California Department of Fish and Wildlife

North Central Region

Sierra District

Summary of the 2022 Clear Lake Hitch Survey on Clear Lake

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Summary

To evaluate the Clear Lake Hitch (*Lavinia exilicauda chi*) (HCH-C) fishery in Clear Lake, we conducted a Schnabel and Schumacher-Eschmeyer mark-recapture survey from March 16, 2022 through May 17, 2022. We collected a total of 357 HCH-C in 2022, compared to 348 in 2021, 431 in 2020, and 184 in 2019 (Ewing 2019, 2020, 2021). A record drought from 2012–2016, combined with below average rainfall from 2020–2022 (California Department of Water Resources 2022), may explain the low numbers of HCH-C observed by CDFW from 2019–2022 compared to relative numbers historically seen. With Clear Lake experiencing low lake level conditions during the 2022 surveys, it is likely that many HCH-C were not accessible to sample. Much of the shoreline we had historically sampled was too shallow for electrofishing boat access, likely causing less HCH-C to be collected. The data from this survey will be used in conjunction with future and past data, to monitor the status of this fishery and inform adaptive management actions.

Introduction

The objectives of this survey were to:

- Determine the number of HCH-C spawning in Holiday Harbor, Konocti Casino Harbor, Clear Lake State Park, and Soda Bay
- Determine the average size of HCH-C spawning in Clear Lake
- Collect population data with which to compare past and future survey efforts

In September of 2012, The Center for Biological Diversity submitted a petition to the California Department of Fish and Wildlife (CDFW) to list the HCH-C as threatened under the California Endangered Species Act (CESA) (Fish and Game Code, 2050). In August 2014, the California Fish and Game Commission voted to list the HCH-C as threatened under CESA.

This report aims to present a more accurate estimate of population size with 95% confidence intervals, mean length, catch per unit effort (CPUE), and numbers of HCH-C

seen for the survey period. The estimate of population size with accompanying confidence intervals was based on multiple mark and recapture survey efforts.

Although HCH-C prefer to spawn in Clear Lake tributaries, Holiday Harbor, Konocti Casino, Soda Bay, and Clear Lake State Park are four historically HCH-C spawning areas in Clear Lake (**Figure 1**). These locations were chosen due to past spawning observations seen as well as the inability to survey the entire Clear Lake shoreline.

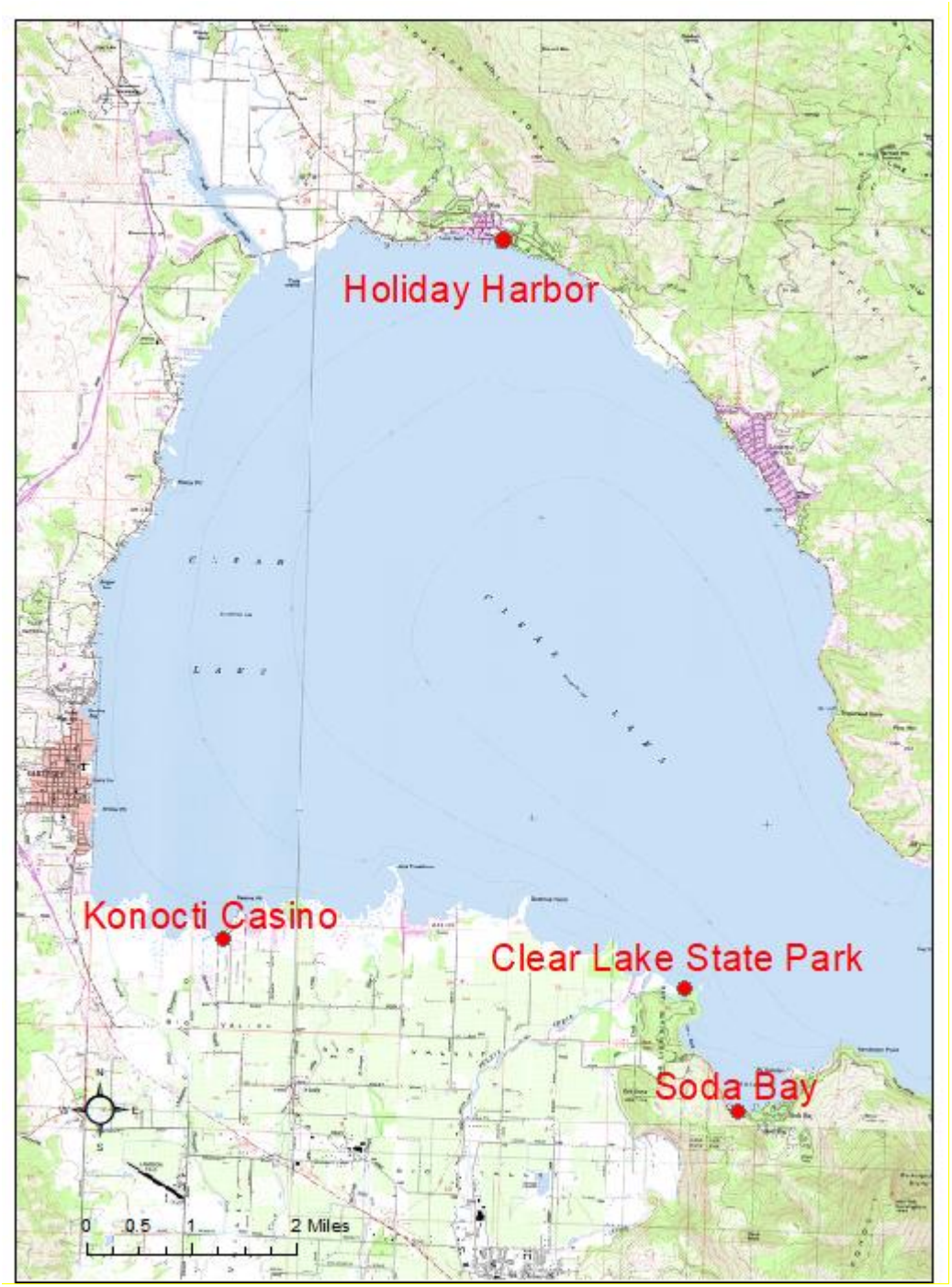

Figure 1. Locations of Holiday Harbor, Konocti Casino, Clear Lake State Park, and Soda Bay boat electrofishing transects, all of which we sampled in Spring, 2022.

Methods and Materials

In estimating the population of HCH-C in these historic spawning areas, CDFW considered the populations to be “closed” with the Schnabel Method (SM) and Schumacher-Eschmeyer Method (SEM) to be used as the statistical analysis. These two methods were used to further solidify CDFW’s confidence in the population estimate. According to Krebs (1999) and Seber (1982), the following assumptions must be met for the estimates to be reliable:

(a) The population is closed, so that N (the population) is constant
(b) All animals have the same probability of being caught in the first sample
(c) Marking does not affect the catchability of an animal.
(d) The second sample is a simple random sample, i.e. each of the possible samples has an equal chance of being chosen.
(e) Animals do not lose their marks in the time between the two samples.
(f) All marks are reported on recovery in the second sample.

We conducted eight sampling efforts to mark and recapture HCH-C on Clear Lake. Population estimates were only calculated for HCH-C collected in Holiday Harbor, Konocti Casino Harbor, Clear Lake State Park, and Soda Bay.

Each electrofishing sampling effort took one day, using one 18-foot Smith-Root SR electrofishing boat. We used pulsed DC current (2-6 amps) to “stun” the fish. The crew consisted of two forward netters, zero to three staff by livewell, and one boat operator. We navigated the boat in a continuous line parallel to shore. We netted HCH-C under galvanotaxis and placed the fish in a holding tank to recover. We made efforts to capture all shocked HCH-C; however, sometimes HCH-C eluded capture on the outer edge of the electrical field.

The start and stop times for time spent electrofishing were recorded. Water temperatures were also recorded at each effort. We measured the first 100 HCH-C collected in total length (inches,in), regardless of which site they were collected in (**Figure 2**). We marked all HCH-C that were 5.0 in. (127 mm) and greater in total length with a single hole punch on the upper caudal fin, using a handheld hole puncher (**Figure 3**). We marked HCH-C less than 5.0 in. total length with a small caudal fin clip. We used the latter marking technique on smaller fish to minimize harm during this delicate life stage. Both techniques were used because they are temporary marks that

would remain identifiable throughout the three-month survey. After the field portion of the surveys, we later calculated the mean total length, catch per unit effort (CPUE), relative population estimate, and numbers of HCH-C collected.

Figure 2. Juvenile HCH-C being measured (S. Newton, 3/13/14).

Figure 3. HCH-C being marked with hole-punch in caudal fin (I. Chellman, 3/30/23).

Results

Holiday Harbor

In 2022, we collected four HCH-C with a portion of those measured in Holiday Harbor, compared to 18 in 2021 (Ewing 2021), 97 in 2020 (Ewing 2020) and two in 2019 (Ewing 2019). We marked two HCH-C with a single hole punch and did not collect any hole punch recaptures. We marked two HCH-C with a fin clip and did not collect any fin clip recaptures. Of the seven sampling efforts, we did not document any initial mortalities associated with processing HCH-C. We only surveyed Holiday Harbor seven times because boat anglers were present in the transect one of the times and prevented us from ethically surveying the area. In 2022, the average total length for HCH-C we collected in Holiday Harbor was 4.75 in. compared to 12.3 in. in 2021, 8.2 in. in 2020 and 9.6 in. in 2019. In 2022, CPUE was 0.06 fish per minute, compared to 0.13 in 2021, to 1.47 in 2020, and 0.03 fish per minute in 2019.

Konocti Casino Harbor

In 2022, we collected 65 HCH-C and a portion of those measured in Konocti Casino Harbor, compared to 218 in 2021 (Ewing 2021),199 in 2020 (Ewing 2020) and 27 in 2019 (Ewing 2019). We marked 58 HCH-C with a single hole punch and did not collect any hole punch recaptures. We marked seven HCH-C with a fin clip and did not collect any fin clip recaptures. Of the eight sampling efforts, we did not document any initial mortalities associated with processing HCH-C. In 2022, the average total length for HCH-C we collected in Konocti Casino Harbor was 9.6 in., compared to 12.8 in. in 2021, 9.9 in. in 2020, and 11.2 in. in 2019. In 2022, CPUE was 0.53 fish per minute, compared to 0.73 in 2021, 1.11 in 2020, and 0.13 in 2019.

Clear Lake State Park

In 2022, we collected 115 HCH in Clear Lake State Park, compared to 112 HCH-C in 2021 (Ewing 2021), 34 in 2020 (Ewing 2020), and 155 in 2019 (Ewing 2019). We marked 107 HCH-C with a single hole punch and did not collect any hole punch

recaptures. We marked eight HCH-C with a fin clip and did not collect any fin clip recaptures. Of the eight sampling efforts, we did not document any initial mortalities with processing HCH-C. In 2022, the average total length for HCH-C we collected in Clear Lake State Park was 13.0 in. compared to 12.0 in. in 2021, and 12.3 in. in 2019. No HCH-C were measured in 2020. In 2022, CPUE was 0.43 fish per minute, compared to CPUE 0.28 fish in 2021, 0.09 in 2020, and 0.23 fish per minute in 2019.

Soda Bay

In 2022, we collected 173 HCH-C in Soda Bay, compared to zero in 2021 (Ewing 2021), 171 in 2020 (Ewing 2020) and zero in 2019 (Ewing 2019). We marked 122 HCH-C with a single hole punch and collected two, hole punch recaptures. We marked 49 HCH-C with a fin clip, and did not collect any fin clip recaptures. Of the eight sampling efforts, we did not document any initial mortalities with processing HCH-C. In 2022, the average total length for HCH-C we collected in Soda Bay was 5.5 in. In 2022, CPUE was 1.66 fish per minute, compared to 3.00 in 2020. No HCH-C were captured in 2021 or 2019.

Overall, we collected 357 HCH-C in 2022 (**Table 1**) compared to 348 in 2021, 431 in 2020, and 184 in 2019. In 2022, the average total length was 7.1 in. compared to 12.7 in. in 2021, 8.5 in. in 2020, and 12.2 in. in 2019.

Table 1. Mark-recapture sample data for 2022. Ct = Total number of individuals caught in sample t. Rt = Number of individuals already marked when caught in sample t. Ut = Total number of individuals caught and marked for first time in sample t. Mt = Total number of individuals marked in the population at sample t.

Date	Ct	Rt	Ut	Mt
3/16/2022	79		79	
3/22/2022	108	1	107	79
3/29/2022	30	1	29	186
4/5/2022	31	0	31	215
4/19/2022	20	0	20	246
5/4/2022	22	0	22	266
5/10/2022	32	0	32	288
5/17/2022	35	0	35	320
Total	357	2	355	

The SM resulted in a HCH-C population estimate for the four sampled sites of 25,983 (95% C.I. 7,772 -146,380). The 2022 SM estimate was more than the 2021 estimate of 24,784 and doubled the SM estimate from 2020 (n = 12,770). The SEM resulted in a higher estimate of 45,849 (95% C.I. 13,021 and NA). The 2022 SEM estimate was also an increase from the 2021 SEM estimate of 16,126 and 2020 SEM estimate of 15,195 (95% Lower C.I. of 13,021). However, due to the combination of low recaptures, number of total marked HCH-C, and low number of surveys, an inaccurate upper confidence value was obtained for the SEM, which resulted in an error in the upper 95% confidence interval estimate (i.e. NA, Not Applicable).

Discussion

CDFW was able to calculate a relative population estimate for HCH-C from 2020−2022, however, we could not derive a comparison to results from 2019 because we did not collect any HCH-C recaptures in 2019. The number of HCH-C we collected in 2022 was the second greatest number collected in the four years of surveys, but was still below what we had hoped to collect.

Due to the below average rainfall totals for Clear Lake and the low lake elevation, many

HCH-C may have tried to spawn in other areas of Clear Lake with more deep-water refuge. A large percentage of the shoreline transects that we sampled in 2020 and earlier were dry and not accessible by the electrofishing boat in 2022. This may have been one of the reasons why more HCH-C were collected in 2020 than 2021 and 2022. Historically these four sampling locations have held thousands of HCH-C, thus the reason they were chosen for sampling. It is possible the record drought that California experienced from 2012–2016 as well as the dry 2020–spring 2022 seasons may have negatively impacted the HCH-C spawning. Many of the tributaries that would have normally held suitable water during the spawning season, were unsuitable or dry during the low-water years. The negative side-effects of the 20212–2016 drought and the 2020–2022 years now may be showing the impacts it had on the HCH-C. However, there was a large increase in juvenile HCH-C seen (n=66) compared to 2021 (n=3), which may suggest a more successful spawn in 2021 than 2020.

Regardless of the low HCH-C numbers collected, CDFW was able to gather a population estimate for a third consecutive year and this information will be used for comparison to future years.

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