500 electrofishing generator seconds in a continuous line parallel to the shore. The 18 transects were sampled over a three-day period using one 18 ft. Smith-Root electrofishing boat. Pulsed DC current (2-12 amps) was used to "stun" the fish. When an electrical field was applied to the water it was measured on a counter and this time was recorded as generator seconds.

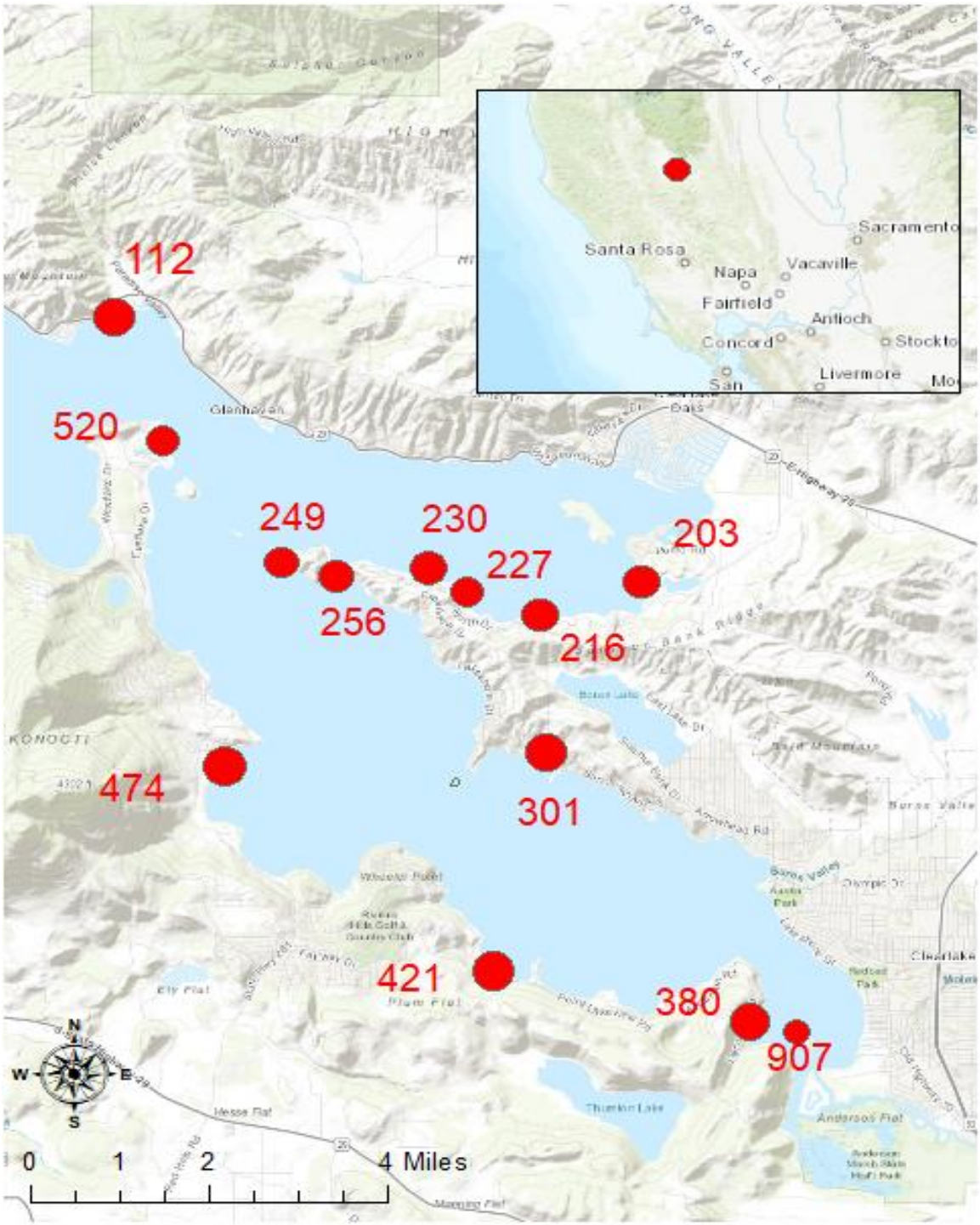

Figure 1. Clear Lake, Lake County with 18 transect locations for general fish surveys performed in June 2015 and 2023. Location of Clear Lake in relation to California found in inset map.

All fish (except Common Carp (*Cyprinus Carpio*, CP), Threadfin Shad (*Dorosoma petense*, TFS), Goldfish (*Carassius auratus*, GF), and Inland Silversides (*Menidia beryllina,* INS), were netted and placed in a livewell in the boat. An effort was made to capture all target species; however, very small fish occasionally eluded capture as did

fish on the outer edge of the electrical field. These fish could not be identified; and therefore, are not included with the Catch Per Unit Effort (CPUE).

The crew consisted of two forward netters, one boat operator, and zero to multiple crewmembers working the livewell, which held the collected fish in circulated water.

All fish collected were identified to species and the first 25 of each species at each transect had measurements recorded for total length (TL) in millimeters (mm). If minimum total lengths were attained for that specific species (Table 15.1, Murphy and Willis 1996), weights in grams (g) would be taken for the first 25 of each species. Minimum total length for Channel Catfish (*Ictalurus punctatus*, CCF) was 70 mm. Minimum total length for Bluegill (*Lepomis macrochirus*, BG), Tule Perch (*Hysterocarpus traski*, TP), Redear Sunfish (*Lepomis microlophus*, RSF), and Green Sunfish (*Lepomis cyanellus*, GSF) was 80 mm. Minimum total length for Sacramento Sucker (*Catostomus occidentalis*, SKR-S), HCH-C, and Sacramento Blackfish (*Orthodon microlepidotus*, SBF) was 90 mm. Minimum total length for both White Crappie (*Pomoxis annularis*, WCR) and Black Crappie (Pomoxis nigromaculatus, BCR) was 100 mm and minimum total length for Largemouth Bass (*Micropterus salmoides*, LMB) was 150 mm. Minimum lengths were designated because weight measurements of small fish tend to be quite variable with low precision and accuracy. Weights were determined using a digital scale or a Boga Grip ™ scale if the fish was over seven pounds. All fish collected after the first 25 of a species were tallied from each transect. The mean length and weight for each species was determined and an analysis of population indices were evaluated for selected species when appropriate. These indices include CPUE (fish/shocking minute) weight-length (millimeters/grams) relationships, relative weight (Wr), and proportional/relative stock density (PSD)/(RSD) (Anderson, R.O. and R.M. Neumann 1996). Relative weights were gathered by collecting the lengths and weights on fish and entering them into fixed slope and intercept parameters for that specific species (Table 15.1, Murphy and Willis 1996):

Log10(Ws) – (Fixed intercept found in Table 15.1) + (Fixed slope found in Table 15.1) * log10(L)

where Ws = standard weight

L = total length

The relative weight index ranges for determining the condition of selected species are: 110 and above: excellent, 90-109: good, 70-89: average, and 69 and below: poor (Ewing and Granfors, personal communication).

Proportional and relative stock density values were gathered by collecting the lengths of fish and comparing them to fixed stock, quality, preferred, and memorable sizes for that specific species (Table 15.2 and 15.3, Murphy and Willis 1996).

Results

In 2023, A total of 150 electrofishing minutes were used to sample the 18 transects. **Tables 1** and **2** summarizes the species composition, CPUE, mean total length and weight, and length ranges. One hundred and seven fish representing seven species were collected during the 2023 survey, compared to 346 fish and 12 identifiable species in 2015 (**Table 1**). In 2023, LMB comprised 44.9 percent of the total fish sampled. HCH-C followed with 23.4 percent of the total fish sampled. White Catfish (*Ameiurus c*atus, WCF) and Brown Bullhead (*Ameiurus nebulosus*, BBH) comprised 13.1 and 8.4 percent of the total catch, respectively. CCF, SBF, and BG concluded the species collected with 4.7, 3.7, and 1.9 percent of the catch, respectively. The total CPUE for this survey effort was 0.71 fish/minute.

Table 1. Species composition from Clear Lake, June 11 and 18, 2015 and June 12,13, and 27, 2023. Mean Total Length (TL) was measured in millimeters (mm). Average Weight was in grams (g).

		2015			2023		
	Species	Number	Percent	CPUE	Number	Percent	CPUE
1	Largemouth Bass	171	49.4%	1.13	48	44.9%	0.32
2	Bluegill	53	15.3%	0.35	2	1.9%	0.01
3	Clear Lake Hitch	24	6.9%	0.16	25	23.4%	0.17
4	Sacramento Sucker	24	6.9%	0.16	0	NA	NA
5	Black Crappie	22	6.4%	0.15	0	NA	NA
6	Tule Perch	15	4.3%	0.10	0	NA	NA
7	Goldfish	11	3.2%	0.07	0	NA	NA
8	Redear Sunfish	10	2.9%	0.07	0	NA	NA
9	Sacramento Blackfish	9	2.6%	0.06	4	3.7%	0.03
10	Brown Bullhead	3	0.9%	0.02	9	8.4%	0.06
11	Prickly Sculpin	2	0.6%	0.01	0	NA	NA
12	Channel Catfish	1	0.3%	0.01	5	4.7%	0.03
13	Unident. Sculpin	1	0.3%	0.01	0	NA	NA
14	White Catfish	0	NA	NA	14	13.1%	0.09
	Total	346			107		
	Generator minutes:	150.8			150		
	CPUE (Fish/ gen. min)	2.29			0.71		
	Water Temperature	76.5^{o} F			72.6^{o} F		

*Weights were only collected when the minimum total length for Bluegill was 80 mm, 90 mm for Clear Lake Hitch, 150 mm for Largemouth Bass. No lengths and weights for common carp were taken due to the damage they do to Department equipment.

Table 2. Comparison of mean total lengths, weights, and length ranges from Clear Lake, June 11 and 18, 2015 and June 12,13, and 27, 2023. Mean Total Length (TL) was measured in millimeters (mm). Average Weight was in grams (g).

		2015			2023		
		(TL) (mm)	Weight (g)	Length Ranges	(TL) (mm)	Weight (g)	Length Ranges
1	Largemouth Bass	275.4	727.9	34 - 603	421.6	1293.1	176 - 526
2	Bluegill	104.4	52.2	32 - 235	156	83.5	146 - 166
3	Clear Lake Hitch	199.3	83.5	158 - 305	157.2	52.6	44-366
4	Sacramento Sucker	272.9	223.0	230 - 405	NA	NA	NA
5	Black Crappie	165.1	70.3	134 - 210	NA	NA	NA
6	Tule Perch	74.3	64.0	55 - 160	NA	NA	NA
7	Goldfish	249.9	365.6	192 - 406	NA	NA	NA
8	Redear Sunfish	167.7	147.9	100 - 276	NA	NA	NA
9	Sacramento Blackfish	221.3	109.8	167 - 248	149.3	38	130 - 184
10	Brown Bullhead	266.7	410.0	153 - 357	392.3	1019.4	360 - 410
11	Prickly Sculpin	41	NA	37 - 45	NA	NA	NA
12	Channel Catfish	NA	NA	NA	270.8	528.7	465 - 745
13	Unident. Sculpin	NA	NA	NA	NA	NA	NA
14	White Catfish	NA	NA	NA	415.8	1169.8	226 - 540

Largemouth Bass

In 2023, LMB total length ranged from 176 – 526 mm (6.9 – 20.7 in.) (**Figure 2)**. The length class with the highest frequency in 2023 was 425 mm (16.7 in.) compared to the 175 mm (6.9 in.) class in 2015 (Ewing et al. 2016). This indicates the 2023 modal length class are likely four to five-year old fish (Moyle 2002). The length frequency distribution shows a LMB population in which there is an uneven distribution and range of size classes, with little recruitment in recent years (**Figure 2**). In 2023, the mean total length for LMB was 421.6 mm (16.6 in.) compared to 275.4 mm (10.8 in.) in 2015. A comparison of LMB collected in the 2023 survey and the 2015 survey indicate a gap in LMB collected from 275 – 350 mm (10.8 – 13.8 in.) (**Figure 2**).

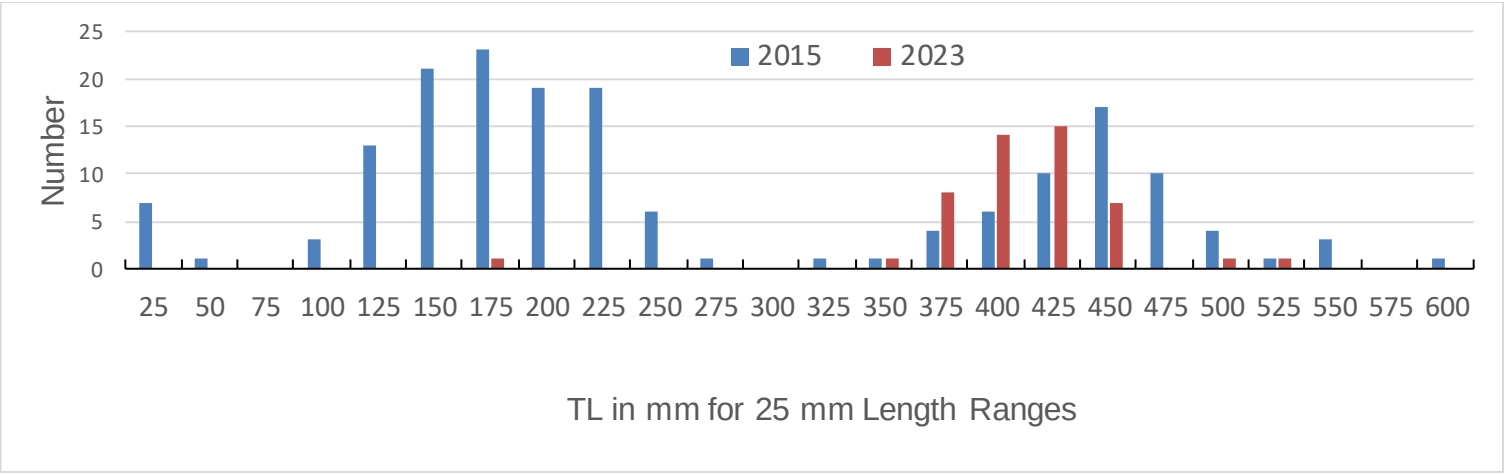

Figure 2. Length-frequency distributions for Largemouth Bass captured by electrofishing at Clear Lake, Summer 2015 and 2023.

Due to the low R^2 value in 2023, no length–weight scatter plot was made for comparison to 2015.

In 2023, PSD for LMB was 97, indicating a population that is unbalanced with larger-sized LMB compared to 56 and a balanced population in 2015. The RSD-P in both 2023 (97) and 2015 (54) were unbalanced with preferred-sized LMB. The RSD-M in both 2023 (6) and 2015 (8) were balanced with memorable-sized LMB. These stock density indices also indicate a partial unbalance in the system with larger than stock-size LMB.

In 2023, LMB had a mean relative value of 109, compared to 104 in 2015. This indicates the LMB collected were in good condition for both years.

Clear Lake Hitch

In 2023, HCH-C total length ranged from 44 – 366 mm (1.7 – 14.4 in.) (**Figure 3)**. The length class with the highest frequency in 2023 was 150 mm (5.9 in.) compared to the 200 mm (7.9 in.) class in 2015 (Ewing et al. 2016). This indicates the 2023 modal length class are likely one to two-year old fish (Moyle 2002). The length frequency distribution suggests an HCH-C population in which there is an uneven distribution and range of size classes, with few adults seen (**Figure 3**). In 2023, the mean total length for HCH-C was 157.2 mm (6.2 in.) compared to 199.3 mm (7.8 in.) in 2015. A comparison of HCH-C collected in the 2023 survey and the 2015 survey indicate an increase in HCH-C collected from 25 – 125 mm (1.0 – 4.9 in.) (**Figure 3**).

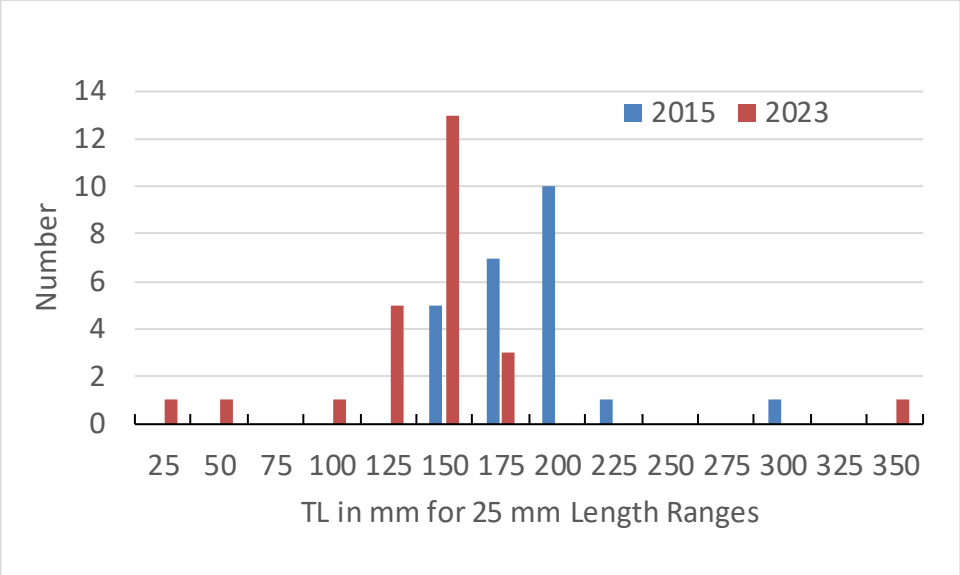

Figure 3. Length-frequency distributions for Clear Lake Hitch captured by electrofishing at Clear Lake, Summer 2015 and 2023.

A linear regression equation can be used to determine a reliable estimated weight from the length of HCH-C for both years' total lengths and weights for HCH-C ≥ 90 mm in total length (**Figure 4**)

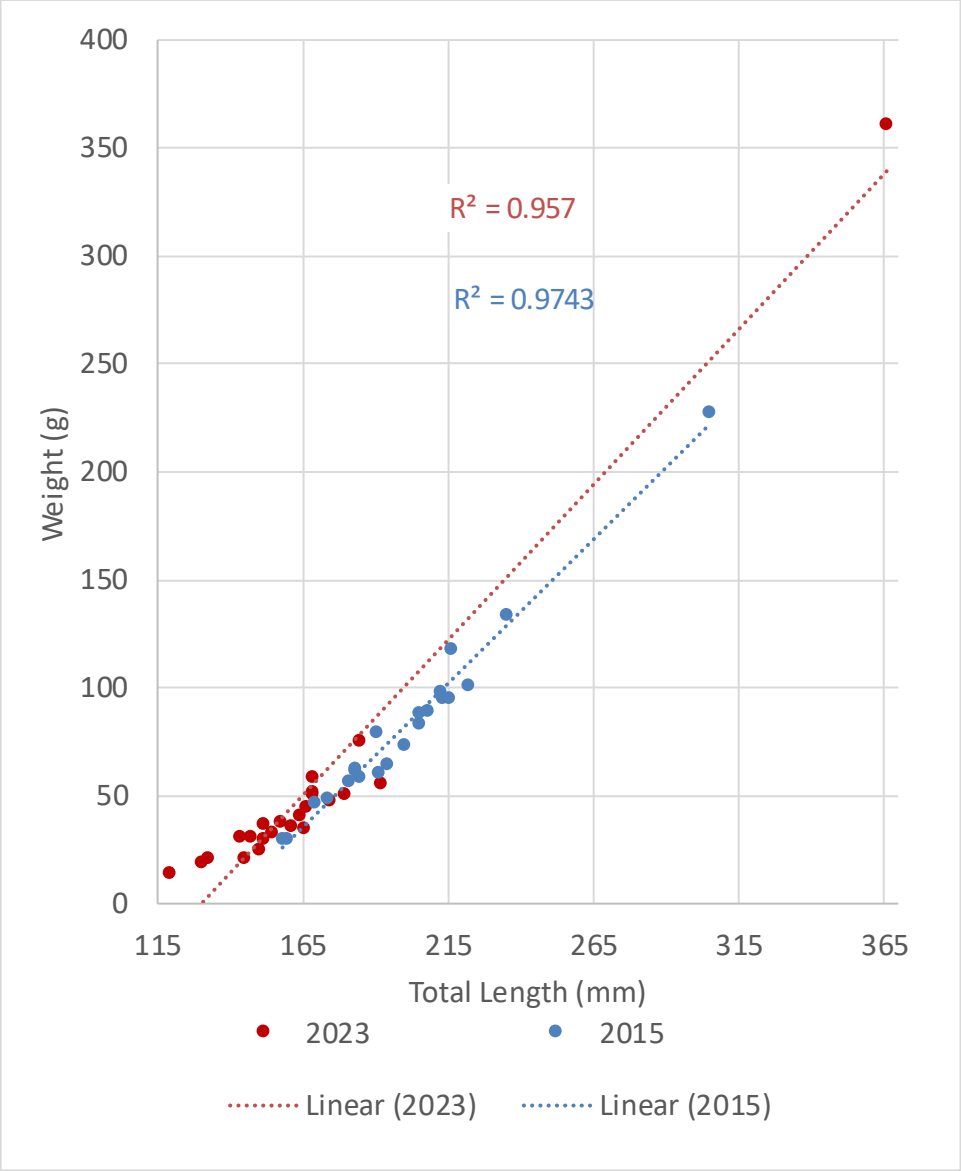

Figure 4. Total length-weight scatter plot with linear regression line for Clear Lake Hitch captured at Clear Lake, Summer, 2015 and 2023.

Discussion

Due to the small sample sizes collected for the other species, no summaries were made. This was due to the increased possibility the data collected would be an unreliable indicator of how that specific species status was in Clear Lake. In 2023, seven different species were sampled compared to 12 (does not count GF). In 2023, 107 fish were collected compared to 335 (not including GF) in 2015. Overall drought conditions the last few years at Clear Lake, including the lowest lake level in recent memory in 2022, likely contributed to the decline in fish seen. In 2022, Clear Lake was very low with a large, bathtub-ring around the lake, offering no structure/vegetation

refuge for eggs/juvenile fish. It is likely many of the eggs/juvenile fish that need this refuge, were predated on by other fish, birds, or mammals. Additionally, during the 2023 survey, much of the shoreline of Clear Lake had a large and possibly toxic algae bloom (**Figure 5**) which may have forced many fish to seek refuge into deeper water.

Figure 5. Clear Lake on June 27, 2023.

Of the 107 species that were collected in 2023, LMB were captured in the greatest number (n = 48, 44.9%). This was also true for 2015 (**Table 1**). Although, overall numbers of LMB decreased from 2015, the 2023 PSD and RSD-P for LMB were unbalanced with larger-sized fish. These values likely indicate the lack of decreased

recruitment in recent drought years. According to Gablehouse (1984), there is an imbalance, but Clear Lake is also well known throughout the world as a lake that grows a significant amount of large bass due to factors such as large surface area/volume, long growing season, and abundance of forage fish. It is possible with the 2023 historical high rainfall and the lake reaching capacity that more juvenile LMB will survive and bring the PSD and RSD-P into balance.

The 2023 average Wr for LMB was 109 which indicates the population is in "good" condition. The reasons mentioned above for the larger-sized LMB likely can be said for LMB's continued "good" relative weight classification.

The 2023 length frequency distribution offers further support that the LMB population had prior poor recruiting seasons. It is likely the 2023 LMB recruitment was an improvement, but with the historical high rainfall, the LMB may have spawned later in the year due to the cooler water temperatures earlier in the season. With the later spawn, many of the juveniles may have been too small to collect by boat electrofishing at the time of the survey.

HCH-C made up the second greatest number of fish collected in 2023 compared to fourth in 2015. It was positive to see the increase of HCH-C relative to the total number of species collected. HCH-C may never be the top species of number collected in a general fish survey, but to consistently be in the top five, would be a positive sign for the species. Thirty-two percent of the HCH-C collected were likely less than one year of age which suggests that there was at least a portion of the population that was able to spawn successfully in 2022.

By sampling the same 18 transects that were surveyed in June 2015, CDFW was able to gather consistent and comparable data that will be used to be inform management decisions.

References

Anderson, R. O. and R. M. Newmann. 1996. Length, weight and associated structural indices. Pages 447-482 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Ewing, B. and Granfors, Q. Personal Communication. California Department of Fish and Wildlife. Unpublished.

Ewing, B., Hickey, Kassie and J. Rowan. 2014 - 2015 Clear Lake Fishery and Habitat Evaluation. 2016. California Department of Fish and Wildlife. Available from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=116729

Gablehouse, D.W., Jr. 1984a. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273-285.

Moyle, P. 2002. Inland Fishes of California. University of California Press, Berkeley and Los Angeles, California. Pg. 138, 400.

Murphy, B.R. and D.W. Willis. 1996. Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland. Pages 458 and 462.