State of California
Department of Fish and Wildlife

2014 - 2015 Clear Lake Fishery and Habitat Evaluation

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North Central Region
High Elevation Fisheries

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Fish and Habitat Evaluation Summary

In an effort to assist the California Department of Fish and Wildlife (CDFW) find more information on the Clear Lake fishery, including the diet of what largemouth bass (*Micropterus salmoides)* (LMB), smallmouth bass (*Micropterus dolomieu*) (SMB) and catfish (*Ictaluridae*) taxa were consuming , multiple boat-based electrofishing surveys were conducted from July 22, 2014 through June 18, 2015. Each month, 18 randomly selected shoreline transects were surveyed. After the survey was conducted, it was determined that inland silversides (*Menidia beryllina*, INS), a non-native forage fish, was the greatest identifiable fish species seen in black bass and catfish stomach contents. Native fish species made up four of the top seven fish species collected at Clear Lake. A positive correlation was made between Clear Lake hitch (*Lavinia exilicauda chi*, HCH-C) and the amount of total weed cover in the littoral zone. A regression analysis was performed on the number of LMB present at sites with HCH-C and no significance was found, showing the occurrence of LMB does not have a negative or positive effect on HCH-C presence. For a detailed list of species acronyms used throughout this report refer to Appendix A at the end of this report.

Introduction

In September, 2012, the Center for Biological Diversity submitted a petition to the United States Fish and Wildlife Service (USFWS) and CDFW to list the HCH-C as a threatened and/or endangered species. This is pursuant to the federal Endangered Species Act 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. Currently the HCH-C is in the status review process by the USFWS to determine if it warrants being protected by the federal endangered species list.

The objectives of this survey were to:

- Determine fish species composition and species relative abundance
- Determine if there was a correlation between habitat and fish species presence
- Determine what black bass and Ictaluridae consumed throughout the year
- Determine the overall health and size class composition for black bass

This year-long survey by CDFW was conducted to help gather more information on the Clear Lake fishery by collecting information about lengths, weights, and relative numbers of fish species in the lake. In addition, gastric lavage was used to determine if HCH-C are being eaten by non-native fish. This survey will also gather information on the fishery as a whole which could include other potentially listed native fish. A physical habitat evaluation was also conducted to determine if there were any trends between sensitive fish species and habitat type variables.

Methods and Materials

Eighteen randomly selected transects of the shoreline at Clear Lake were sampled each month except for October, 2014 due to the lack of staffing availability. Each transect was sampled for 500 electrofishing generator seconds. Each transect was sampled in a continuous line parallel to shore. The eighteen transects were sampled over a two or three day period during the afternoon using one or two 18 ft. Smith-Root electrofishing boats. 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.

All fish (except common carp (*Cyprinus carpio*) (CP), threadfin shad (*Dorosoma petense*) (TFS), and (INS), which were recorded as present or absent in the transect) were netted and placed in a livewell in the boat. An effort was made to capture all desired species; however, very small fish occasionally eluded capture as did those fish on the outer edge of the electrical field. These fish could not be collected or identified, thus not being 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 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 goldfish (*Carassius auratus*, GF), Sacramento sucker (*Catostomus occidentalis*, SKR-S), HCH-C, and Sacramento blackfish (*Orthodon microlepidotus*, SBF) was 90 mm. Minimum total length for crappie was 100 mm while LMB was 150 mm. Minimum lengths were designated because weight measurements of small fish tend to be quite variable (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. 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):

$Log_{10}(Ws)$ – (Fixed intercept found in Table 15.1)+ (Fixed slope found in Table 15.1) * $log_{10}(L)$

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).

The first three bass and first three catfish species collected that were 200 mm (7.9 in.) or greater in length at each transect would have gastric lavage performed on them to evaluate stomach contents. Gastric lavage is the oldest and most widely used technique for obtaining the stomach contents of live fish; it appears to be a non-injurious method that is fast and easy to use and removes all types and sizes of natural food (Foster 1977). For fish generally less than 200 mm (8 in.), a 5 mm outside diameter feeding tube attached to a 60 cc bulb syringe was used. The syringe was filled completely with lake water; the feeding tube would then be inserted into the fish's stomach and pumped once. The fish was pumped a total of three consecutive times without any trace of stomach contents before the fish was released back into the lake. For fish generally greater than 200 mm in total length, two 3/8 in. inside diameter plastic tubes were attached to each end of a primer bulb. One tube would be placed in the livewell with the other tube inserted into the fish's stomach and pumped 10 – 15 times for a total of one set. The fish was pumped a total of three consecutive sets without any trace of stomach contents before the fish was released back into the lake.

Any stomach contents would be put into a plastic jar of 95% alcohol with labels placed on the inside and outside of the jar indicating the date, species of fish the gastric lavage was performed, total length, weight, and transect the fish was collected. Stomach contents would then be analyzed at the Region 2 CDFW laboratory and recorded.

For the habitat evaluation, a qualitative method from the U.S. Environmental Protection Agency's (USEPA) physical habitat characterization of lakes was used (Baker 1997). Blank data sheets showing all variables collected can be seen in Appendix B. At each station, a habitat observation plot was designated from the boat, 10 m offshore, and the perimeters in the figure below were estimated by eye. Ranking systems were then used in evaluating variables in the following zones: riparian, littoral and shoreline.

The categories used in ranking the abundance of variables were 0 to 4: 0 = absent, 1 = sparse (<10%), 2 = moderate (10 to 40%), 3 = heavy (40 to 75%) and 4 = very heavy (>75%). Fish cover in the littoral zone, a ranking system of 0 to 2 was used for habitat features: 0 = absent, 1 = present but sparse, and 2 = moderate to abundant. Human influence was categorized into 3 groups: 0 = absent, 1(B) = observed adjacent to or behind the plot and 2(✓) = present within plot.

For each station, a habitat observation plot was defined by eye from the 10 m (30 ft.) offshore location. Limitations were set for the riparian zone, 15 m (50 ft.) wide by 15 m (50 ft.) inland from the shoreline, and littoral zone was set to an area 15 m (50 ft.) wide by 10 m (30 ft.) from the shoreline to the boat (Figure 1).

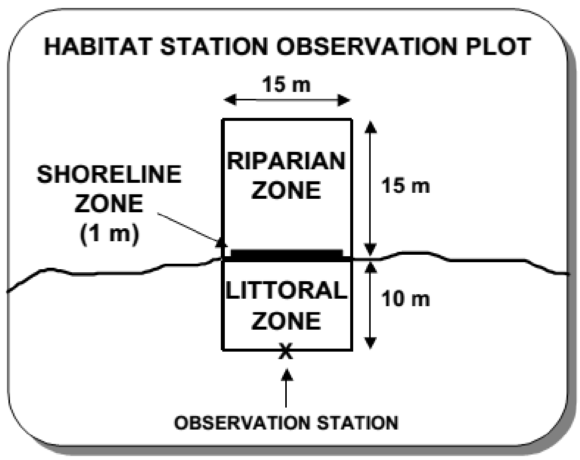

Figure 1. Physical habitat characterization plot dimensions.

To determine significance between habitat variables and specific fish species, regression analyses were conducted and Pearson correlation coefficients (r) were calculated for each variable with the number of fish present at a site with that variable. This was used to determine negative or positive correlations of each habitat variable on HCH-C, TP, and LMB.

Fishery Results

July

A total of 151.6 electrofishing minutes were used to sample the eighteen transects. Table 1 summarizes the species composition, CPUE, mean total length and weight, length ranges, and mean relative weights. A total of 682 fish representing twelve species and one unidentified minnow were collected during the survey (Table 1). Largemouth bass comprised 63.2 percent of the total fish sampled. Bluegill followed with 8.2 percent of the total fish sampled. Black crappie (Pomoxis nigromaculatus, BCR) and SKR-S comprised 7.9 and 6.2 percent of the total catch, respectively. White crappie (*Pomoxis annularis*, WCR), HCH-C, GF and SBF each made up 5.1, 2.9, 1.8, and 1.6 percent of the catch, respectively. Tule perch, channel catfish (*Ictalurus punctatus*, CCF), unidentified minnow, *Cyprinidae*), prickly sculpin, Cottus asper) (SCP-I), and RSF concluded the species collected with 1.3, 1.0, 0.3 each, and 0.1 percent of the catch, respectively. The total CPUE for this survey effort was 4.50 fish/minute.

Table 1. Species composition from Clear Lake, July, 2014.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	431	63.2%	2.84	182.8	1153.6	44 - 588	106
2	Bluegill	56	8.2%	0.44	104.4	39.4	29 - 146	118
3	Black crappie	54	7.9%	0.43	62.1	NA	45 - 86	NA
4	Sacramento sucker	42	6.2%	0.33	139.2	142.8	95 - 568	NA
5	White crappie	35	5.1%	0.28	62.2	NA	52 - 74	NA
6	Clear Lake hitch	20	2.9%	0.16	102.5	20.0	70 - 224	NA
7	Goldfish	12	1.8%	0.09	158.5	294.1	73 - 416	NA
8	Sacramento blackfish	11	1.6%	0.09	89.4	8.6	78 - 106	NA
9	Tule perch	9	1.3%	0.07	78.9	16.4	80 - 94	NA
10	Channel catfish	7	1.0%	0.06	419.9	1825.7	58 - 721	NA
11	Unidentified minnow	2	0.3%	0.02	84	7	78 - 90	NA
12	Prickly sculpin	2	0.3%	0.02	43.5	NA	38 - 49	NA
13	Redear sunfish	1	0.1%	0.01	57	NA	NA	NA
	Total	682						

Table 1 cont.

Generator minutes:	151.6
CPUE (Fish/ gen. min)	4.50
Water Temperature **	80º F

*Weights were only collected when the minimum total length for channel catfish was 70 mm, bluegill, Tule perch, redear sunfish, green sunfish was 80 mm, 90 mm for goldfish, sucker, hitch, Sacramento blackfish, 100 mm for crappie, and 150 mm for largemouth bass (Table 15. 1 Murphy and Willis 1996)

**Water temperature was a numeric average taken from one to multiple transects on three different days.

Largemouth bass

As seen in Table 1, LMB total length ranged from 44 mm to 588 mm (1.7 in. – 23.1 in.). The length class with the highest frequency was the 100 mm (3.9 in.) class (Figure 2). This indicates there are numerous bass in the young-of-the-year to two year age class (Moyle 2002).

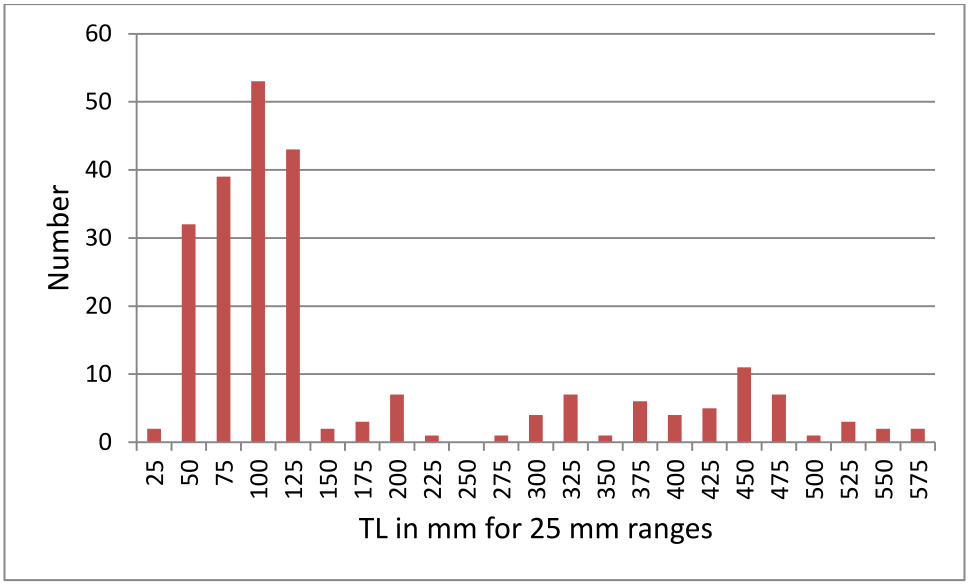

Figure 2. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, July, 2014.

The PSD for LMB was 85, which according to Gablehouse (1984) indicates a population that is unbalanced with larger-sized LMB. RSD-P was 65 while RSD-M was 11. These stock density indices also indicate an unbalance in the system with larger than stock-size (300 mm, 12 in.) LMB.

LMB had a mean relative weight of 106 which indicates the LMB collected were in good condition. Figure 3 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected. Using the linear regression equation present in Figure 3, a reliable estimated weight can be determined from the length of a LMB. These estimates are considered reliable due to the high R^2 (coefficient of determination) for this equation.

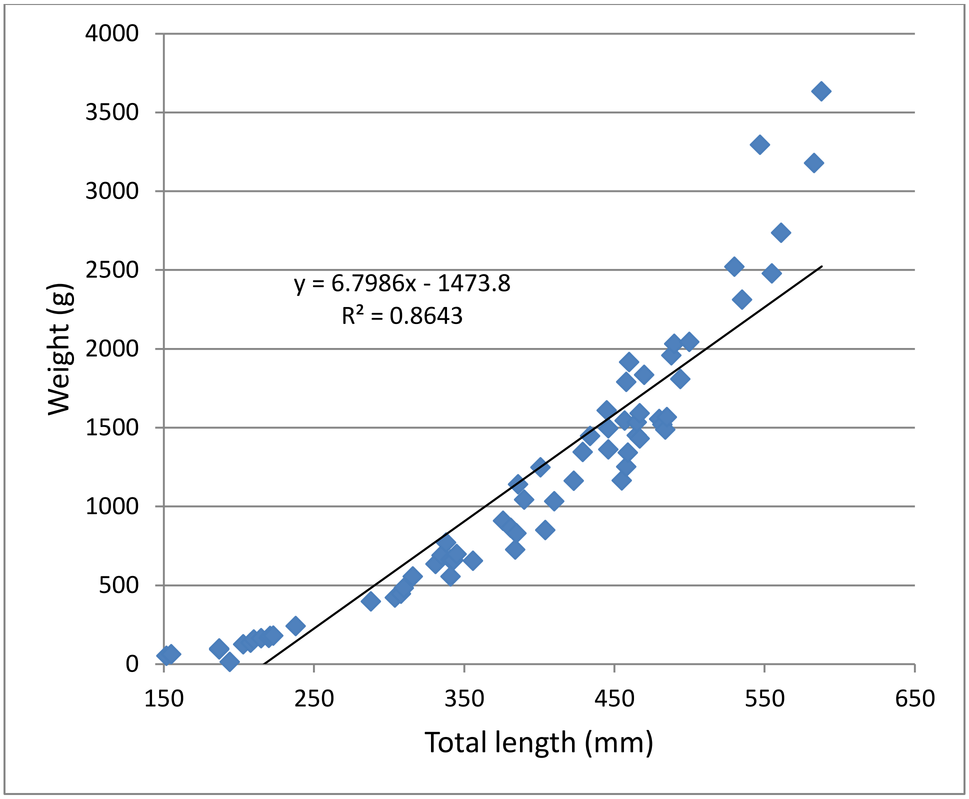

Figure 3. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, July 2014.

Of the 24 LMB that had gastric lavage performed on them and had stomach contents, 34 recognizable/unrecognizable organisms were documented. Six LMB had no contents pumped. The largest percentage of organisms seen were unidentifiable fish, parts, etc. (63%) (Figure 4). Inland silversides made up the greatest number of identifiable fish collected (11%) in the stomachs of LMB.

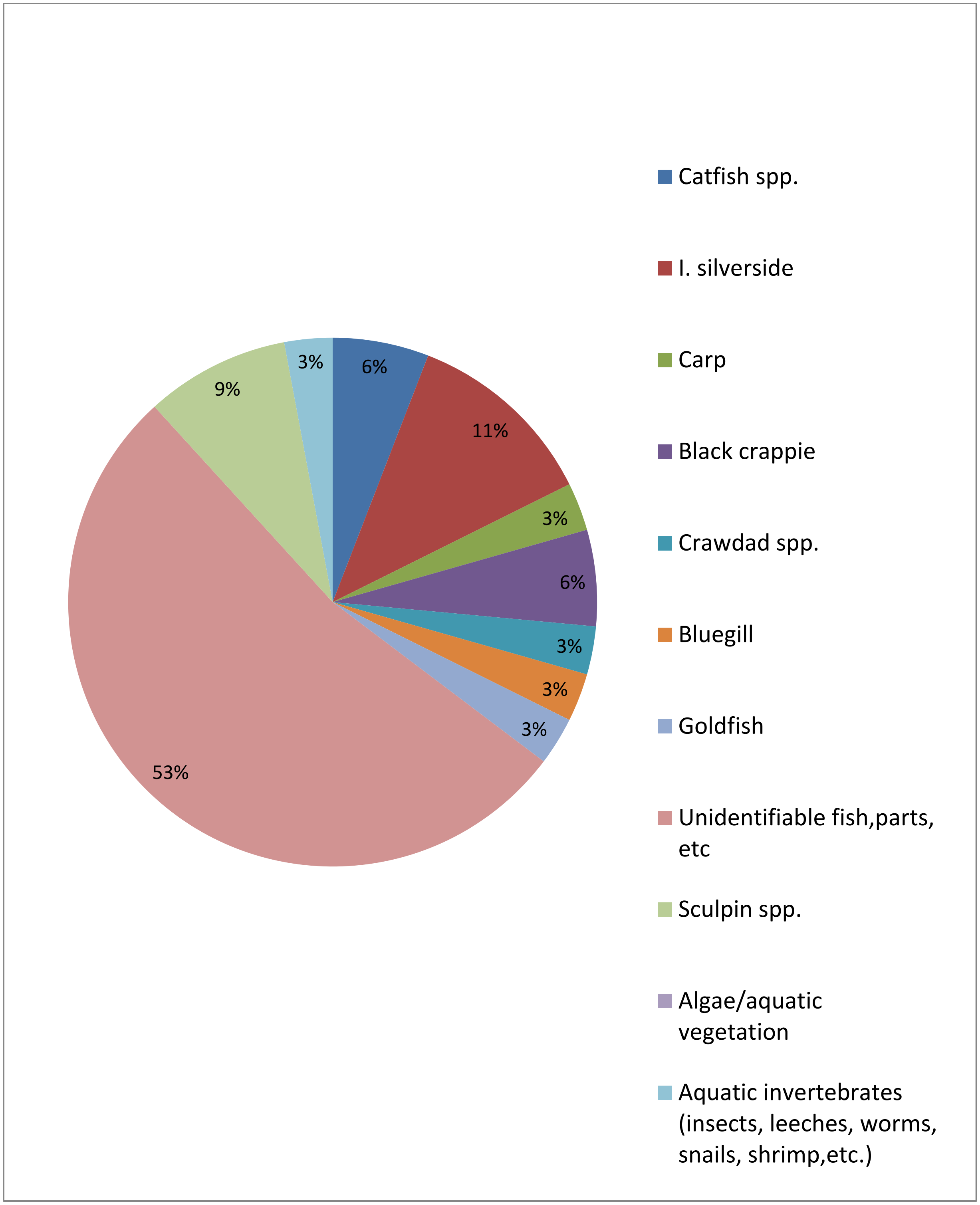

Figure 4. Percentage of organisms (n=34) found in 24 LMB collected, July, 2014 at Clear Lake.

Channel catfish

As seen in Table 1, CCF total length ranged from 58 mm to 721 mm (2.3 in. – 28.4 in.). Mean total length and weight for the seven CCF collected and measured was 419.9 mm (16.5 in.) and 1825.7 g (4.0 lbs.).

The four CCF that had gastric lavage performed on them all had stomach contents. Ten recognizable/unrecognizable organisms were documented (Figure 5). The largest percentage of organisms seen were aquatic invertebrates (40%) followed by sculpin, aquatic vegetation, and unidentifiable fish, parts, etc. with 20% each.

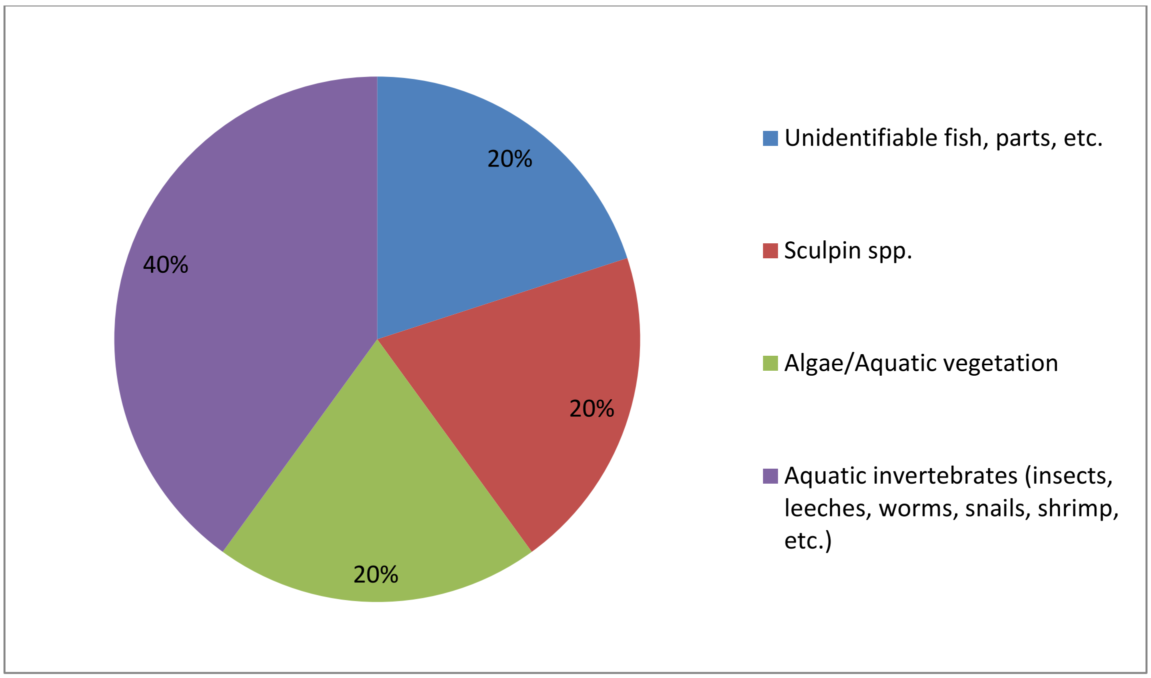

Figure 5. Percentage of organisms (n=10) found in 4 CCF collected, July, 2014 at Clear Lake.

Of the 18 transects sampled, INS were present in 12 (67%) of them, while CP and TFS were both present in 5 (28%) of the transects.

August

A total of 152.5 electrofishing minutes were used to sample the eighteen transects (Table 2). A total of 1115 fish representing thirteen species and one unidentified sculpin species were collected during the survey (Table 2). Largemouth bass comprised 78.9 percent of the total fish sampled. Black crappie followed with 8.6 percent of the total fish sampled. Sacramento blackfish and SKR-S finished with 3.8 and 3.0 percent of the total catch, respectively. Bluegill, GF, WCR, and SCP-I each made up 2.8, 1.3, 0.5, and 0.3 percent of the catch, respectively. Clear Lake hitch, CCF, RSF, unidentified sculpin (*Cottidae*), TP, and GSF concluded the species collected with 0.2 and 0.1 percent of the catch, respectively. The total CPUE for this survey effort was 7.31 fish/minute.

Table 2. Species composition from Clear Lake, August, 2014.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	880	78.9%	5.77	171.4	665.3	42 - 592	116
2	Black crappie	96	8.6%	0.63	68.5	16	30 - 100	NA
3	Sacramento blackfish	42	3.8%	0.28	104.8	15.2	85 - 136	NA
4	Sacramento sucker	34	3.0%	0.22	120.6	18.3	98 - 152	NA
5	Bluegill	31	2.8%	0.20	84.2	35.9	26 - 175	NA
6	Goldfish	14	1.3%	0.09	130.9	152.1	90 - 385	NA
7	White crappie	6	0.5%	0.04	71	NA	64 - 78	NA
8	Prickly sculpin	3	0.3%	0.02	63.0	16.0	34 - 112	NA
9	Clear Lake hitch	2	0.2%	0.01	136.0	26.0	95 - 177	NA
10	Channel catfish	2	0.2%	0.01	360.0	717.5	226 - 494	NA
11	Redear sunfish	2	0.2%	0.01	207.5	290.5	151 -264	NA
12	Unidentified sculpin	1	0.1%	0.01	70	NA	NA	NA
13	Tule perch	1	0.1%	0.01	95	13	NA	NA
14	Green sunfish	1	0.1%	0.01	108	26	NA	NA
	Total	1115						
	Generator minutes:	152.5						
	CPUE (Fish/ gen. min)	7.31						
	Water Temperature	82º F						

Largemouth bass

As presented in Table 2, LMB total length ranged from 42 mm to 592 mm (1.7 in. – 23.3 in.). The length class with the highest frequency was the 125 mm (4.9 in.) class (Figure 6). This indicates there were numerous bass in the one to two year age class (Moyle 2002).

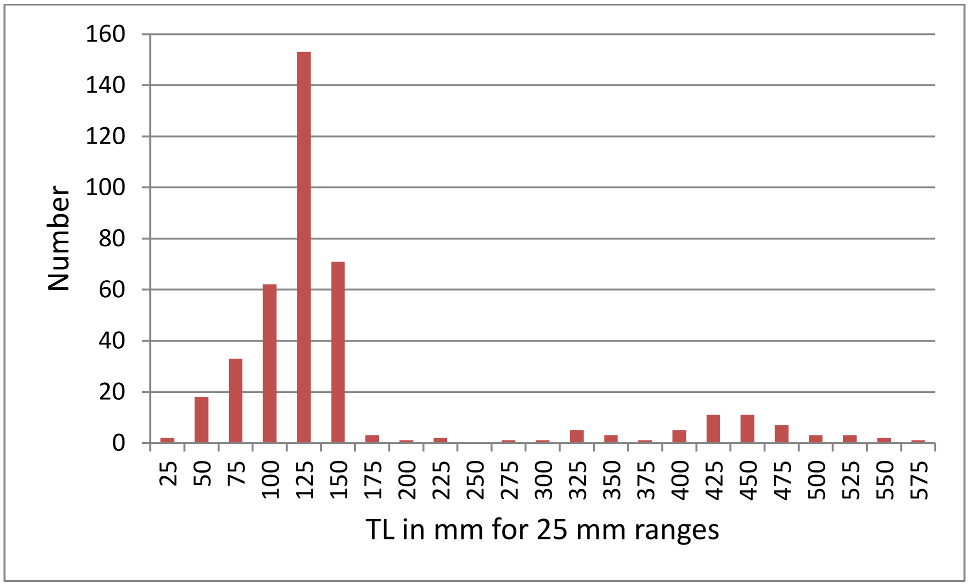

Figure 6. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, August, 2014.

The PSD for LMB was 93, indicating a population that is unbalanced with larger-sized LMB. RSD-P was 77 while RSD-M was 12. These stock density indices also indicate an unbalance in the system with larger than stock-size LMB.

LMB had a mean relative weight of 116 which indicates the LMB collected were in excellent condition. Figure 7 presents a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected. Using the linear regression equation present in Figure 7, a reliable estimated weight can be determined from the length of a LMB.

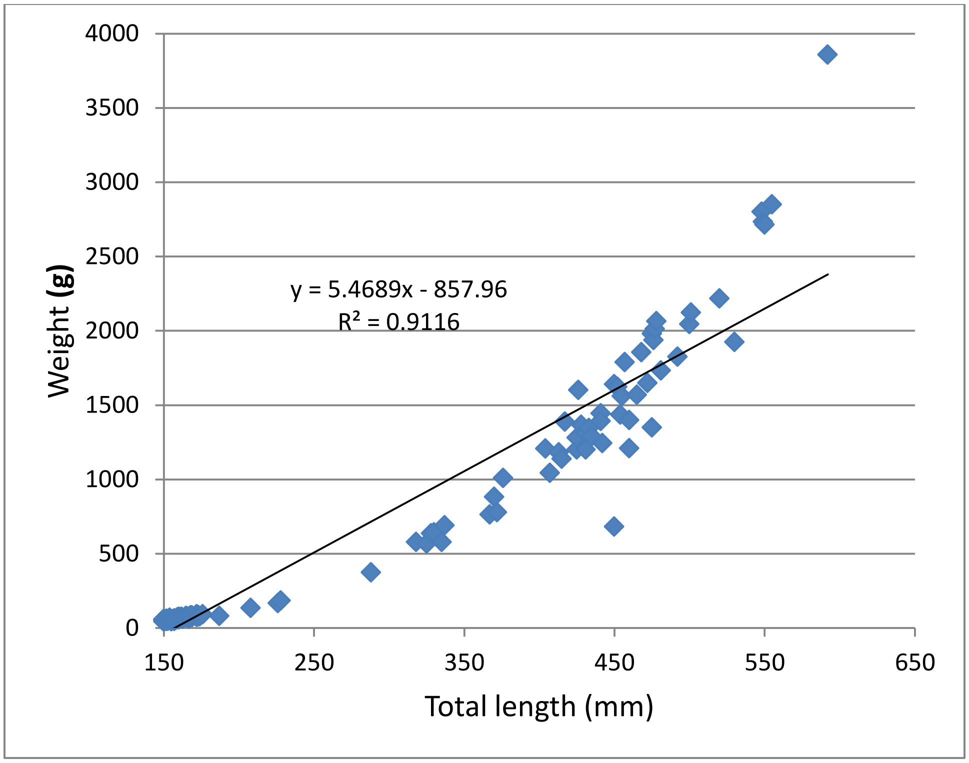

Figure 7. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, August, 2014.

Of the 23 LMB that had gastric lavage performed on them and had stomach contents, 35 recognizable/unrecognizable organisms were documented. Nine LMB had no contents pumped. The largest percentage of organisms seen were unidentifiable fish, parts, etc. (54%) (Figure 8). Inland silversides made up the greatest number of fish collected (23%) for the second straight month.

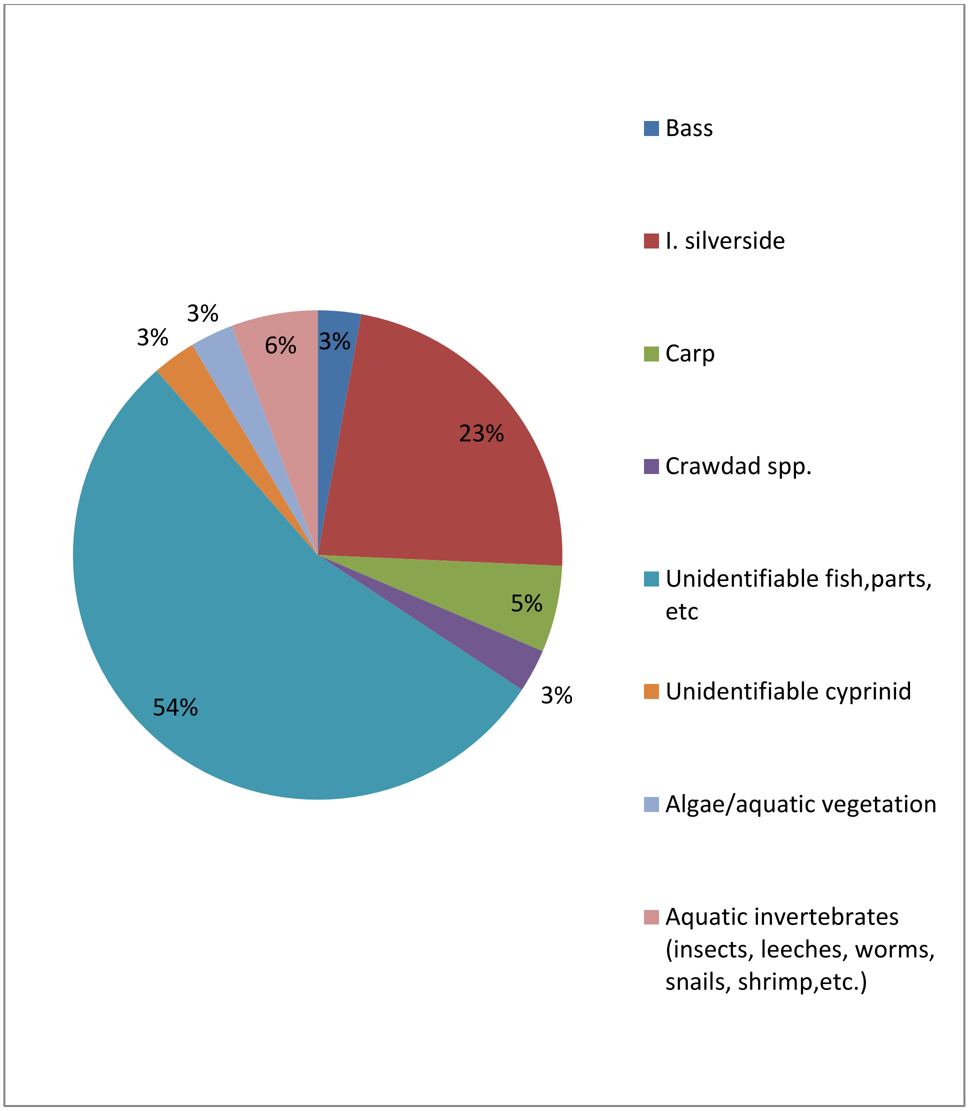

Figure 8. Percentage of organisms (n=35) found in 23 LMB collected, August, 2014 at Clear Lake.

Channel catfish

As seen in Table 2, CCF total length ranged from 226 mm to 494 mm (8.9 in. – 19.4 in.). Mean total length and weight for the two CCF collected and measured was 360.0 mm (14.2 in.) and 717.5 g (1.6 lbs.).

Both of the CCF that had gastric lavage performed on them had nothing removed from their stomachs.

Of the 18 transects sampled, INS, CP, and TFS were present in 12 (67%), 10 (56%) and 2 (11%) of the transects, respectively.

September

A total of 152.6 electrofishing minutes were used to sample the eighteen transects (Table 3). A total of 985 fish representing thirteen species were collected during the survey (Table 3). Largemouth bass comprised 83.5 percent of the total fish sampled. Black crappie followed with 4.5 percent of the total fish sampled. Bluegill and TP finished with 4.2 and 1.9 percent of the total catch, respectively. Sacramento blackfish, GF, and CCF each made up 1.5, 1.3, and 0.9 percent of the catch, respectively. Sacramento sucker, HCH-C, brown bullhead (*Ameiurus nebulosus*, BBH), GSF, RSF, and WCR concluded the species collected with 0.6, 0.5, 0.3, and 0.2 percent of the catch, respectively. The total CPUE for this survey effort was 6.45 fish/minute.

Table 3. Species composition from Clear Lake, September, 2014.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	822	83.5%	5.39	191.4	581.3	56 - 601	109
2	Black crappie	44	4.5%	0.29	92.9	28.1	66 - 165	NA
3	Bluegill	41	4.2%	0.27	107.1	64.7	22 - 185	110
4	Tule perch	19	1.9%	0.12	106	21.3	36 - 122	NA
5	Sacramento blackfish	15	1.5%	0.10	141.5	32.2	105 - 166	NA
6	Goldfish	13	1.3%	0.09	152.1	172.2	88 - 412	NA
7	Channel catfish	9	0.9%	0.06	581.7.	4566.7	105 - 840	NA
8	Sacramento sucker	6	0.6%	0.04	158.8	43.5	140 - 192	NA
9	Clear Lake hitch	5	0.5%	0.03	133.2	24.0	107 - 142	NA
10	Brown bullhead	3	0.3%	0.02	120.3	27.3	103 - 135	NA
11	Green sunfish	3	0.3%	0.02	74	26	49 - 112	NA
12	Redear sunfish	3	0.3%	0.02	158.7	421	77 - 312	NA
13	White crappie	2	0.2%	0.01	119.5	28	113 -126	NA
	Total	985						

Generator minutes:	152.6
CPUE (Fish/ gen. min)	6.45
Water Temperature	81º F

Largemouth bass

LMB total length ranged from 56 mm to 601 mm (2.2 in. – 23.7 in.) (Table 3). The length class with the highest frequency was the 150 mm (5.9 in.) class (Figure 9). This indicates there are numerous bass in the one year to two year age class (Moyle 2002).

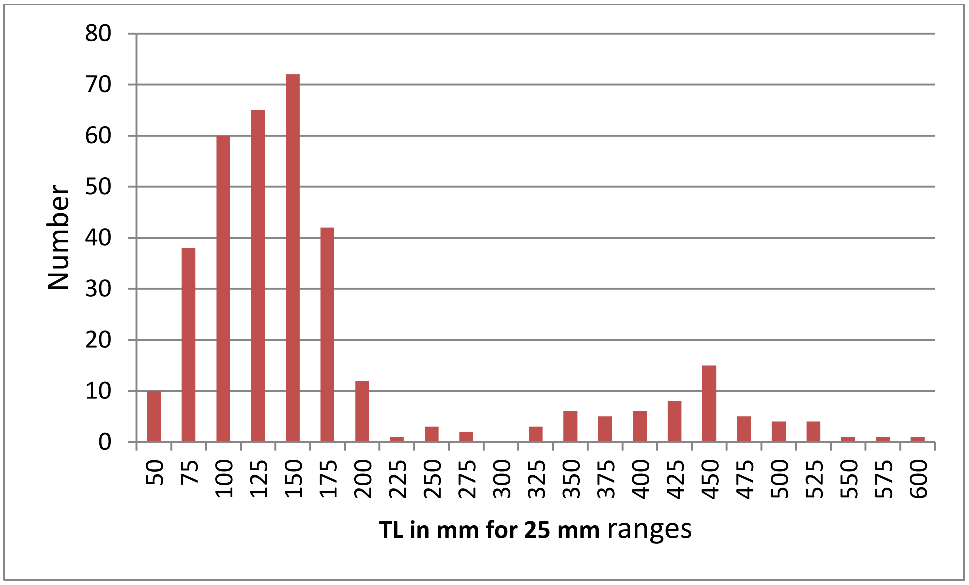

Figure 9. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, September, 2014.

The PSD for LMB was 77, which indicates a population that is unbalanced with larger-sized LMB. RSD-P was 62 while RSD-M was 12. These stock density indices also indicate an unbalance in the system with larger than stock-size LMB. This is consistent with what has been seen the previous two months.

LMB had a mean relative weight of 109 which indicates the LMB collected were in good condition. This is fairly consistent with the previous two months relative weights. Figure 10 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected. Using the linear regression equation present in Figure 10, a reliable estimated weight can be determined from the length of a LMB.

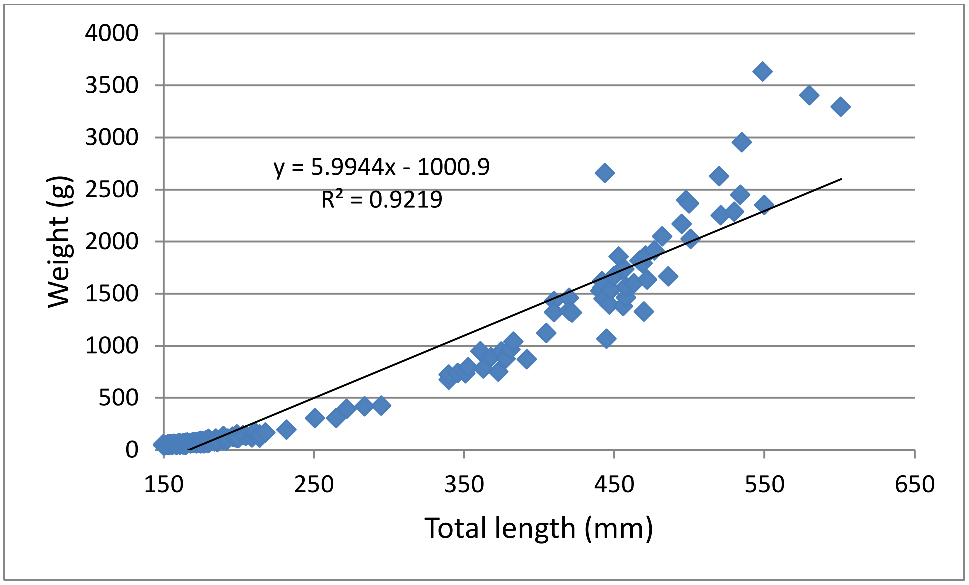

Figure 10. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, September, 2014.

Of the 11 LMB that had gastric lavage performed on them and had stomach contents, 11 recognizable/unrecognizable organisms were documented. Twenty-four LMB had no contents pumped. The largest percentage of organisms seen were unidentifiable fish, parts, etc. (91%) while one unidentifiable crappie was the only other organism collected.

Channel catfish

As seen in Table 3, CCF total length ranged from 105 mm to 840 mm (0.6 in. – 33.1 in.). Mean total length and weight for the nine CCF collected and measured was 581.7 mm (22.9 in.) and 4566.7 g (10.1 lbs.).

Of the three CCF that had gastric lavage performed on them and had stomach contents, five recognizable/unrecognizable organisms were documented. Two CCF had no contents pumped. The largest percentage of organisms seen were aquatic invertebrates (40%) followed by one LMB, one BCR, and one unidentifiable organism which all made up 20% each of the stomach contents collected.

Of the 18 transects sampled, CP were present in 11 (61%) of them, while INS and TFS were present in 10 (56%) and 6 (33%) of the transects, respectively.

November

A total of 151.3 electrofishing minutes were used to sample the eighteen transects (Table 4). A total of 286 fish representing eight species were collected during the survey. Largemouth bass comprised 82.9 percent of the total fish sampled. Sacramento blackfish followed with 4.2 percent of the total fish sampled. Sacramento sucker and BCR finished with 3.8 and 3.1 percent of the total catch. Bluegill and GF each made up 1.7 percent of the catch while TP and CCF represented 1.4, and 1.0 percent of the catch. The total CPUE for this survey effort was 1.89 fish/minute, which is a significant decrease from previous surveys.

Table 4. Species composition from Clear Lake, November, 2014.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	237	82.9%	1.57	224.9	644.4	78 - 566	111
2	Sacramento blackfish	12	4.2%	0.08	152.3	35.5	129 - 187	NA
3	Sacramento sucker	11	3.8%	0.07	243.5	267.5	165 - 436	NA
4	Black crappie	9	3.1%	0.06	161.6	49.6	125 - 200	NA
5	Bluegill	5	1.7%	0.03	101.2	26.8	76 - 143	NA
6	Goldfish	5	1.7%	0.03	189.0	127.2	176 - 197	NA
7	Tule perch	4	1.4%	0.03	123.25	27.3	118 - 128	NA
8	Channel catfish	3	1.0%	0.02	737.5	4199.5	695 - 780	NA
	Total	286						

Generator minutes:	151.3
CPUE (Fish/ gen. min)	1.89
Water Temperature **	62º F

Largemouth bass

As seen in Table 4, LMB total length ranged from 78 mm to 566 mm (3.1 in. – 22.3 in.). The length class with the highest frequency was the 175 mm (6.9 in.) class (Figure 11). These fish are likely the 150 mm length class seen in the September survey.

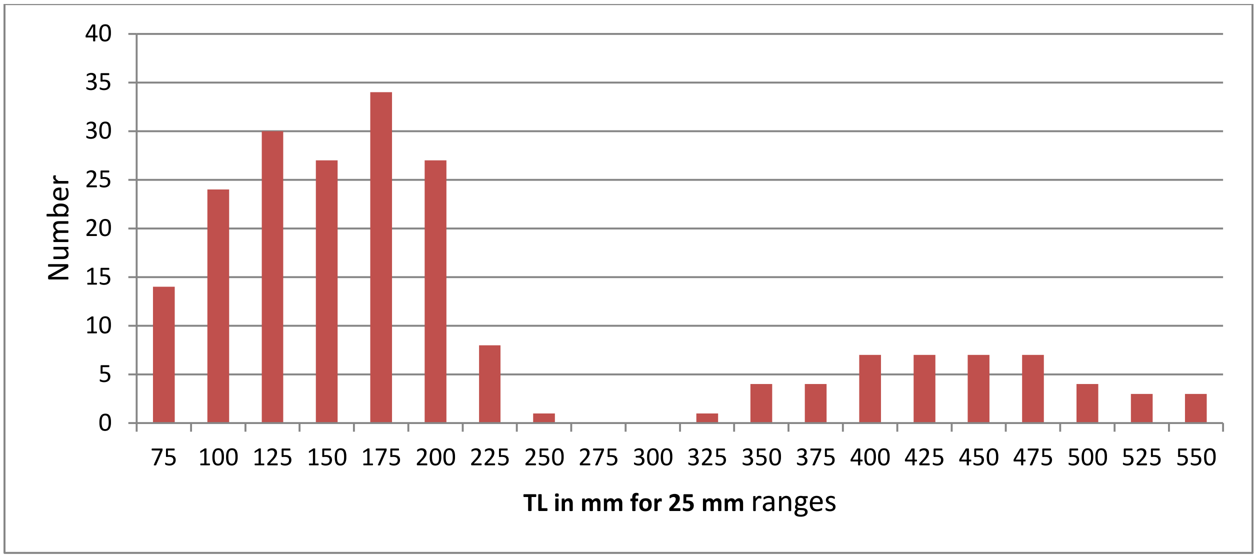

Figure 11. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, November, 2014.

The PSD for LMB was 57, indicating a population that is balanced with larger-sized LMB. RSD-P was 51 while RSD-M was 10. The RSD-P stock density indices indicate an unbalance in the system with preferred-size LMB. The RSD-M stock density indices indicate a balance of memorable-size LMB. With more of the young-of-the-year fish growing into the stock-size length class, a more size-balanced population is resulting compared to previous months.

LMB had a mean relative weight of 111 which indicates the LMB collected were in excellent condition. Figure 12 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected. Using the linear regression equation present in Figure 12, a reliable estimated weight can be determined from the length of a LMB.

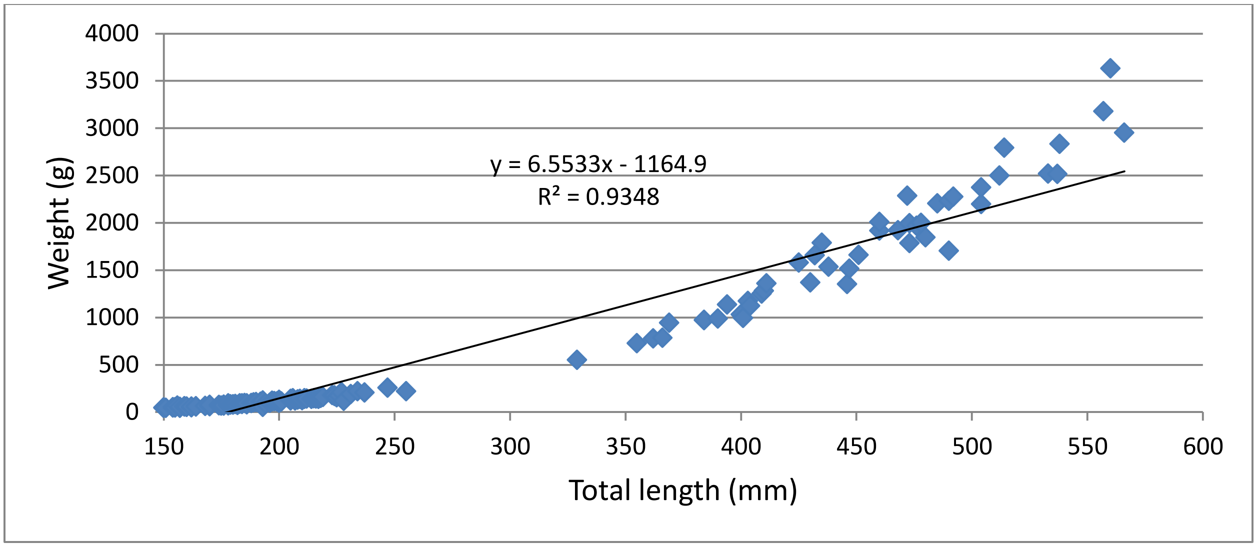

Figure 12. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, November, 2014.

Of the 23 LMB that had gastric lavage performed on them and had stomach contents, 29 recognizable/unrecognizable organisms were documented. Fifteen LMB had no contents pumped. The largest percentage of organisms seen were inland silversides (45%) (Figure 13). Inland silversides also made up the greatest number of fish collected in LMB for the third time out of the first four months sampled.

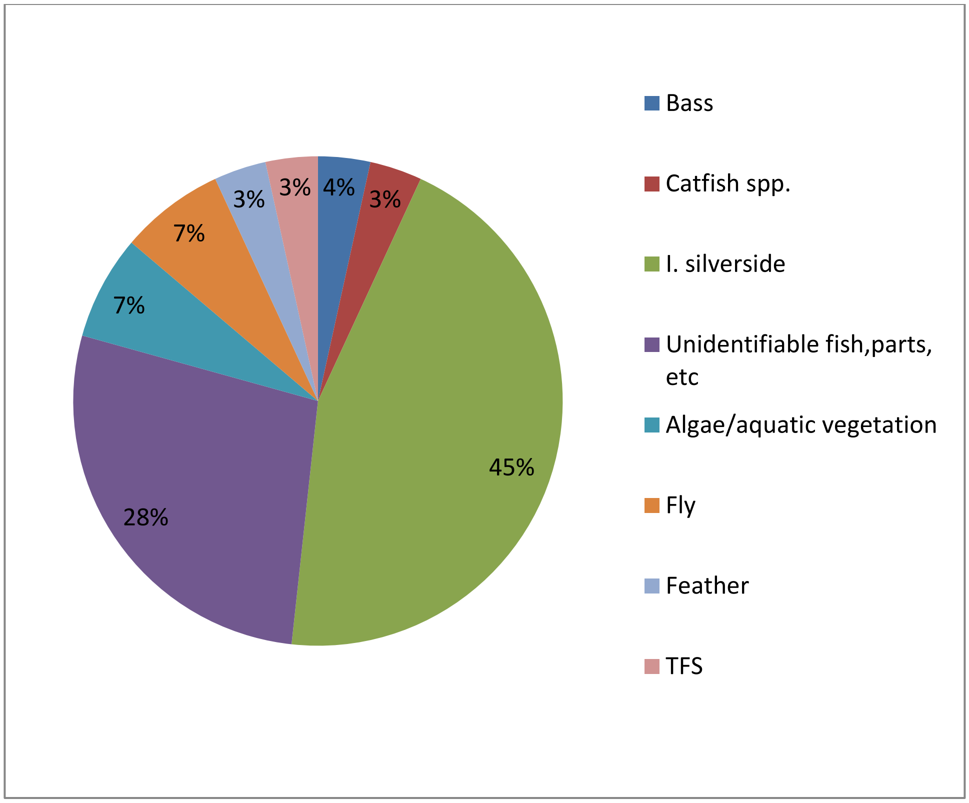

Figure 13. Percentage of organisms (n=29) found in 23 LMB collected, November, 2014 at Clear Lake.

Channel catfish

As seen in Table 4, CCF total length ranged from 695 mm to 780 mm (27.4 in. – 30.7 in.). Mean total length and weight for the two CCF collected and measured was 737.5 mm (29.0 in.) and 4199.5 g (9.3 lbs.). One of the CCF collected was just tallied.

Of the two CCF that had gastric lavage performed on them, only one coughed up any contents, which was considered an unidentifiable fish, parts, etc.

Of the 18 transects sampled, INS, TFS, and CP were present in 17 (94%), 13 (72%) and 5 (28%) of the transects, respectively.

December

A total of 160.3 electrofishing minutes were used to sample the nineteen transects (Table 5). A miscalculation made so an additional transect was sampled for this month. A total of 118 fish representing ten species were collected during the survey. Largemouth bass comprised 64.4 percent of the total fish sampled. Sacramento sucker and SBF followed with 13.6 and 11.0 percent of the total fish sampled. Black crappie, BG, and GF all finished with 2.5 percent of the total catch. Tule perch, HCH-C, RSF, and SMB each comprised 0.8 percent of the catch. The total CPUE for this survey effort was 0.74 fish/minute, which is a significant decrease from previous surveys.

Table 5. Species composition from Clear Lake, December, 2014.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	76	64.4%	0.47	249.0	681.9	80 - 565	110
2	Sacramento sucker	16	13.6%	0.10	216.3	113.6	193 - 265	NA
3	Sacramento blackfish	13	11.0%	0.08	175.8	69.4	135 - 230	NA
4	Black crappie	3	2.5%	0.02	175.7	126.0	145 - 192	NA
5	Bluegill	3	2.5%	0.02	121.3	18.0	82 - 175	NA
6	Goldfish	3	2.5%	0.02	188.3	138.3	165 - 225	NA
7	Tule perch	1	0.8%	0.01	111	23	NA	NA
8	Clear Lake hitch	1	0.8%	0.01	171	45	NA	NA
9	Redear sunfish	1	0.8%	0.01	95	21	NA	NA
10	Smallmouth bass	1	0.8%	0.01	330	490	NA	NA
	Total	118						

Generator minutes:	160.3
CPUE (Fish/ gen. min)	0.74
Water Temperature **	50º F

Largemouth bass

As seen in Table 5, LMB total length ranged from 80 mm to 565 mm (3.1 in. – 22.2 in.). The length class with the highest frequency was the 175 mm (6.9 in.) class (Figure 14).

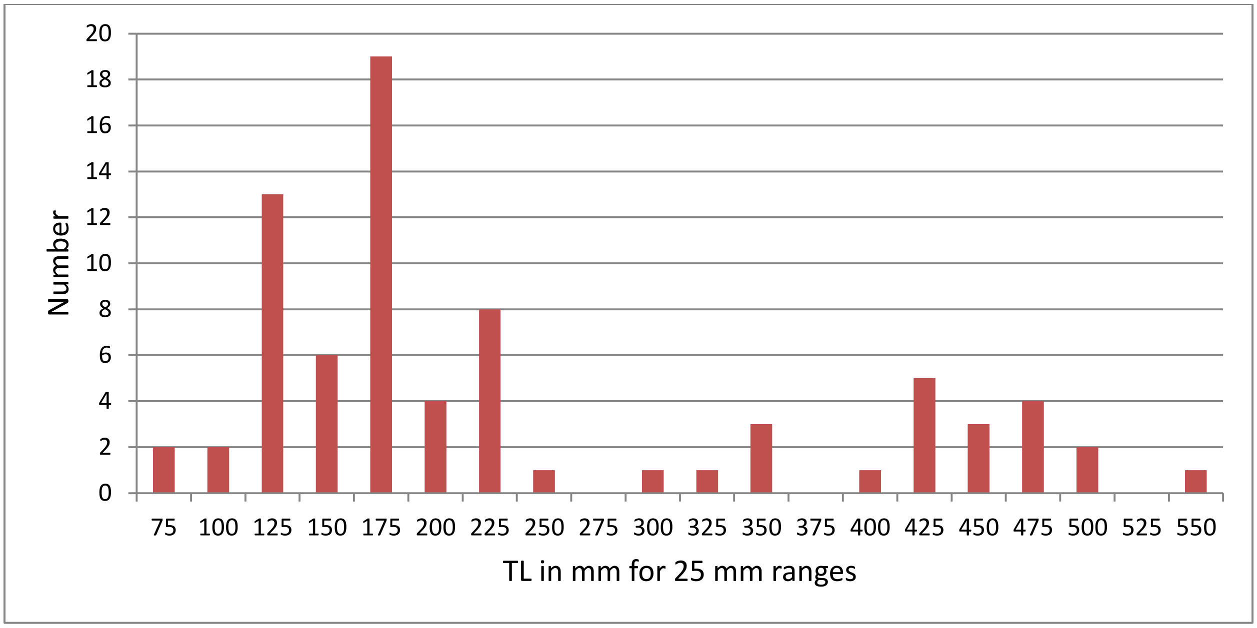

Figure 14. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, December, 2014.

The PSD for LMB was 62, indicating a population that is balanced with larger-sized LMB. RSD-P was 47 while RSD-M was 6. The RSD-P stock density indices indicate an unbalance in the system with preferred-size LMB. The RSD-M stock density indices indicate a balance of memorable-size LMB. Like November, with more of the young-of-the-year fish growing into the stock-size length class, a more size-balanced population is resulting compared to previous months.

LMB had a mean relative weight of 110 which indicates the LMB collected were in excellent condition. Figure 15 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected.

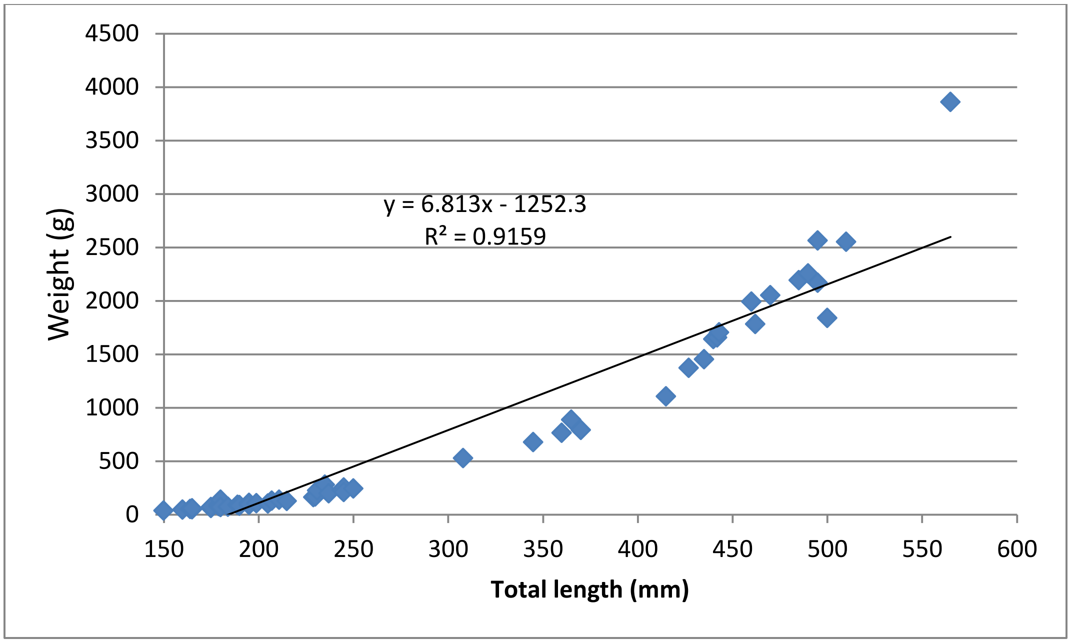

Figure 15. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, December, 2014.

Of the nine LMB that had gastric lavage performed on them and had stomach contents, 11 recognizable/unrecognizable organisms were documented. Fourteen LMB had no contents pumped. The largest percentage of organisms seen were aquatic invertebrates (45%) (Figure 16). Inland silversides made up the greatest number of fish collected for the fourth time out of the first five months sampled.

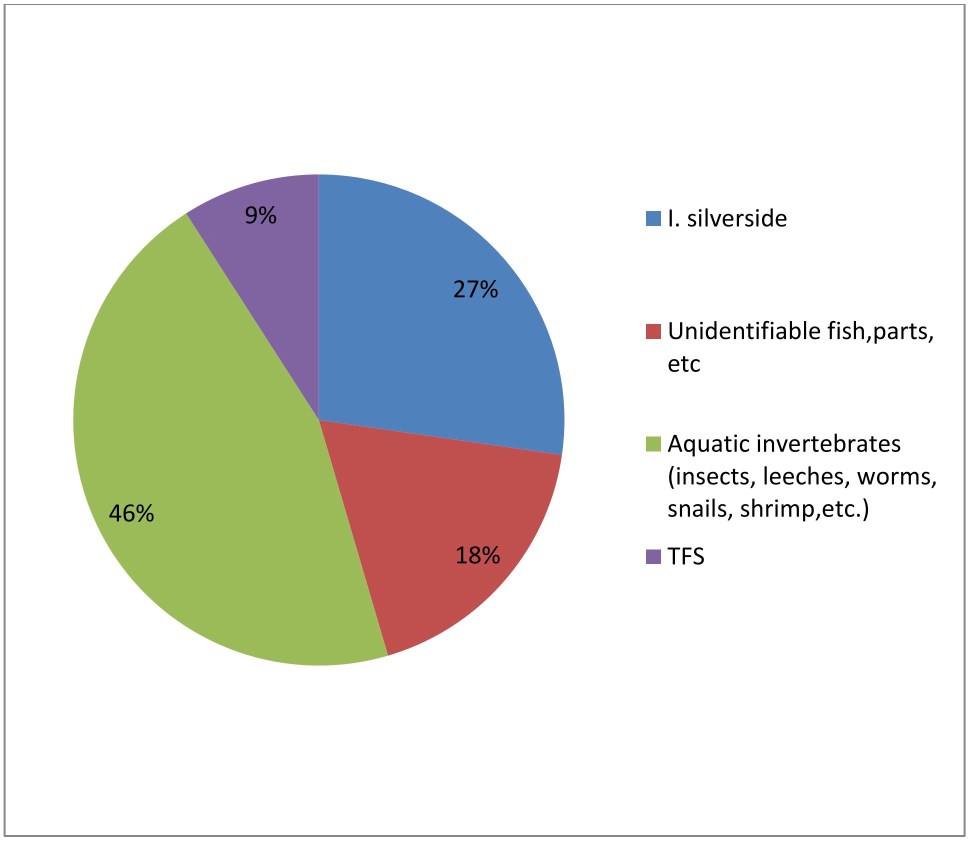

Figure 16. Percentage of organisms (n=15) found in 9 LMB collected, December, 2014 at Clear Lake.

Smallmouth bass

One SMB had gastric lavage performed on it and also had stomach contents removed. One LMB and one rock were found inside the stomach. This is the first documented SMB collected during this year-long survey.

Of the 19 transects sampled, INS, TFS, and CP were present in 14 (74%), 6 (32%) and 2 (11%) of the transects, respectively.

January

A total of 152.5 electrofishing minutes were used to sample the eighteen transects (Table 6). A total of 253 fish representing seven species were collected during the survey. Largemouth bass comprised 77.9 percent of the total fish sampled. Bluegill and BCR followed with 13.0 and 3.6 percent of the total fish sampled. Sacramento sucker and WCR finished with 2.8 and 2.0 percent of the total catch. Sacramento blackfish and RSF each comprised 0.4

percent of the catch.   The total CPUE for this survey effort was 1.66 fish/minute, which is an increase from last month but still down overall from prior surveys.

Table 6. Species composition from Clear Lake, January, 2015.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	197	77.9%	1.29	215.1	435.3	86 - 576	102
2	Bluegill	33	13.0%	0.22	96.9	42.5	44 - 186	NA
3	Black crappie	9	3.6%	0.06	130.1	32.2	107 - 165	NA
4	Sacramento sucker	7	2.8%	0.05	230.3	133.4	191 - 270	NA
5	White crappie	5	2.0%	0.03	112.2	17.5	99 - 128	NA
6	Sacramento blackfish	1	0.4%	0.01	170.0	38	NA	NA
7	Redear sunfish	1	0.4%	0.01	229	268.0	NA	NA
	Total	253						

Generator minutes:	152.5
CPUE (Fish/ gen. min)	1.66
Water Temperature **	52º F

Largemouth bass

As seen in Table 6, LMB total length ranged from 86 mm to 576 mm (3.4 in. – 22.7 in.). The length class with the highest frequency for the third straight month was the 175 mm (6.9 in.) class (Figure 17).

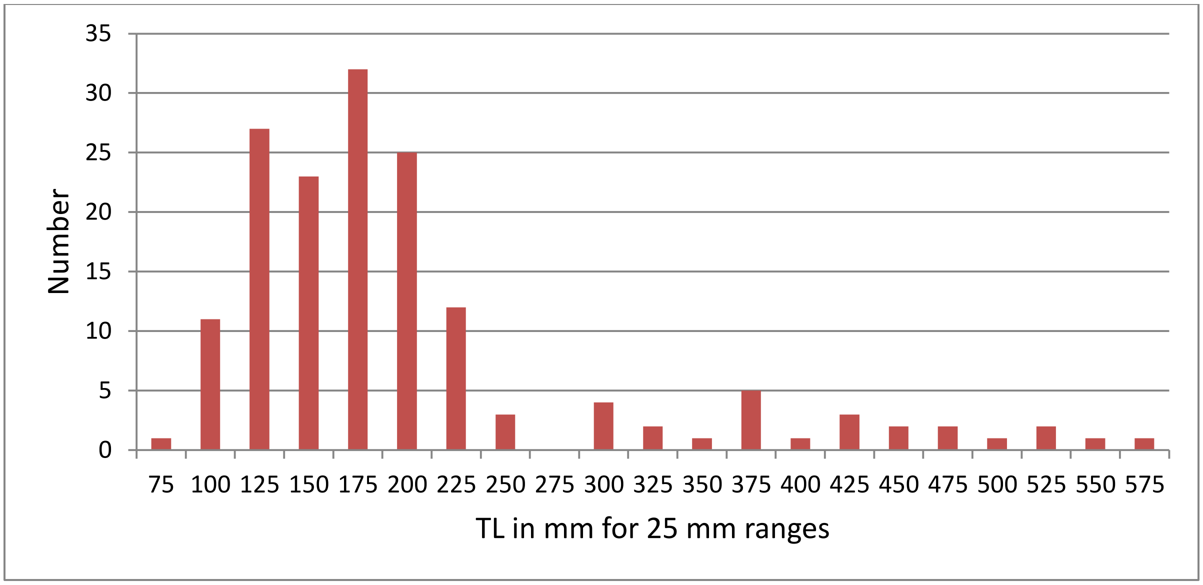

Figure 17. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, January, 2015.

The PSD for LMB was 38, indicating a population that is unbalanced with smaller, stock-sized LMB. This is the first time this season that the PSD was unbalanced with stock-size LMB. The clear sunny sky, combined with the cold surface water temperatures of the lake could have persuaded the larger-sized LMB to occupy greater depths at the time of the sampling. RSD-P was 25 while RSD-M was 8. The RSD-P stock density and RSD-M stock density indices indicate a balance of preferred and memorable-size LMB. Like November and December, with more of the young-of-the-year fish growing into the stock-size length class, the PSD had dropped, but there were still a large number of greater than quality-size LMB to stay in the balanced indexes.

LMB had a mean relative weight of 102 which indicates the LMB collected were in good condition. Figure 18 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected.

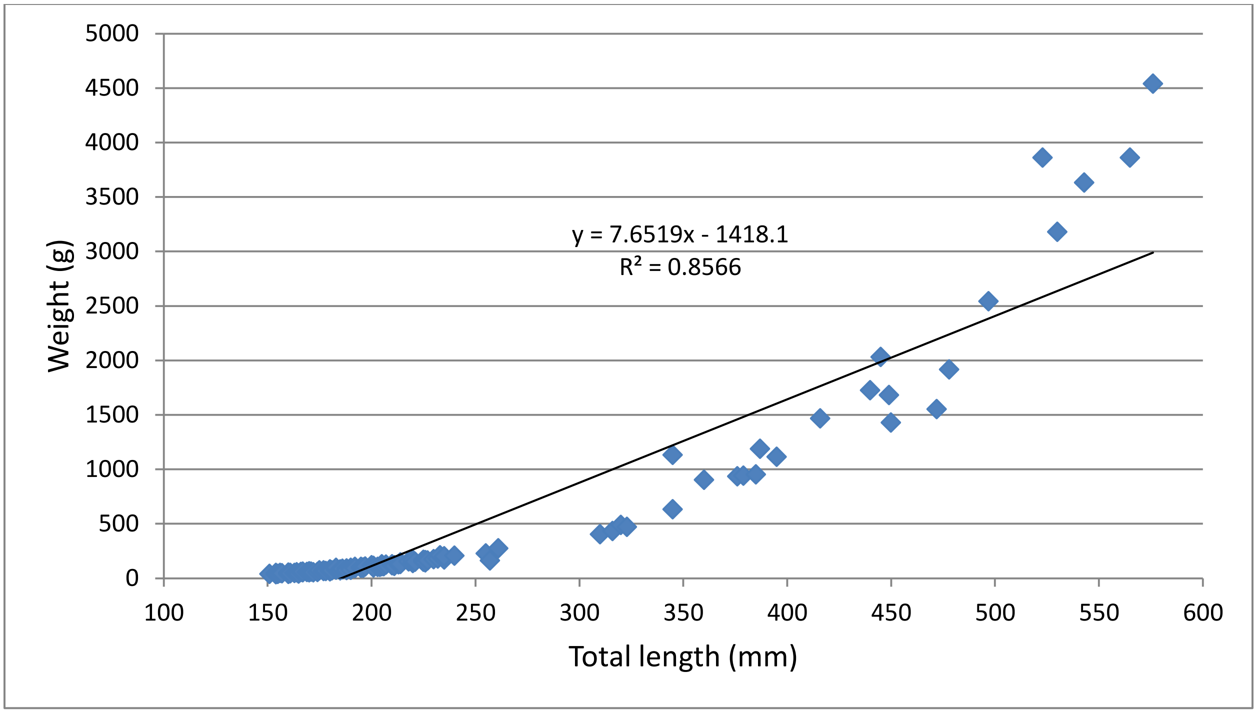

Figure 18. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, January, 2015.

Of the 12 LMB that had gastric lavage performed on them and had stomach contents, 15 recognizable/unrecognizable organisms were documented. Sixteen LMB had no contents pumped. The largest percentage of organisms seen were unidentifiable fish, parts, etc. (53%) (Figure 19). Inland silversides made up the greatest number of fish collected for the fifth time out of the first six months sampled.

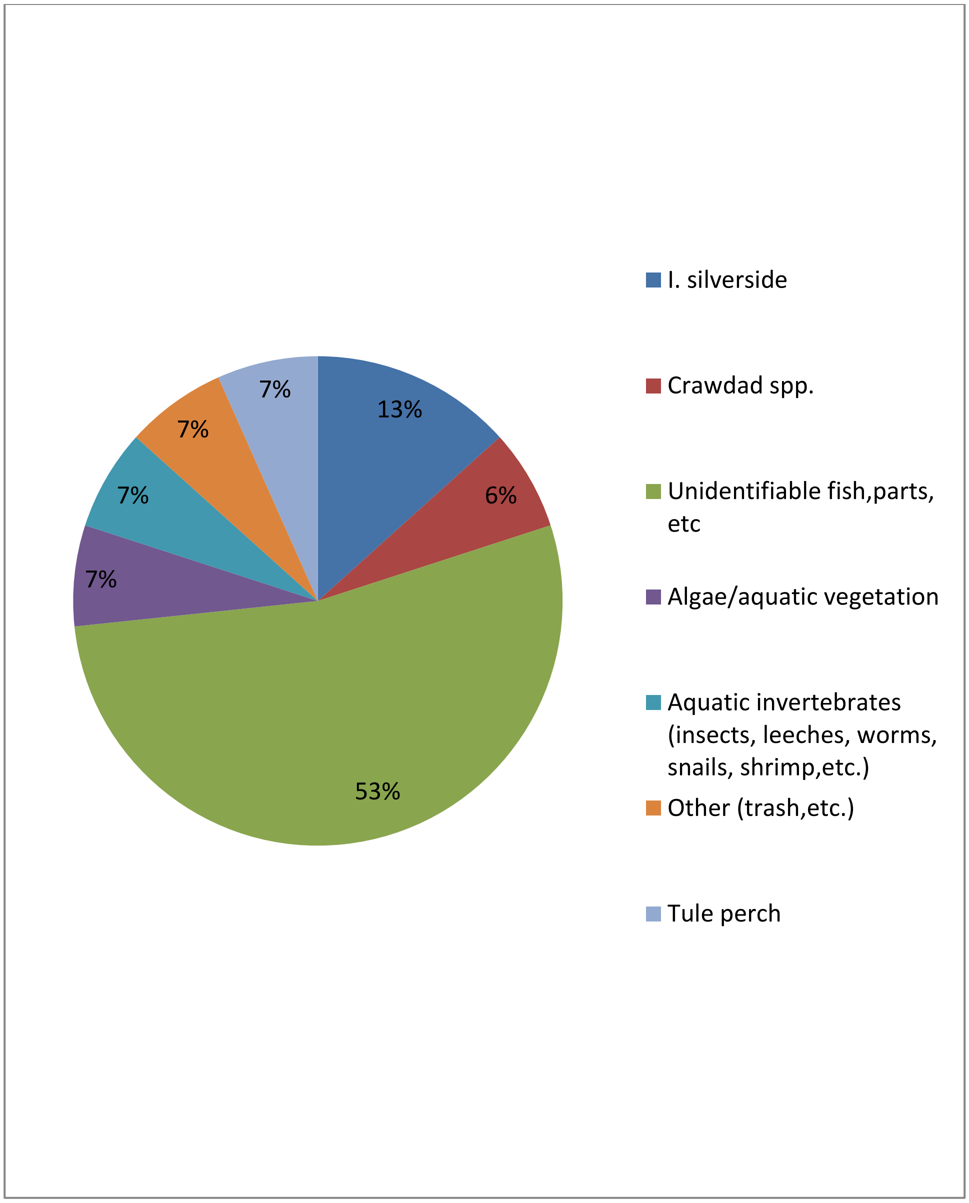

Figure 19. Percentage of organisms (n=15) found in 12 LMB collected, January, 2015 at Clear Lake.

Of the 18 transects sampled, INS, TFS, and CP were present in 5 (28%), 2 (11%) and 1 (6%) of the transects, respectively.

February

A total of 154.4 electrofishing minutes were used to sample the eighteen transects (Table 7). A total of 445 fish representing 10 species were collected during the survey. Largemouth bass comprised 51.7 percent of the total fish sampled. Black crappie and TP followed with 16.0 and 10.8 percent of the total fish sampled, respectively. Bluegill, SKR-S, and SBF finished with 9.4, 6.7, and 3.1 percent of the total catch, respectively. Goldfish, RSF, HCH-C, and GSF all finished with less than one percent of the total catch, respectively. The total CPUE for this survey effort was 2.88 fish/minute, which is the largest CPUE since September.

Table 7. Species composition from Clear Lake, February, 2015.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	230	51.7%	1.49	282.0	856.7	82 - 585	110
2	Black crappie	71	16.0%	0.46	154.1	80.2	105 - 323	108
3	Tule perch	48	10.8%	0.31	136.6	39.2	123 - 154	NA
4	Bluegill	42	9.4%	0.27	123.0	53.0	46 - 193	95
5	Sacramento sucker	30	6.7%	0.19	245.4	206.7	116 - 499	NA
6	Sacramento blackfish	14	3.1%	0.09	209.2	101.5	108 - 244	NA
7	Goldfish	4	0.9%	0.03	453.3	2049.3	440 - 467	NA
8	Redear sunfish	3	0.7%	0.02	159	167.3	94 - 278	NA
9	Clear Lake hitch	2	0.4%	0.01	225.5	130.0	180 - 271	NA
10	Green sunfish	1	0.2%	0.01	83	13	NA	NA
	Total	445						

Generator minutes:	154.4
CPUE (Fish/ gen. min)	2.88
Water Temperature **	53º F

Largemouth bass

As seen in Table 7, LMB total length ranged from 82 mm to 585 mm (3.2 in. – 23.0 in.). The length class with the highest frequency was the 150 mm (5.9 in.) class (Figure 20).

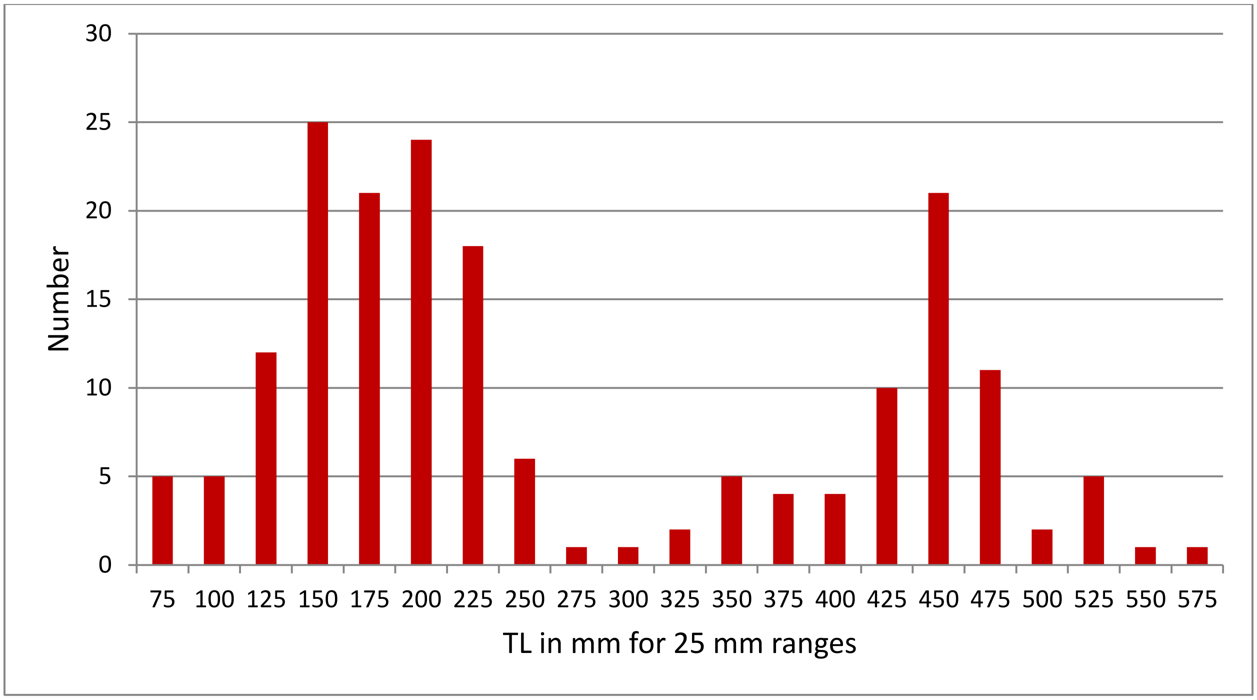

Figure 20. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, February, 2015.

The PSD for LMB was 58, indicating a population that is balanced with quality-sized LMB. It is possible with the warming waters that larger-sized LMB are moving into shallower water preparing to spawn. RSD-P was 49 while RSD-M was 6. The RSD-P stock density and RSD-M stock density indices indicate an unbalance of preferred-size LMB and a balance of memorable-size LMB. Like the PSD values, it is likely that a large amount of preferred-size LMB are moving up into the shallows for the pre-spawn and displacing smaller-sized LMB.

LMB had a mean relative weight of 110 which indicates the LMB collected were in excellent condition. Figure 21 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected.

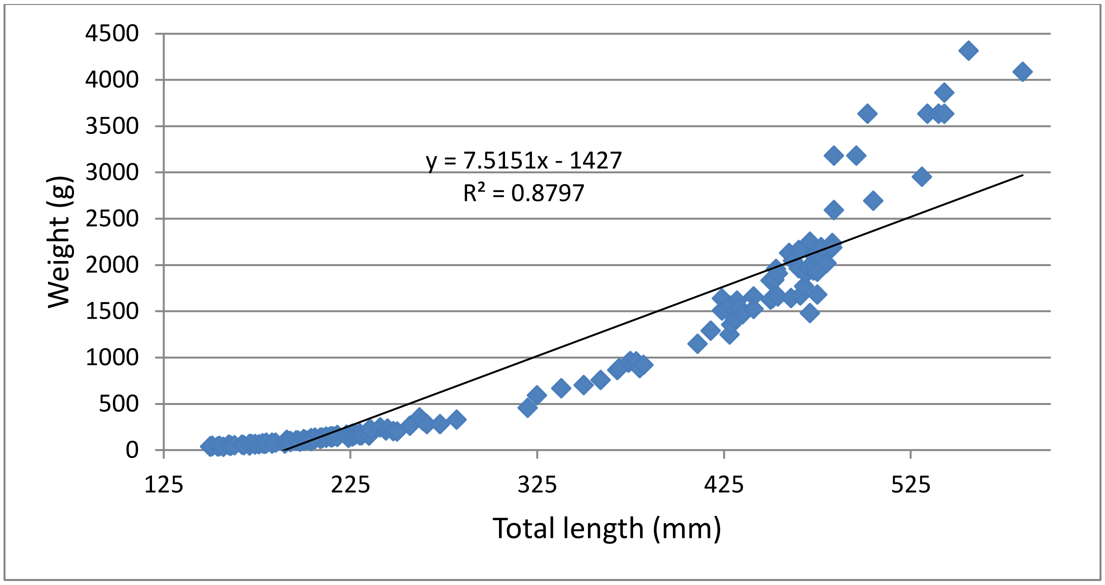

Figure 21. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, February, 2015.

Of the 19 LMB that had gastric lavage performed on them and had stomach contents, 26 recognizable/unrecognizable organisms were documented. Twenty four LMB had no contents pumped. The largest percentage of organisms seen were unidentifiable fish, parts, etc. (58%) (Figure 22). Inland silversides made up the greatest number of fish collected for the sixth time out of the first seven months sampled.

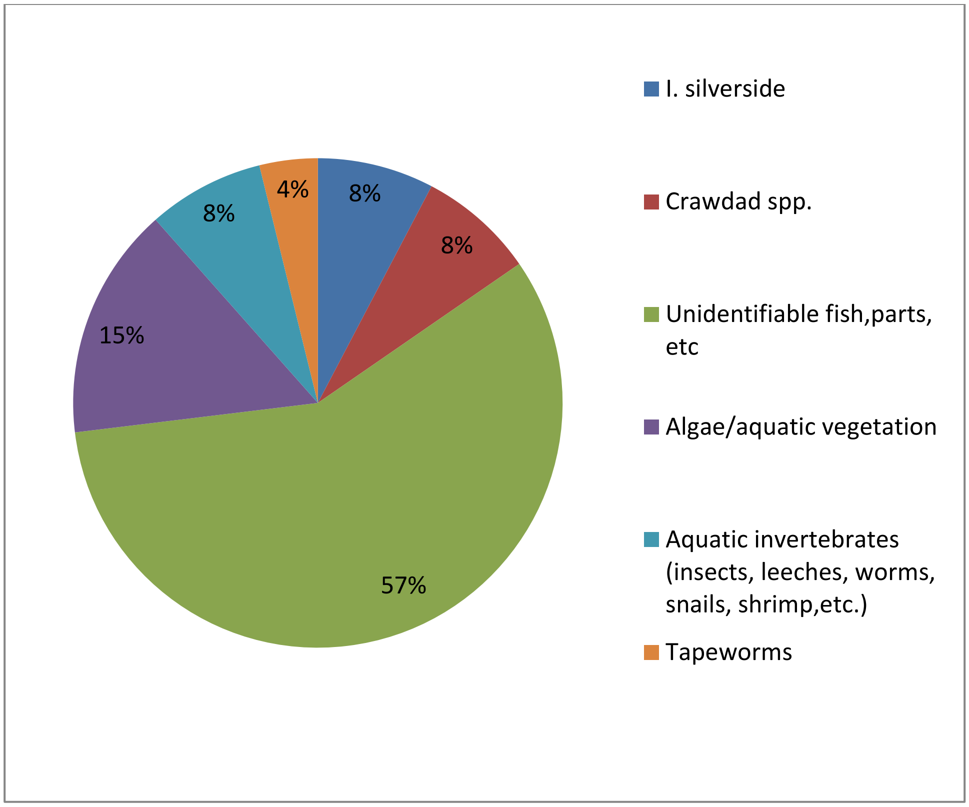

Figure 22. Percentage of organisms (n=26) found in 19 LMB collected, February, 2015 at Clear Lake.

Of the 18 transects sampled, INS, TFS, and CP were all present in 2 (11%) of the transects.

March

A total of 152.8 electrofishing minutes were used to sample the eighteen transects (Table 8). A total of 805 fish representing nine species were collected during the survey. Largemouth bass comprised 49.6 percent of the total fish sampled. Tule perch and BCR followed with 31.3 and 10.1 percent of the total fish sampled, respectively. Bluegill and Sacramento sucker finished with 3.7 and 3.2 percent of the total catch, respectively. Clear Lake hitch, SBF, SMB, and RSF each comprised one or less percent of the catch, respectively. The total CPUE for this survey effort was 5.27 fish/minute, which is a significant increase from previous months but down from summer surveys.

Table 8. Species composition from Clear Lake, March, 2015.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	399	49.6%	2.61	272.0	642.2	63 - 572	105
2	Tule perch	252	31.3%	1.65	138.0	41.8	111 - 184	NA
3	Black crappie	81	10.1%	0.53	189.6	215.3	101 - 399	101
4	Bluegill	30	3.7%	0.20	117.4	39.9	65 - 186	90
5	Sacramento sucker	26	3.2%	0.17	248.4	163.5	207 - 280	NA
6	Clear Lake hitch	8	1.0%	0.05	185.4	61	161 - 232	NA
7	Sacramento blackfish	7	0.9%	0.05	207.6	91	170 - 257	NA
8	Smallmouth bass	1	0.1%	0.01	459	1440	NA	NA
9	Redear sunfish	1	0.1%	0.01	111	24	NA	NA
	Total	805						

Generator minutes:	152.8
CPUE (Fish/ gen. min)	5.27
Water Temperature **	58º F

Largemouth bass

As seen in Table 8, LMB total length ranged from 63 mm to 572 mm (2.5 in. – 22.5 in.). The length class with the highest frequency was the 200 mm (7.9 in.) class (Figure 23).

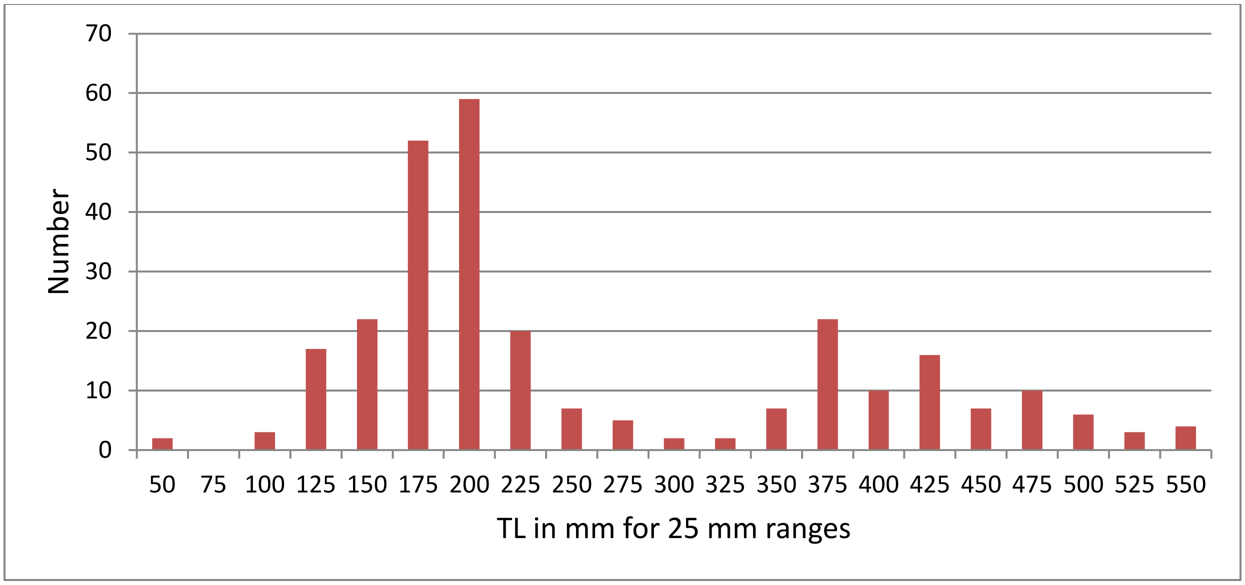

Figure 23. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, March, 2015.

The PSD for LMB was 49, indicating a population that is balanced with quality-sized LMB. The warming surface water temperatures of the lake could have persuaded the larger-sized LMB to occupy shallower depths at the time of the sampling in preparation of the spawn. RSD-P was 42 while RSD-M was 6. The RSD-P stock density and RSD-M stock density indices indicate an unbalance of preferred and balanced memorable-size LMB.

LMB had a mean relative weight of 105 which indicates the LMB collected were in good condition. Figure 24 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected.

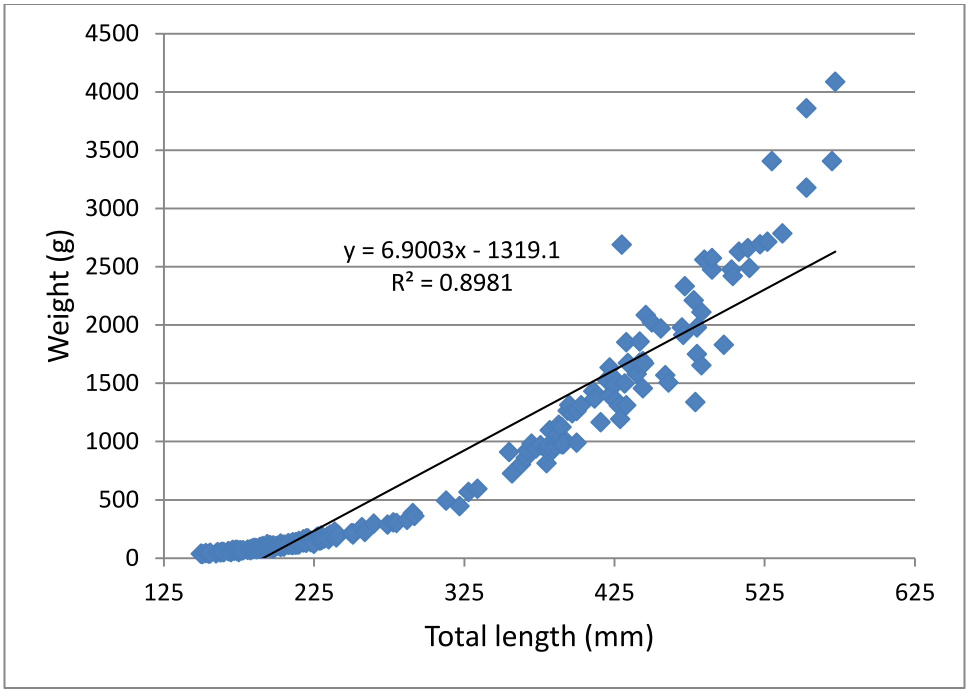

Figure 24. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, March, 2015.

Of the 13 LMB that had gastric lavage performed on them and had stomach contents, 16 recognizable/unrecognizable organisms were documented. Thirty-three LMB had no contents pumped. The largest percentage of organisms seen were unidentifiable fish, parts, etc. and aquatic invertebrates (44%) (Figure 25). Black crappie made up the greatest number of fish collected.

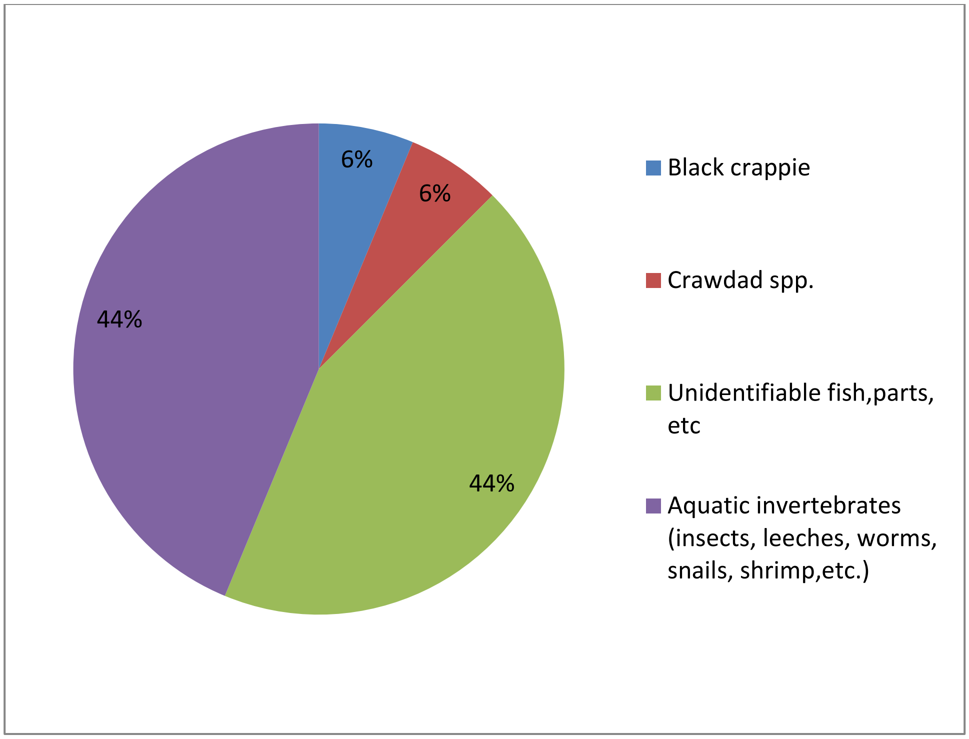

Figure 25. Percentage of organisms (n=16) found in 13 LMB collected, March, 2015 at Clear Lake.

Of the 18 transects sampled, CP, INS, and TFS were present in 1 (6%), 3 (17%) and 4 (22%) of the transects, respectively.

April

A total of 154.5 electrofishing minutes were used to sample the eighteen transects (Table 9). A total of 589 fish representing 12 species were collected during the survey. Largemouth bass comprised 69.6 percent of the total fish sampled. Sacramento sucker and BCR followed with 11.4 and 7.6 percent of the total fish sampled, respectively. Tule perch and GF finished with 3.4 and 2.0 percent of the total catch, respectively. Bluegill and SBF both finished with 1.9 percent of the total catch, respectively. Clear Lake hitch and BBH finished with 1.4 and 0.3 percent of the total catch, respectively. SMB, riffle sculpin (Cottus gulosus, SCP-R) and RSF each comprised 0.2 percent of the catch, respectively. The total CPUE for this survey effort was 3.81 fish/minute, which is a significant increase from previous months but down from the March survey.

Table 9. Species composition from Clear Lake, April, 2015.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	410	69.6%	2.65	266.9	599.8	97 - 581	106
2	Sacramento sucker	67	11.4%	0.43	217.4	115.9	109 - 285	NA
3	Black crappie	45	7.6%	0.29	160.6	75.4	99 - 315	110
4	Tule perch	20	3.4%	0.13	159.7	79.9	141 - 196	NA
5	Goldfish	12	2.0%	0.08	258	405.8	198 - 411	NA
6	Bluegill	11	1.9%	0.07	122.9	48.6	90 - 170	NA
7	Sacramento blackfish	11	1.9%	0.07	228.9	180.9	151 - 460	NA
8	Clear Lake hitch	8	1.4%	0.05	239.1	142.5	174 - 309	NA
9	Brown bullhead	2	0.3%	0.01	413.5	1123	407 - 420	NA
10	Smallmouth bass	1	0.2%	0.01	338	568	NA	NA
11	Riffle sculpin	1	0.2%	0.01	98	14	NA	NA
12	Redear sunfish	1	0.2%	0.01	92	18	NA	NA
	Total	589						

Generator minutes:	154.5
CPUE (Fish/ gen. min)	3.81
Water Temperature **	65º F

Largemouth bass

As seen in Table 9, LMB total length ranged from 97 mm to 581 mm (3.8 in. – 22.9 in.). The length class with the highest frequency for the second consecutive month was the 200 mm (7.9 in.) class (Figure 26).

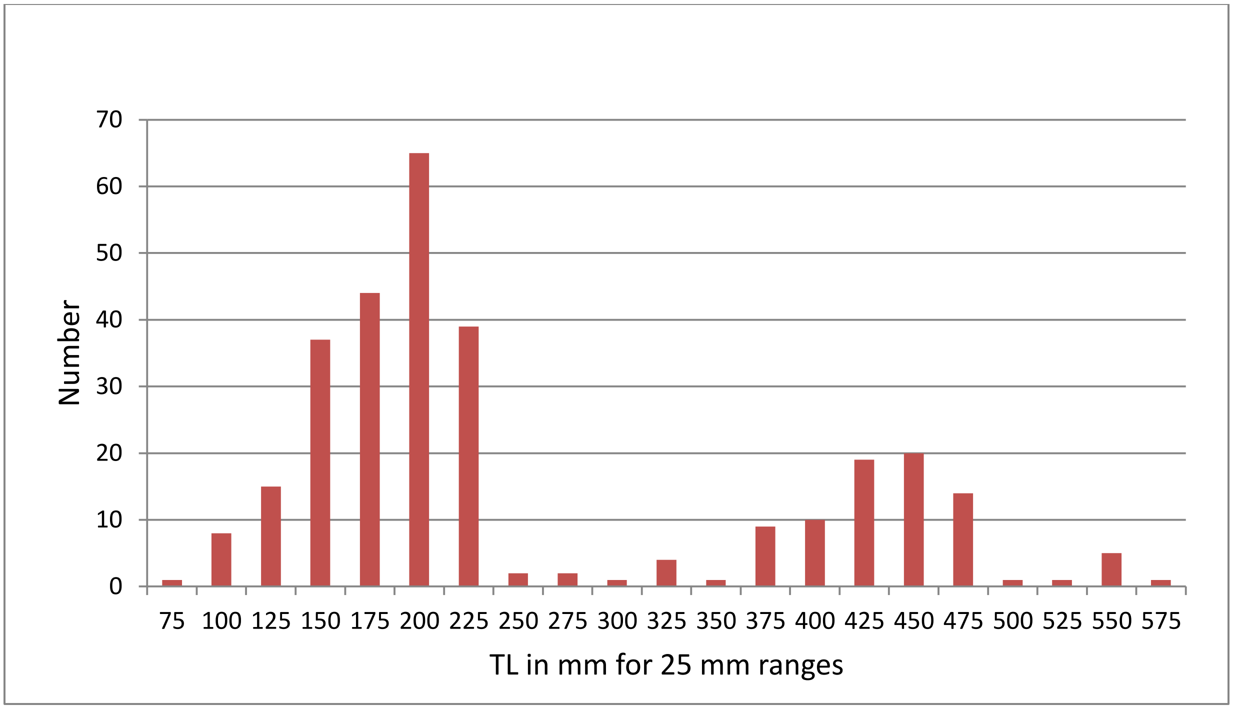

Figure 26. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, April, 2015.

The PSD for LMB was 44, indicating a population that is balanced with quality-sized LMB. As seen in March, warming surface temperatures of the lake could have persuaded the larger-sized LMB to occupy shallower depths at the time of the sampling in preparation of the spawn. RSD-P was 41 while RSD-M was 4. The RSD-P stock density and RSD-M stock density indices indicate an unbalance of preferred and balanced memorable-size LMB.

LMB had a mean relative weight of 106 which indicates the LMB collected were in good condition. Figure 27 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected.

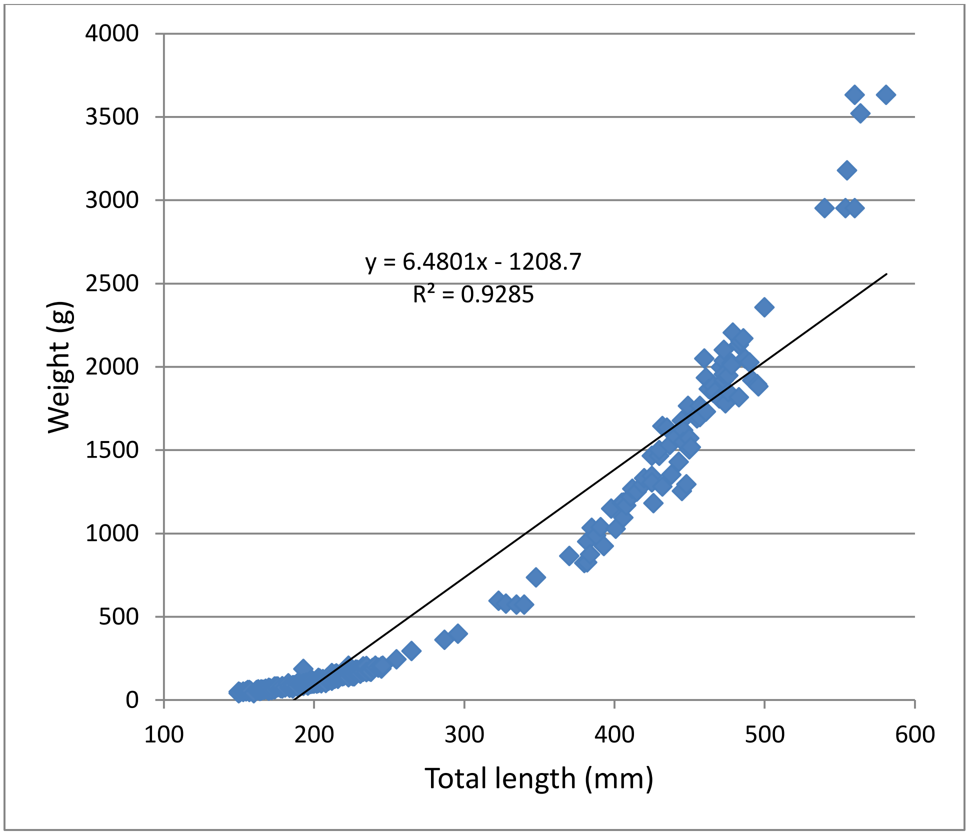

Figure 27. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, April, 2015.

Of the 28 LMB that had gastric lavage performed on them and had stomach contents, 35 recognizable/unrecognizable organisms were documented. Twenty-one LMB had no contents pumped. The largest percentage of organisms seen were unidentifiable fish, parts, etc. and aquatic invertebrates (57%) (Figure 28). Sculpin made up the greatest number of fish collected.

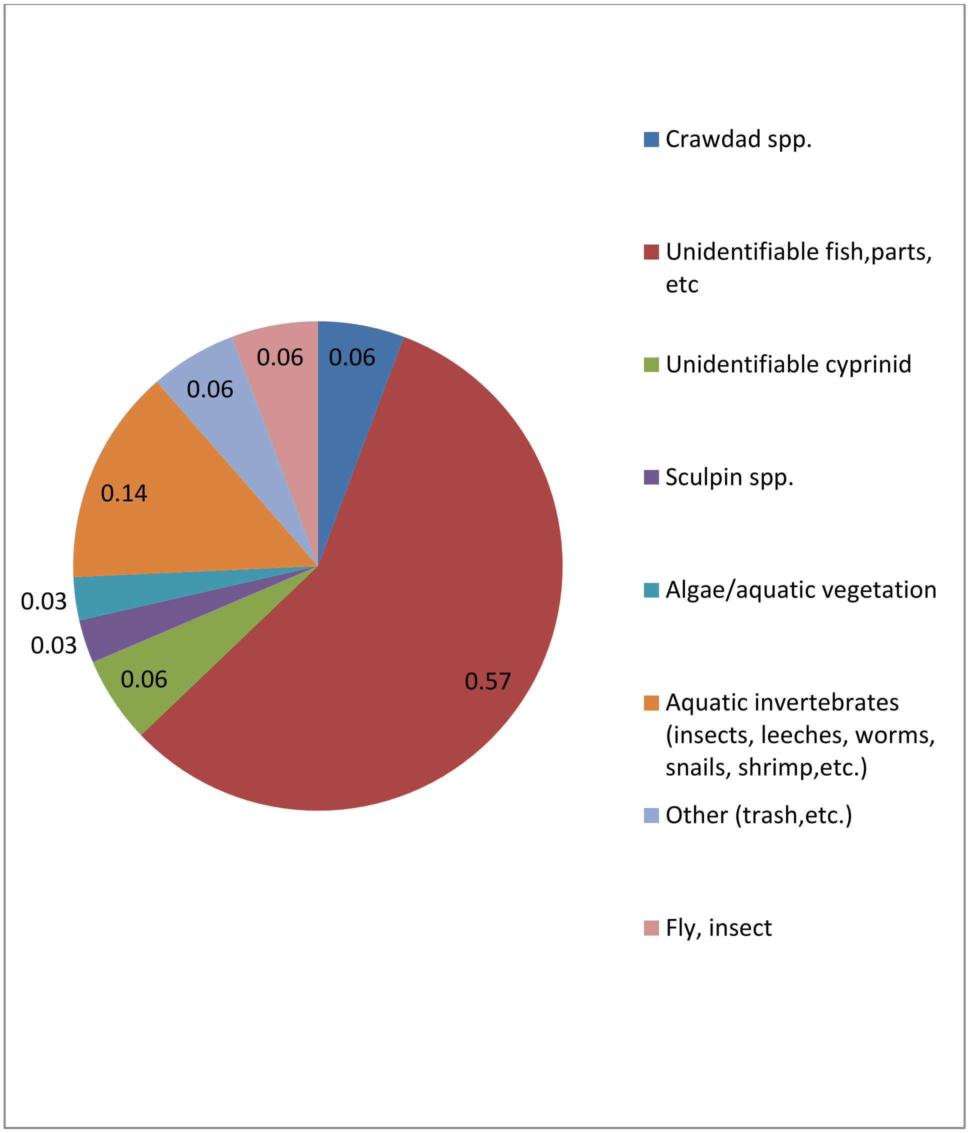

Figure 28. Percentage of organisms (n=35) found in 28 LMB collected, April, 2015 at Clear Lake.

Smallmouth bass

One SMB had gastric lavage performed on it and also had stomach contents removed. Unidentifiable fish, parts, etc. and algae/aquatic vegetation were found inside. This is the third documented SMB collected during this year-long survey.

Of the 18 transects sampled, CP and TFS, were present in 5 (28%) of the transects while INS were found in 3 (17%) of the transects, respectively.

May

A total of 152.4 electrofishing minutes were used to sample the eighteen transects (Table 10). A total of 423 fish representing 10 species were collected during the survey. Largemouth bass comprised 57.7 percent of the total fish sampled. Clear Lake hitch and TP followed with 13.2 and 10.9 percent of the total fish sampled, respectively. SKR-S and BG finished with 9.2 and 4.0 percent of the total catch, respectively. Sacramento blackfish and BCR both finished with 1.9 % of the total catch, respectively. Goldfish, RSF, and BBH rounded out the total species collected with less than one percent of the total catch, respectively. The total CPUE for this survey effort was 2.78 fish/minute, which is a significant decrease from the two previous months.

Table 10. Species composition from Clear Lake, May, 2015.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	244	57.7%	1.60	266.0	586.5	99 - 594	105
2	Clear Lake hitch	56	13.2%	0.37	180.8	55.4	135 - 225	NA
3	Tule perch	46	10.9%	0.30	152.9	59.0	125 - 169	NA
4	Sacramento sucker	39	9.2%	0.26	261.1	214.0	163 - 368	NA
5	Bluegill	17	4.0%	0.11	138.1	70.9	87 - 184	NA
6	Sacramento blackfish	8	1.9%	0.05	203.0	86.25	160 - 250	NA
7	Black crappie	8	1.9%	0.05	166.4	74.8	128 - 198	NA
8	Goldfish	3	0.7%	0.02	219.7	201.3	195 - 254	NA
9	Redear sunfish	1	0.2%	0.01	123	35.0	NA	NA
10	Brown bullhead	1	0.2%	0.01	367	944.7	304 - 412	NA
	Total	423						

Generator minutes:	152.4
CPUE (Fish/ gen. min)	2.78
Water Temperature **	70º F

Largemouth bass

As seen in Table 10, LMB total length ranged from 99 mm to 594 mm (3.9 in. – 23.4 in.). The length class with the highest frequency for the third consecutive month was the 200 mm (7.9 in.) class (Figure 29).

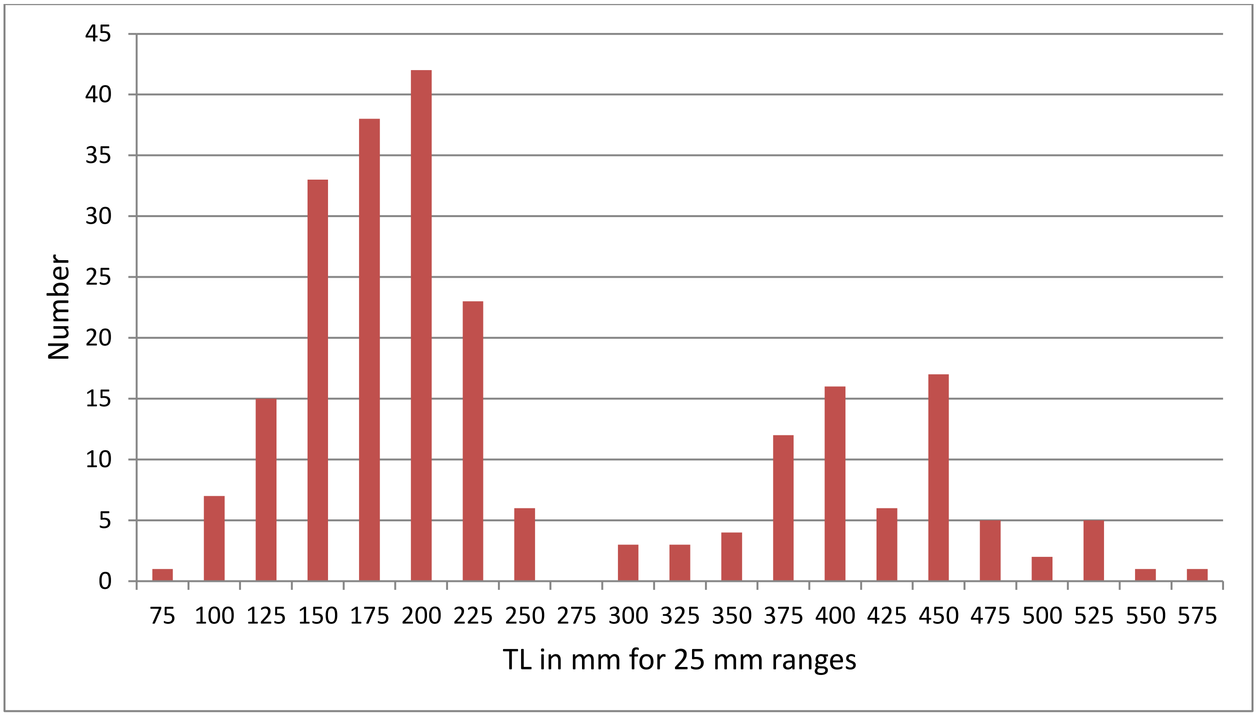

Figure 29. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, May, 2015.

The PSD for LMB was 51, indicating a population that is balanced with quality-sized LMB. RSD-P was 44 while RSD-M was 6. The RSD-P stock density and RSD-M stock density indices indicate an unbalance of preferred and balanced memorable-size LMB.

LMB had a mean relative weight of 105 which indicates the LMB collected were in good condition. Figure 30 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected.

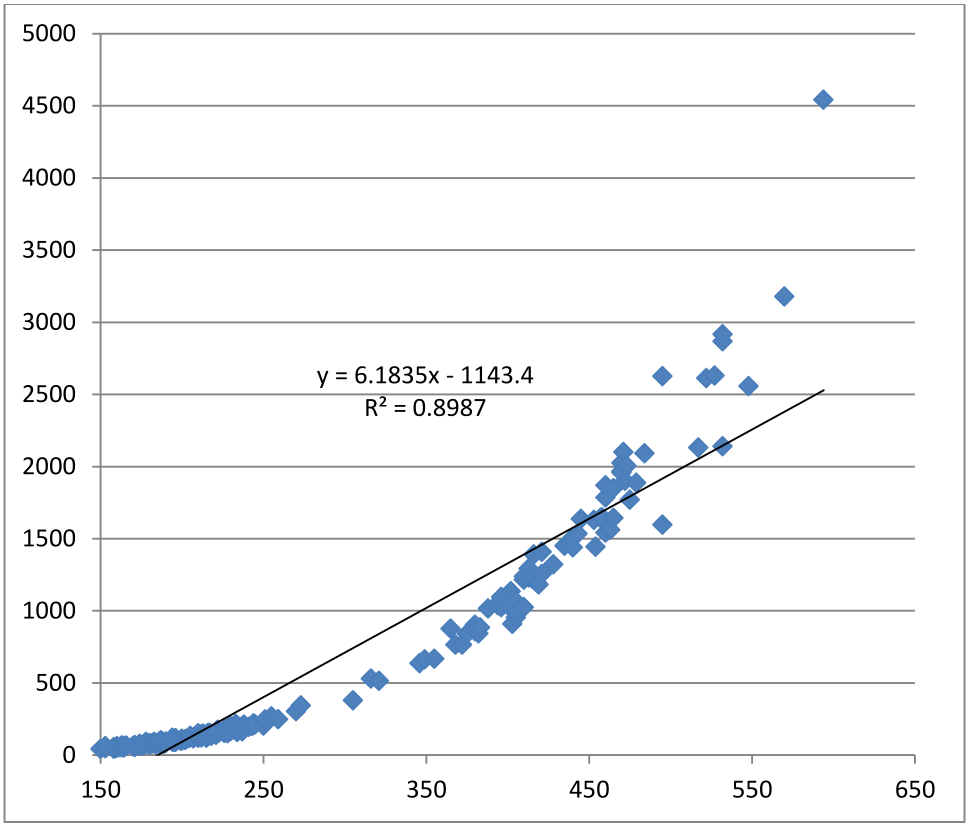

Figure 30. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, May, 2015.

Of the 27 LMB that had gastric lavage performed on them and had stomach contents, 34 recognizable/unrecognizable organisms were documented. Twenty-three LMB had no contents pumped. The largest percentage of organisms seen for a second straight month were unidentifiable fish, parts, etc. and aquatic invertebrates (53%) (Figure 31).

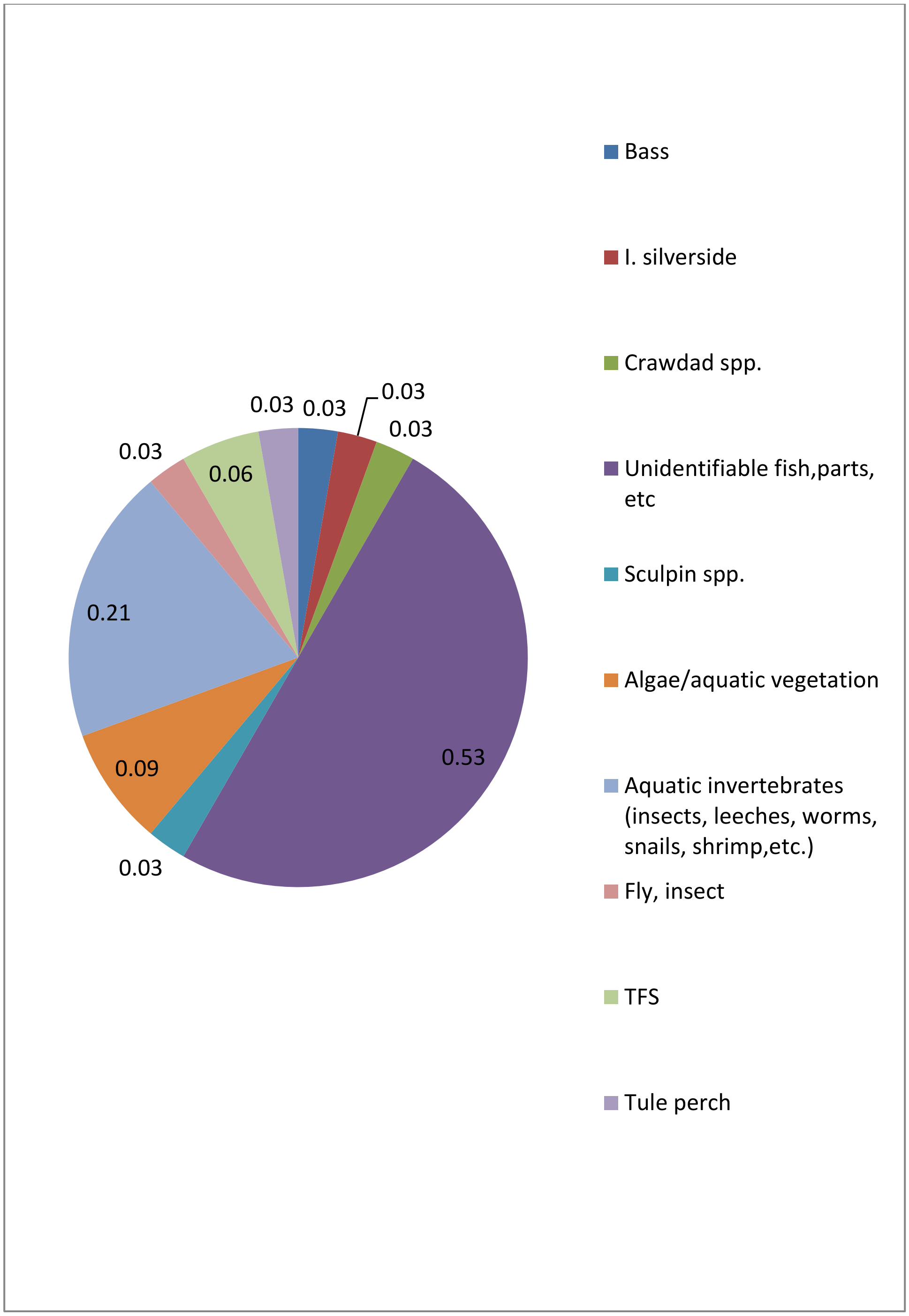

Figure 31. Percentage of organisms (n=34) found in 27 LMB collected, May, 2015 at Clear Lake.

Brown bullhead

One BBH had gastric lavage performed on it and also had stomach contents removed. Unidentifiable fish, parts, etc. and algae/aquatic vegetation were found inside. Two BBH had no contents pumped.

Of the 18 transects sampled, CP were present in 9 (50%) of the transects while INS and TSH were found in 6 (33%) of the transects, respectively.

June

A total of 150.8 electrofishing minutes were used to sample the eighteen transects (Table 11). A total of 346 fish representing at least 12 species were collected during the survey. Largemouth bass comprised 49.4 percent of the total fish sampled. Bluegill finished with 15.3% of the total catch. Clear Lake hitch and SKR-S followed with 6.9 percent each, respectively. Black crappie and TP finished with 4.4 and 4.3 percent of the total catch, respectively. Goldfish, RSF, and SBF finished with 3.2, 2.9, and 2.6 percent of the total catch, respectively. Brown bullhead, SCP-P, CCF, and one unidentified sculpin species all finished with less than one percent of the total catch, respectively. The total CPUE for this survey effort was 2.29 fish/minute, which is the least number of fish seen since the January survey.

Table 11. Species composition from Clear Lake, June, 2015.

	Species	Number	Percent	CPUE	Mean (TL) (mm)	Mean Weight (g)*	Length Ranges	Mean Relative Weight
1	Largemouth bass	171	49.4%	1.13	275.4	727.9	34 - 603	104
2	Bluegill	53	15.3%	0.35	104.4	52.2	32 - 235	107
3	Clear Lake hitch	24	6.9%	0.16	199.3	83.5	158 - 305	NA
4	Sacramento sucker	24	6.9%	0.16	272.9	223.0	230 - 405	NA
5	Black crappie	22	6.4%	0.15	165.1	70.3	134 - 210	NA
6	Tule perch	15	4.3%	0.10	74.3	64.0	55 - 160	NA
7	Goldfish	11	3.2%	0.07	249.9	365.6	192 - 406	NA
8	Redear sunfish	10	2.9%	0.07	167.7	147.9	100 - 276	NA
9	Sacramento blackfish	9	2.6%	0.06	221.3	109.8	167 - 248	NA
10	Brown bullhead	3	0.9%	0.02	266.7	410.0	153 - 357	NA
11	Prickly sculpin	2	0.6%	0.01	41	NA	37 - 45	NA
12	Channel catfish	1	0.3%	0.01	NA	NA	NA	NA
13	Unidentifiable sculpin	1	0.3%	0.01	NA	NA	NA	NA
	Total	346						

Generator minutes:	150.8
CPUE (Fish/ gen. min)	2.29
Water Temperature **	76.5º F

Largemouth bass

As seen in Table 11, LMB total length ranged from 34 mm to 603 mm (1.3 in. – 23.7 in.). The length class with the highest frequency was the 175 mm (6.9 in.) class (Figure 32).

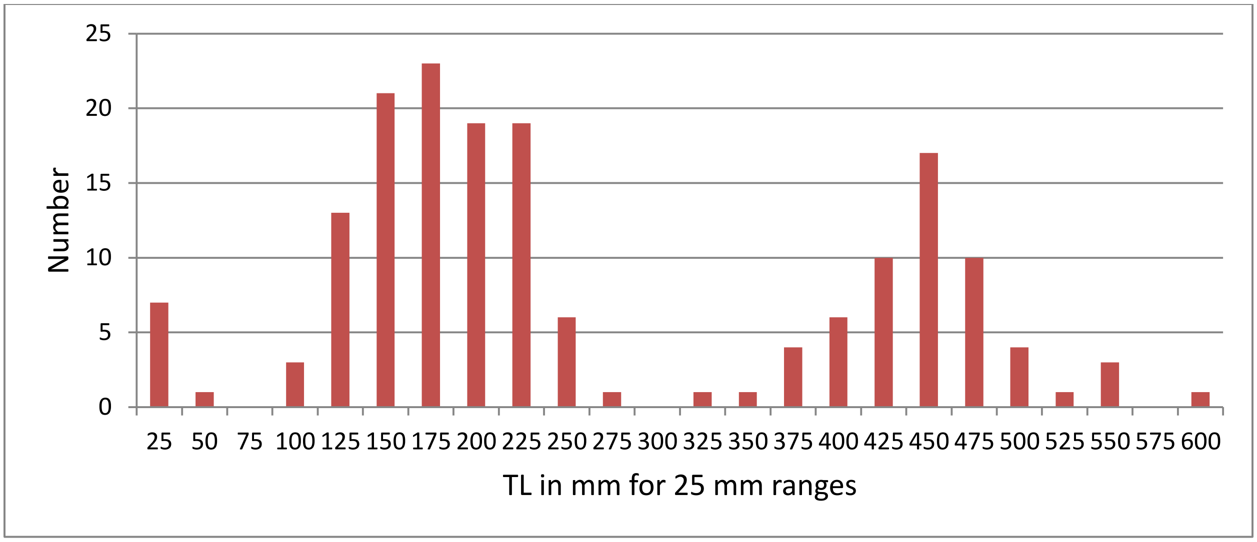

Figure 32. Length-frequency distribution for largemouth bass captured by electrofishing at Clear Lake, June, 2015.

The PSD for LMB was 56, indicating a population that is balanced with quality-sized LMB. RSD-P was 54 while RSD-M was 8. The RSD-P stock density and RSD-M stock density indices indicate an unbalance of preferred and balanced memorable-size LMB.

LMB had a mean relative weight of 104 which indicates the LMB collected were in good condition. Figure 33 is a scatter plot of total lengths and weights for LMB 150 mm in total length or greater collected.

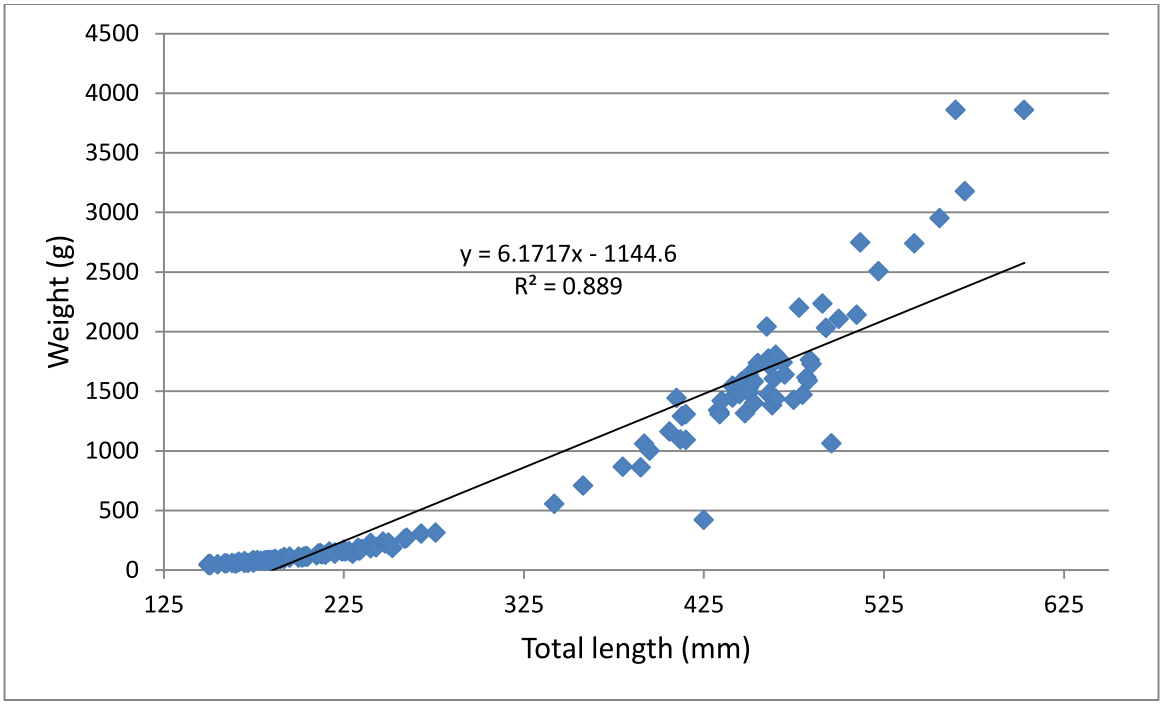

Figure 33. Total length-weight scatter plot with linear regression line for LMB ≥ 150 mm captured at Clear Lake, June, 2015.

Of the 27 LMB that had gastric lavage performed on them and had stomach contents, 33 recognizable/unrecognizable organisms were documented. Twenty-one LMB had no contents pumped. The largest percentage of organisms seen were unidentifiable fish, parts, etc. and aquatic invertebrates (67%) for a third straight month (Figure 34). Crawdads made up the greatest number of identifiable animals collected.

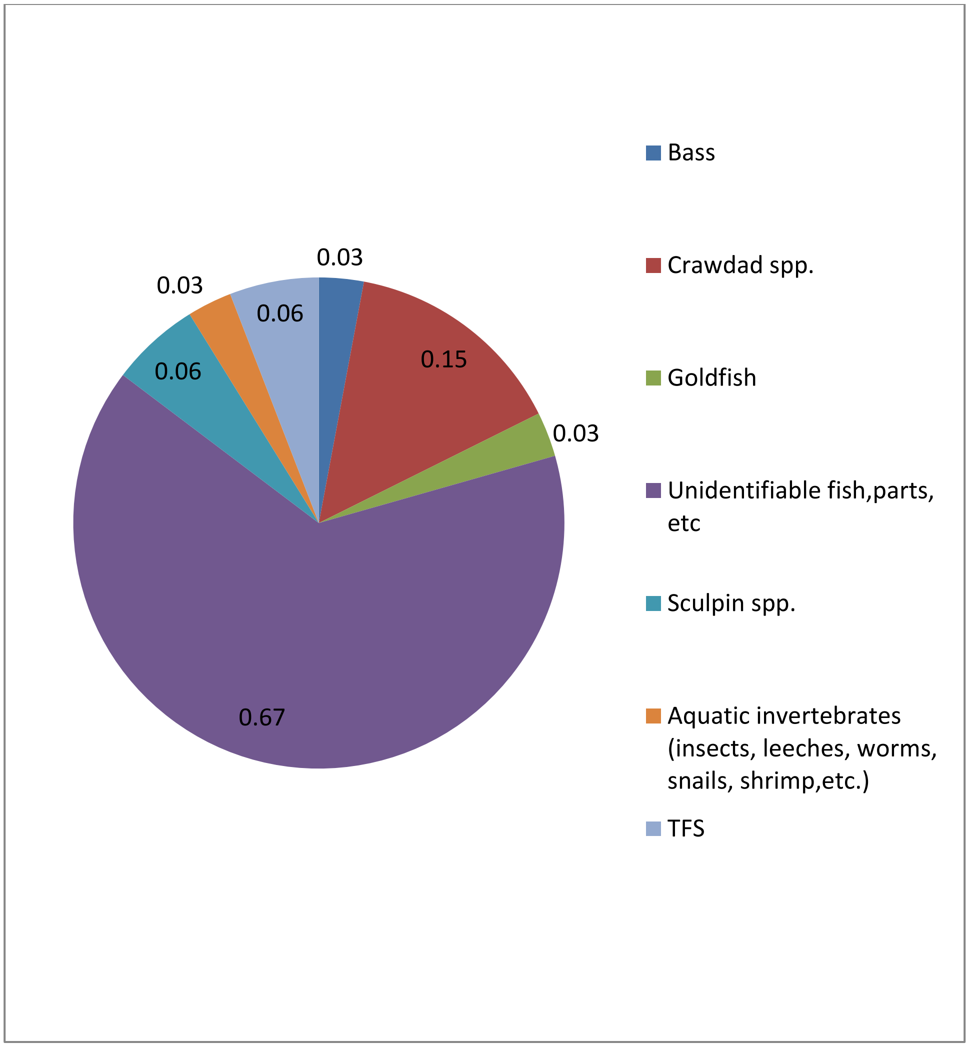

Figure 34. Percentage of organisms (n=33) found in 27 LMB collected, June, 2015 at Clear Lake.

Brown bullhead

Two BBH had gastric lavage performed on them but no stomach contents were found in either one of them.

Of the 18 transects sampled, CP, TFS, and INS were present in 11 (61%), 3 (17%), and 2 (11%) of the transects. This matched the highest number of carp seen for the year-long survey.

Fishery Discussion

Not including CP, INS, or TSH, or unidentified fish species, a total of 16 different species were sampled over the year-long survey. The total number of fish collected was 6,047 including 4 unknown species tallied. Of the 6,043 known species that were collected, LMB was the greatest number of species collected (n = 4,097, 67.80%) (Table 12). The average PSD for LMB for the entire survey period was 61, which indicates balanced population of LMB 300 mm (12 in.) and greater. The average RSD-P for LMB was 51 which indicates an unbalanced population of LMB 380 mm (15.0 in.) and greater. According to Gablehouse, 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. The large amount of habitat and food available coupled with a long growing season could likely contribute to the larger LMB. The average RSD-M for LMB was 8 which indicates a balanced population of LMB 510 mm (20.1 in.) and greater. It is possible that with a greater harvest of LMB in the preferred-size range that the average RSD-P would fall into a balanced range.

Average Wr for LMB for the entire sampling period was 107 which indicates the population is in “good” condition. The reasons mentioned above for the larger-sized LMB likely can be said for LMB’s “good” relative weight classification.

Table 12. Total number of each species collected at Clear Lake (July, 2014 - June, 2015).

Number	Percentage	
4097	67.80%	Largemouth bass
442	7.31%	Black crappie
415	6.87%	Tule perch
322	5.33%	Bluegill
302	5.00%	Sacramento sucker
143	2.37%	Sacramento blackfish
126	2.09%	Clear Lake hitch
77	1.27%	Goldfish
48	0.79%	White crappie
24	0.40%	Redear sunfish
22	0.36%	Channel catfish
9	0.15%	Brown bullhead
7	0.12%	Prickly sculpin
5	0.08%	Green sunfish
3	0.05%	Smallmouth bass
1	0.02%	Riffle sculpin
6043		Total

The length frequency distribution from July thru September showed a LMB population which had a successful recruiting season.

The length frequency distribution for HCH-C indicated the greatest number collected were in the 175 mm – 199 mm length class which are likely two to three year old fish (Moyle 2002). Forty-three 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 2014 and 2015.

The month with the greatest number of fish collected was August when 1,115 fish were collected. This may be due to all of the young-of-the-year fish seeking refuge in the shallows from predators. The least number of fish collected was December with 118. With a 50°F surface water temperature, which was the coldest month surveyed, the majority of fish may have been occupying greater water depths seeking warmer water. The low and high surface water temperatures throughout the sampling period may have inhibited larger-size LMB and other species from occupying shallower water and thus being collected by the electrofishing boat. Smaller-sized fish are more likely to inhabit shallow water in non-preferred temperatures due to the presence of habitat and refuge from larger-sized fish predators that inhabit deeper water.

A total of 281 items were identified from 216 LMB that had gastric lavage performed and had stomach contents. Unidentifiable fish, parts, etc. made up the greatest percentage of stomach contents seen with 52.3% (Table 13) of the 20 different categories. Inland silversides made up the greatest number of identified fish species collected with 33 samples collected (11.7%).

Table 13. Total number of contents collected in LMB at Clear Lake (July, 2014 - June, 2015).

Number	Percentage	Contents
147	52.3%	Unidentifiable fish, parts, etc.
33	11.7%	I. silverside
31	11.0%	Aquatic invertebrates (insects, leeches, worms, snails, shrimp, etc.)
14	5.0%	Crawdad spp.
12	4.3%	Algae/Aquatic vegetation
7	2.5%	Sculpin spp.
5	1.8%	Fly, insect
5	1.8%	TFS
4	1.4%	Bass
3	1.1%	Catfish spp.
3	1.1%	Carp
3	1.1%	Black crappie
3	1.1%	Unidentifiable cyprinid
3	1.1%	Other (trash, etc.)
2	0.7%	Goldfish
2	0.7%	Tule perch
1	0.4%	Bluegill
1	0.4%	Unidentifiable crappie
1	0.4%	Feather
1	0.4%	Tapeworms
281		Total

A total of 18 items were identified from 8 CCF that had gastric lavage performed and had stomach contents. Aquatic invertebrates (insects, leeches, worms, snails, shrimp, etc.) made up the greatest percentage of stomach contents seen with 33% (Table 14) of the seven different categories. Inland silversides made up the greatest number of identified fish species collected with 2 samples collected (11%).

Table 14. Total number of contents collected in CCF at Clear Lake (July, 2014 - June, 2015).

Number	Percentage	Contents
6	33%	Aquatic invertebrates (insects, leeches, worms, snails, shrimp, etc.)
4	22%	Unidentifiable fish, parts, etc.
2	11%	I. silverside
2	11%	Sculpin spp.
2	11%	Algae/Aquatic vegetation
1	6%	LMB
1	6%	B. crappie
18		Total

A total of four items were identified from two SMB that had gastric lavage performed and had stomach contents. Bass species, unidentifiable fish, parts, etc., algae/aquatic vegetation and other (trash) all made up 25% of stomach contents seen.

A total of 2 items were identified from one BBH that had gastric lavage performed and had stomach contents. Unidentifiable fish, parts, etc. and algae/aquatic vegetation each made up 50% of the stomach contents seen.

It should be noted that although many of the fish that had gastric lavage performed on them did not regurgitate up anything, does not mean that their stomachs were empty. Forty nine percent (n=206) of LMB collected did not regurgitate anything. In order to confirm with total certainty if a fish did or didn't have any stomach contents, the fish would have to be killed and their stomachs cut open. To help avoid mortality during this study, the non-lethal way of gastric lavage was performed.

Inland silversides were seen in 86 of the 199 (43%) of the transects sampled. Carp and TSH were seen in 62 (31%) and 54 (27%) of the transects.

Due to the lack of staffing availability for the month of October, no survey was conducted.

Habitat Evaluation Results

In determining the habitat assessment results, all physical characterization variables were correlated with HCH-C, LMB, and TP to discover trends present with any variables. During the year-long survey, there were no habitat assessments taken during October and only fish surveys were conducted in December due to staff availability and weather, which is the result of a difference in total fish since there was no habitat data for comparison.

In total, there were 57 different physical habitat variables assessed and correlated with fish presence or absence. Of those 57 variables, only 3 were found to be either negatively or positively significant related to the presence or absence of any of the three fish species: total weed cover, vegetated shoreline, and wind exposure. Total weed cover is described as macrophyte coverage in the littoral zone which includes submerged, emerged, and floating vegetation. Vegetated shoreline is a variable from the shoreline substrate zone measuring the estimated abundance of vegetation along the 1m of shoreline. Wind exposure is the categorized amount of exposure the site has to wind at the time of assessment. These three habitat variable relationships are shown for each of the three species shown below.

Hitch (HCH-C)

A regression analysis was conducted for the number of HCH-C present and the amount of total weed cover. It was found that there was a highly significant positive relationship between HCH-C presence and total weed cover with r = 0.867589 and a p-value of 0.056. Out of 125 HCH-C, 84 (67.2%) of them were found at sites with categorized very high (>75%) total weed cover. Figure 35 below shows the number of HCH-C found in each categorized level of weed cover (0-4).

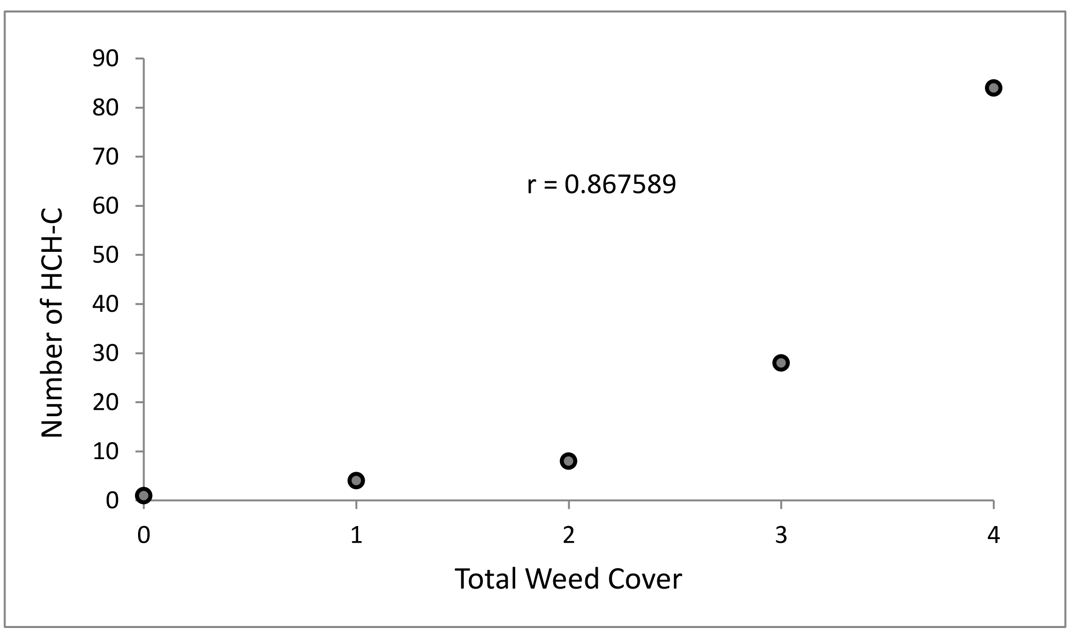

Figure 35. Scatter plot showing the total number of HCH-C present at each categorized level of total weed cover (0-4)

A regression analysis was determined for HCH-C present and amount of vegetated shoreline (r = 0.685028) showing a positive relationship (Figure 36) with a p-value of 0.202, therefore not significant. However, 23 HCH-C were found at a site where the vegetated shoreline was unable to be categorized due to a lack of visibility. Therefore, we cannot determine the true significance of this variable in relation to HCH-C present. Of the 125 HCH-C caught, 67 (53.6%) were found at a site that had very high (>75%) vegetated shoreline. The figure below shows the number of HCH-C found in each categorized level of vegetated shoreline (0-4).

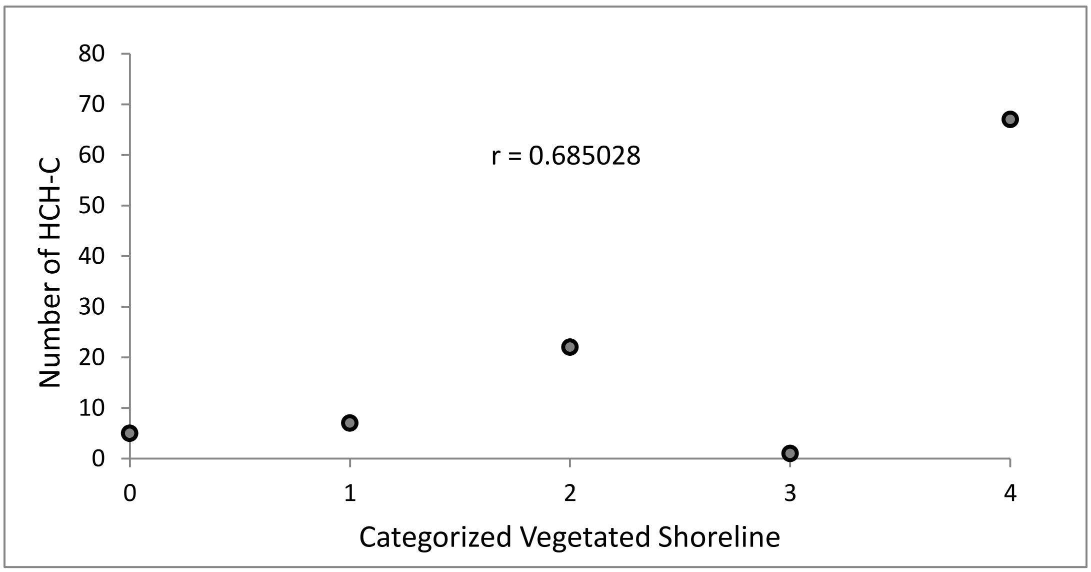

Figure 36. Scatter plot of the total number of HCH-C present at each categorized amount of vegetated shoreline (0-4).

The Pearson Correlation coefficient for wind exposure and the number of HCH-C present was found to be r = -0.64241 (Figure 37). This shows a slight negative correlation, however not significant with a p-value of 0.1689, between the amount of wind exposure and the number of HCH-C present. Of the 125 HCH-C, 84 (67.2%) were found at sites with categorized wind exposure of 1 and 32 (25.6 %) were found at sites with categorized wind exposure of 0, and the remaining 9 (7.2%) HCH-C were found at sites with wind exposure of 2-5 (Figure 37).

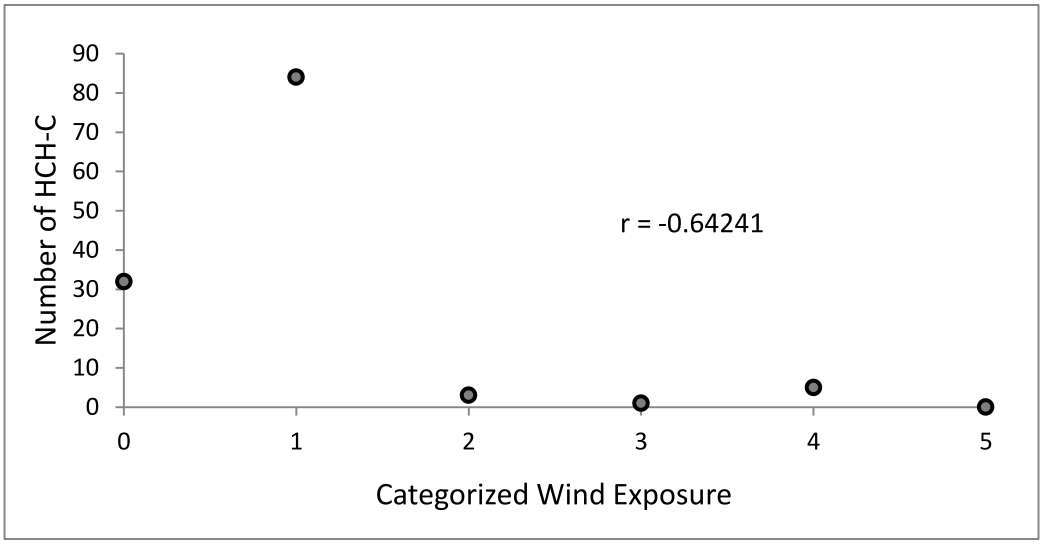

Figure 37. Scatter plot showing the total number of HCH-C present at each categorized level of wind exposure

Largemouth Bass (LMB)

The Pearson Correlation coefficient for LMB and total macrophyte weed cover in the littoral zone was r = -0.4713 (Figure 38). Out of 4021 LMB, 1673 (44.5%) were found at sites with macrophyte weed cover being absent or sparse (<10%). At sites with total weed cover being moderate (10-40%) there were 1057(26.3%) LMB found. There were 708 (17.6%) LMB found at sites with weed cover that was considered very heavy (>75%), 524 (13.3%) at sites with heavy (40-75%) weed cover and 59 LMB were at sites where the percent of weed cover was not recorded. The Pearson correlation shows a slight negative relationship between LMB and total weed cover, however, not significant enough to determine any true trend (p-value, 0.4229).

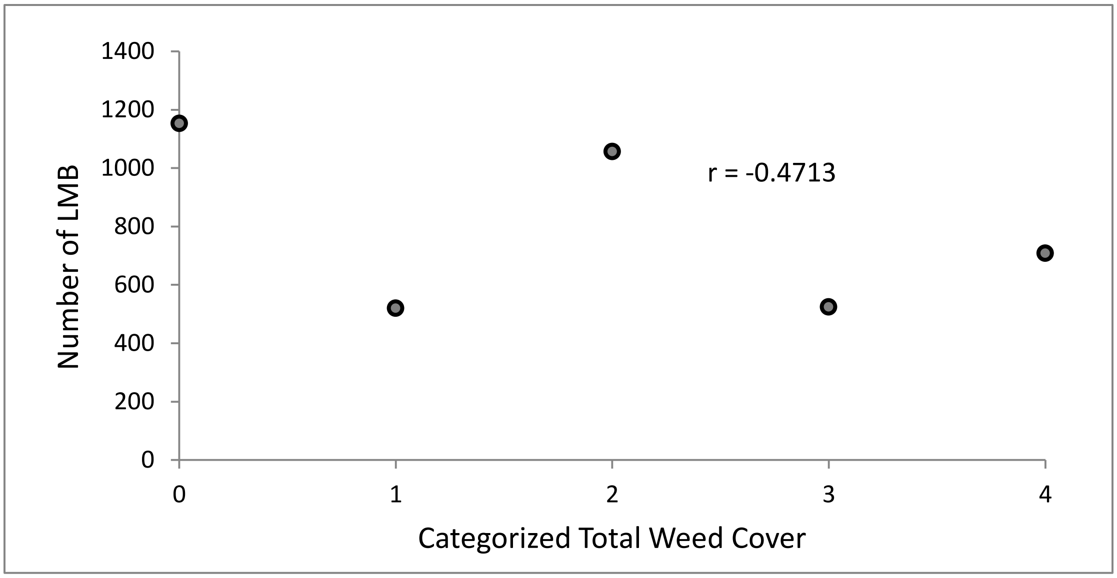

Figure 38. Scatter plot with regression analysis (r) showing the total number of LMB present in each categorized amount of total weed cover

The Pearson correlation coefficient for LMB and the amount of vegetation in the shoreline substrate zone was r = -0.3133 showing a non-significant (p-value, 0.6078) negative relationship between the two variables (Figure 39). Of the 4021 LMB, 2217 (55.1%) were found at sites where the vegetation was absent or sparse (<10%) on the shoreline. Only 301 (7.5%) LMB were found at sites with moderate (10-40%) or heavy (40-75%) vegetated shoreline. There were 1220 (30.3%) LMB found at sites with very heavy (>75%) vegetation on the shoreline. Additionally, there were 238 LMB found at sites that the amount of categorized vegetation was not recorded.

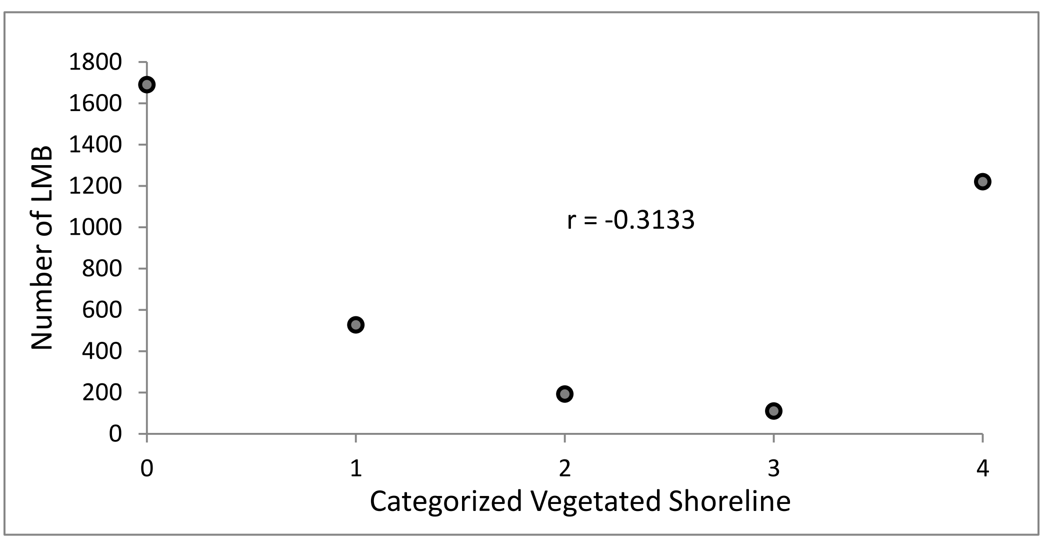

Figure 39. Scatter plot showing the total number of LMB present at each categorized amount of vegetated shoreline

To determine if there was any significance between the amount of wind exposure at each site and the number of LMB present, a Pearson Correlation was calculated (r = -0.9173) and regression analysis resulted in a p-value of 0.009. There were 1296 LMB found in sites with no wind exposure and 1545 LMB at sites with a level of 1 wind exposure which equals 70.7% of all LMB collected. There were 918 (22.8%) LMB found at sites with wind exposures 2-3. Alternatively, 217 (5.4%) LMB were collected at sites with a wind exposure of 4-5. This shows a strong negative relationship between wind exposure and the number of LMB (Figure 40).

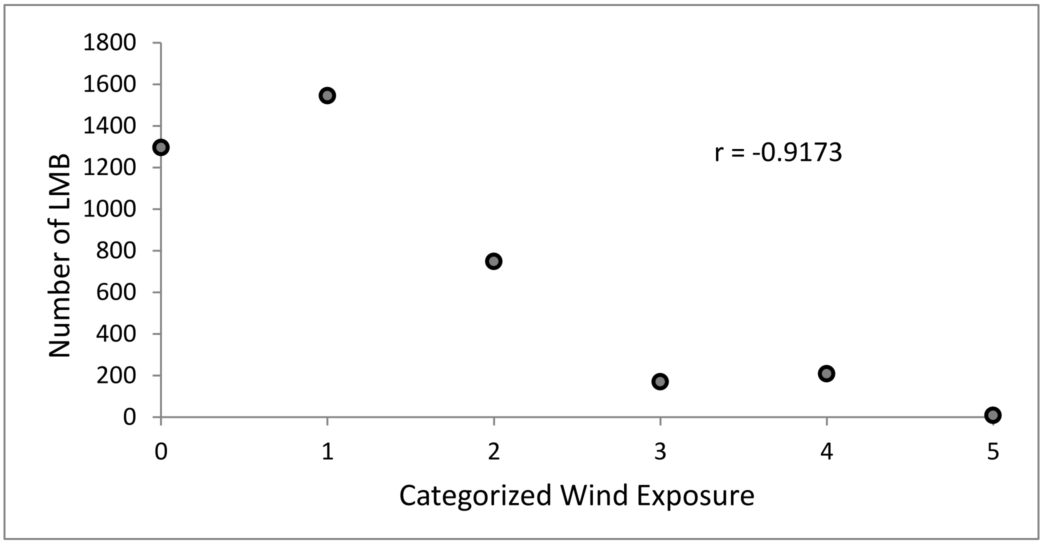

Figure 40. Scatter plot showing the number of LMB present at each categorized wind exposure level (0-5)

Tule Perch (TP)

There were 414 TP collected at the sites surveyed for the habitat evaluation. The presence of TP was correlated with the three variables listed above using the Pearson Correlation and regression analysis. When looking at the total macrophyte weed coverage in the littoral zone r= -0.28855 (Figure 41). This shows a small negative relationship between TP presence and total weed cover, however not significant with a p-value of 0.6377. Of the 414 TP collected, there were 110 (26.6%) TP found at sites with weed cover being absent and 57 (13.8%) TP found at sites with weed coverage very high (>75%).

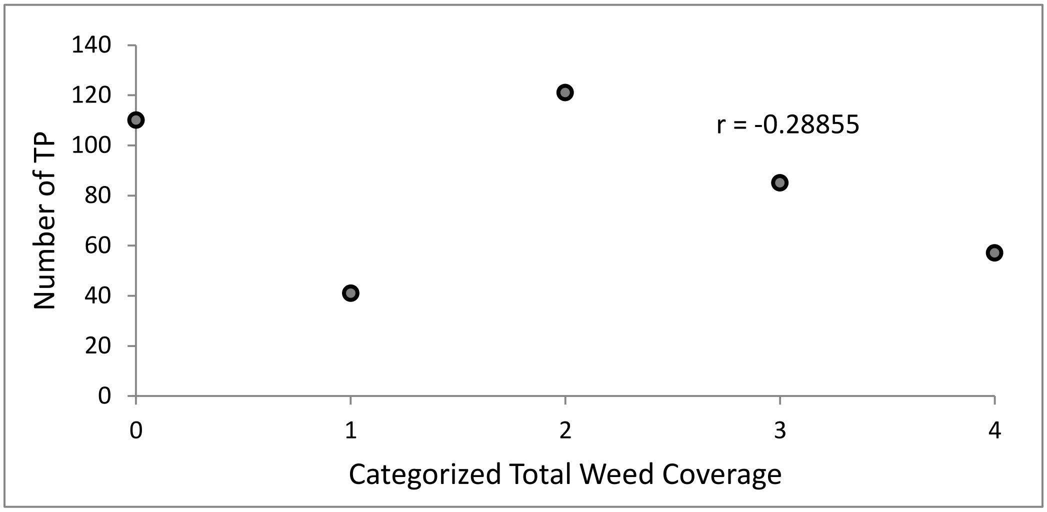

Figure 41. Scatter plot showing the total number of TP present at each category of total weed cover in the littoral zone

The amount of vegetated shoreline was correlated with the presence of TP and it was determined r = -0.67506. With this negative relationship, there were 148 (35.8%) TP found at sites with zero vegetated shoreline. There were 79 (19.1%) TP found at sites with very heavy (>75%) vegetated shoreline. The majority of TP collected were at sites with either zero or sparse (<10%) amounts of vegetation on the shoreline (Figure 42), however not significant enough to provide any true trends between the two variables with a p-value of 0.2111.

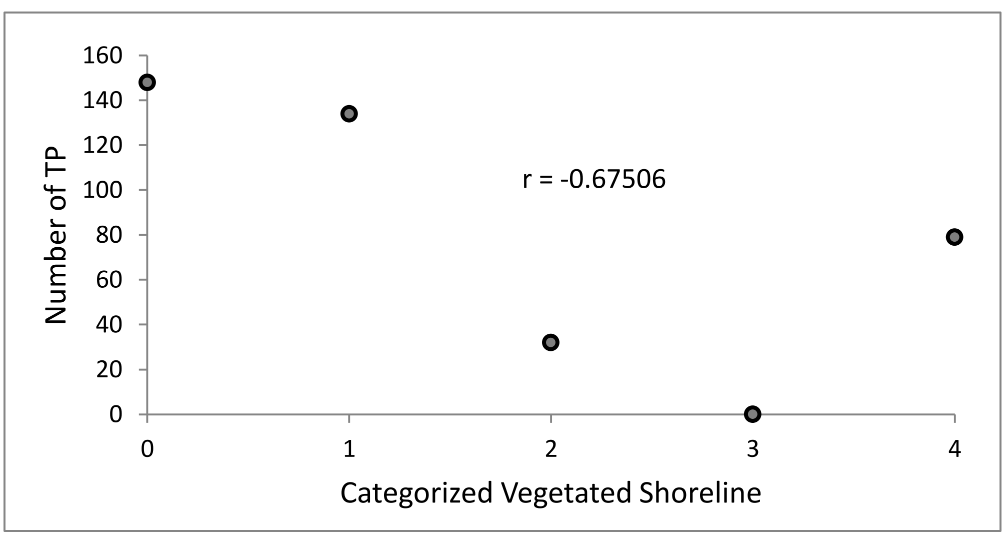

Figure 42. Scatter plot showing total number of TP at each categorized amount of vegetated shoreline (0-4)

Wind exposure at each site was found to have a highly significant negative effect on the number of TP present (r = -0.89269) with a p-value of 0.017. Of the 414 TP collected, 248 TP (59.9%) were at sites with wind indexes of 0-1 and only 9 TP (2.2%) were at sites with wind indexes of 4-5 (Figure 43).

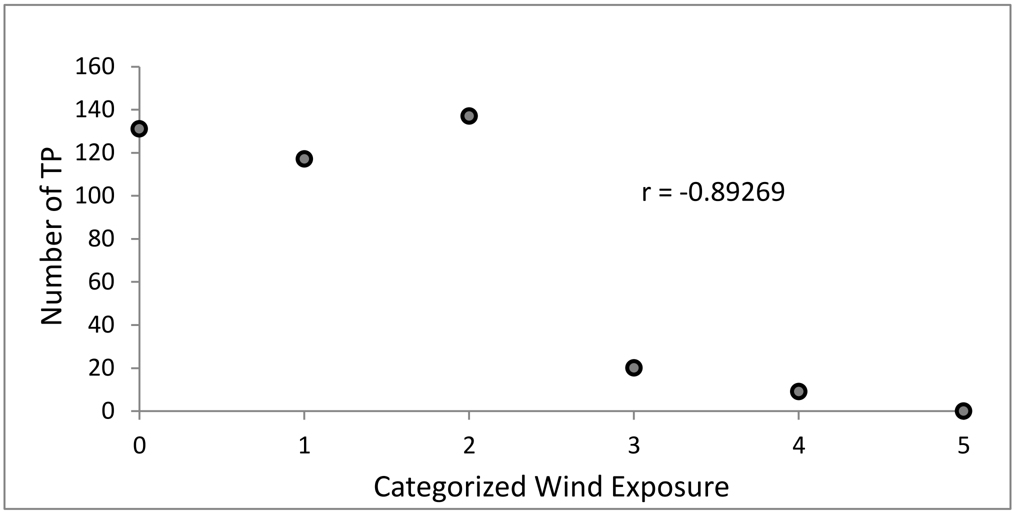

Figure 43. Scatter plot showing the total number of TP at each categorized level of wind exposure (0-5)

Conclusion

Of all 57 habitat variables measured and analyzed for TP, HCH-C, and LMB, only the total weed coverage of macrophytes in the littoral zone and wind exposure were found to be significant to the number of fish present at each site. It is possible that the decrease in fish seen at the high wind transects could be related to other indirect factors. Turbidity was likely higher in high wind transects that would make seeing fish more difficult. High winds could have also encouraged fish to seek refuge in deeper water in order to avoid being washed up on the shoreline. Also, high winds generally force the boat driver to keep the boat in constant gear in order to avoid being washed onto the shoreline. Keeping the boat in gear instead of being able to stop to net fish could have also contributed to the decrease of fish seen in the high wind transects.

The habitat assessment allowed us to compare any characteristic trends between species. We were unable to determine any significant correlations between HCH-C and LMB presence or absence, showing the presence of LMB did not result in an increase or decrease of HCH-C during our study period. Though, vegetated shoreline was positively correlated with the presence of HCH-C. It should be noted that the highest percentage of both LMB and TP were found at sites with no vegetated shoreline, inversely related to the results of HCH-C, however not significant enough to make any true relationship trends. Further analysis, including habitat mapping, may provide more information about species abundance and certain physical characteristic variables throughout the lake.

Future studies should focus on collecting quantitative habitat measurement assessments on the shoreline, littoral zone, and bottom substrate rather than qualitative estimated percentages. This would enable the determination of the more significant variables on the presence or absence of fish at various sites. Additionally, water quality data and physiochemical variables (i.e. dissolved oxygen, pH, conductivity, salinity, alkalinity, TDS and TSS and wind speed) should be collected in order to further help with the determination as to what affects the presence and absence of different fish species.

Although LMB made up the greatest number of species collected, four of the top seven species collected were native to Clear Lake including TP, SKR-S, SBF, and HCH-C. Even though the majority of fish species collected throughout the year were non-native, it is a positive note to see that the actual numbers of native fish compared to non-natives was greater than expected.

Largemouth bass, smallmouth bass, and catfish likely all feed on HCH-C and other native fish if the opportunity presents itself at the right time even though the majority of identifiable fish seen in the stomach contents were non-native. Inland silversides made up the greatest number of fish collected in predatory fish stomach contents. It is possible that the large predatory and piscivorous fish such as black bass and catfish are less of a negative effect on native fish species than INS, TFS, and CP, which don't predate directly on HCH-C and other native fish, but compete for resources and feed on native fish eggs. This might suggest that LMB are not currently one of the significant stressors limiting the HCH-C population but that the stressors for HCH-C could be related to tributary flows and impediments and spawning habitat.

It is not known if INS made up the greatest number of fish collected in bass and catfish due to the huge presence of INS in the lake and their easy availability as a food source or that bass and catfish prefer the taste, meet their caloric intake needs, and/or are easier to catch.

Average PSD for LMB throughout the year-long sampling period was 61 which indicates a balanced population of quality-sized fish (Gablehouse 1984a). Average RSD-Preferred Size was 51 which indicates an unbalanced population (Range is 10 – 40) of preferred-size fish. Average RSD-Memorable Size was eight which indicates a balanced population of memorable-size fish.

Clear Lake is world famous for the LMB fishery and anglers come from all over the world to fish the lake. With the consistent quality-size and larger LMB caught throughout the year, the LMB fishery appears to be a top tier fishery that is deserving of the attention it gets.

By being able to sample 18 random transects a month except October (fisheries and habitat) and December (habitat only), CDFW hoped to gain a large enough sample scale to incorporate factors such as weather, water temperature, lake conditions, habitat types, etc.

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Appendix

Appendix A. List of species acronyms used including common and scientific name for each.

Acronym	Common Name	Scientific Name
BBH	Brown bullhead	*Ameiurus nebulosus*
BCR	Black crappie	*Pomoxis nigromaculatus*
BG	Bluegill	*Lepomis macrochirus*
CCF	Channel catfish	*Ictalurus punctatus*
CP	Common carp	*Cyprinus carpio*
GF	Goldfish	*Carassius auratus*
GSF	Green sunfish	*Lepomis cyanellus*
HCH-C	Clear Lake hitch	*Lavinia exilicauda chi*
INS	Inland silverside	*Menidia beryllina*
LMB	Largemouth bass	*Micropterus salmoides*
RSF	Redear sunfish	*Lepomis microlophus*
SBF	Sacramento blackfish	*Orthodon microlepidotus*
SCP-I	Prickly sculpin	*Cottus asper*
SCP-R	Riffle sculpin	*Cottus gulosus*
SKR-S	Sacramento sucker	*Catostomus occidentalis*
SMB	Smallmouth bass	*Micropterus dolomieu*
TFS	Threadfin shad	*Dorosoma petense*
TP	Tule perch	*Hysterocarpus traski*
WCR	White crappie	*Pomoxis annularis*

Appendix B. Blank data sheets for Riparian and Littoral zone habitat variables.

PHYSICAL HABITAT CHARACTERIZATION FORM-LAKES											
LAKE NAME:	DATE OF VISIT: / /									VISIT #: 1 2	
LAKE ID: __ __ __ __ __ L	TEAM ID (circle): 1 2 3 4 5 6 7 8 9 10 OTHER: __										
RIPARIAN ZONE	STATION ID:										
VEGETATION TYPE N=NONE, D=DECID., C= CONIF., M= MIXED	CANOPY LAYER (>5M)										
	UNDERSTORY(0.5 TO 5M)										
AREAL COVERAGE CATEGORIES 0 = ABSENT 1 = SPARSE (<10%) 2 = MODERATE (10 TO 40%) 3 = HEAVY (40 TO 75%) 4 = VERY HEAVY (>75%)											
CANOPY LAYER (>5M HEIGHT)	TREES ≥ 0.3M DBH										
	TREES < 0.3 M DBH										
UNDERSTORY (HEIGHT = 0.5 TO 5M)	WOODY SHRUBS & SAPLINGS										
	TALL HERBS, FORBS & GRASSES										
GROUND COVER (< 0.5M HEIGHT)	WOODY SHRUBS & SEEDLINGS										
	HERBS, FORBS & GRASSES										
	STANDING WATER/INUNDATED VEGETATION										
	BARREN OR BUILDINGS										
SHORELINE SUBSTRATE ZONE	BEDROCK (>4000MM; BIGGER THAN A CAR)										
	BOULDERS (250-4000MM; BASKETBALL-CAR SIZE)										
	COBBLE/GRAVEL (2-250MM; LADYBUG -BASKETBALL)										
	LOOSE SAND(<0.06-2MM; GRITTY BETWEEN FINGERS)										
	OTHER FINE SOIL/SEDIMENT(<0.06MM; NOT GRITTY)										
	VEGETATED										
	OTHER (EXPLAIN IN COMMENTS)										
BANK FEATURES (WITHIN PLOT)	ANGLE: V = NEAR VERTICLE.UNDERCUT, S=30-75˚, G=<30˚										
	VERTICAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK										
	HORIZONTAL DISTANCE (M) FROM WATERLINE TO HIGH-WATER MARK										
HUMAN INFLUENCE	0 = ABSENT, CHECK (✓) = PRESENT WITHIN PLOT, B = OBSERVED ADJACENT TO OR BEHIND PLOT										
	BUILDINGS										
	COMMERCIAL										
	PARK FACILITIES										
	DOCKS/BOATS										
	WALLS, DIKES, OR REVETMENTS										
	LITTER, TRASH DUMP, OR LANDFILL										
	ROADS OR RAILROADS										
	ROW CROPS										
	PASTURE OR HAYFIELD										
	ORCHARD										
	LAWN										
	OTHER (EXPLAIN IN COMMENTS)										

PHYSICAL HABITAT CHARACTERIZATION FORM-LAKES										
LAKE NAME: DATE OF VISIT: / / VISIT #: 1 2										
LAKE ID: __ __ __ __ __ L TEAM ID (circle): 1 2 3 4 5 6 7 8 9 10 OTHER: __										
LITTORAL ZONE STATION ID:										
STATION DEPTH (M) AT 10M OFFSHORE										
SURFACE FILM TYPE (S= SCUM, A = ALGAL MAT, P = OILY, N = NONE/OTHER)										
BOTTOM SUBSTRATE: AREAL COVERAGE 0 = ABSENT 1 = SPARSE (<10%) 2 = MODERATE (10 TO 40%) 3 = HEAVY (40 TO 75%) 4 = VERY HEAVY (>75%)										
BEDROCK (>4000 MM ; LARGER THAN A CAR)										
BOULDERS (250 TO 4000 MM; BASKETBALL TO CAR SIZE										
COBBLE (64 TO 250 MM; TENNIS BALL – BASKETBALL SIZE)										
GRAVEL (2 TO 64 MM; LADYBUG TO TENNIS BALL SIZE)										
SAND (0.06 TO 2 MM; GRITTY BETWEEN FINGERS)										
SILT, CLAY, OR MUCK (<0.06 MM; NOT GRITTY)										
WOODY DEBRIS										
MACROPHYTES AREAL COVERAGE 0 = ABSENT 1 = SPARSE (<10%) 2 = MODERATE (10 TO 40%) 3 = HEAVY (40 TO 75%) 4 = VERY HEAVY (>75%)										
SUBMERGENT										
EMERGENT										
FLOATING										
TOTAL WEED COVER										
DO MACROPHYTES EXTEND LAKEWARD (Y OR N)?										
FISH COVER 0 = ABSENT 1 = PRESENT BUT SPARSE 2 = PRESENT IN MODERATE TO VERY HEAVY DENSITY										
AQUATIC WEEDS										
SNAGS >0.3M DIAMETER										
BRUSH OR WOODY DEBRIS <0.3 M DIAMETER										
INUNDATED LIVE TREES >0.3 M DIAMETER										
OVERHANGING VEGETATION < 1M ABOVE SURFACE										
ROCK LEDGES OR SHARP DROPOFFS										
BOUDLERS										
HUMAN STRUCTURES (E.G., DOCKS, LANDINGS PILING RIPRAP, ETC.)										