California Department of Fish and Game
North Central Region

Summary of the Clear Lake Hitch Population Estimate
at Thurston Lake

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Thurston Lake (3/21/2019) (A. Montalvo)

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Introduction

This report presents an estimate of the population size with 95% confidence intervals, for Clear Lake Hitch (*Lavinia exilicauda chi*) (HCH) in Thurston Lake (Thurston). The estimate with accompanying confidence intervals is based on a single, initial marking and one recapture survey effort.

Location

Thurston is a privately-owned lake located at 38.931 N 122.676 W in Lake County, just south of Clear Lake (**Figure 1**). The elevation of Thurston is 1,410 feet above mean sea level. At the time of the survey Thurston was near full capacity due to a third consecutive year of high rainfall. Thurston's main source of water is Thurston Creek. Prior surveys have found Largemouth Bass (*Micropterus salmoides*) (LMB), Black Crappie (*Pomoxis nigromaculatus*) (BCR), Ictaluridae spp., and HCH in Thurston (Ewing 2015).

Methods

In estimating the population size of HCH in Thurston, the populations were assumed to be "closed". According to, Anderson and Newman, 1996; Krebs 1999; and Seber 1982; the following assumptions must be true 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.

In a closed population it is assumed that the population size is constant without recruitment or losses. This includes fish growing into the specific size range during the sampling period. When the assumptions are not met, the estimate is not reliable and will result in large confidence intervals.

Petersen Method

The Petersen method (PM) is the simplest of the mark-recapture methods. It involves going out one time to mark individuals and then collecting individuals on a later date and checking them for marks. The recapture effort must be random with all fish having an equal chance of being collected. At Thurston, a single pass with the boat electrofisher was used for the mark and recapture efforts. HCH were released into the same area where they were collected during the initial and recapture sampling effort. The data collected from this study were:

M = Number of individuals marked in the first sample.

C = Total number of individuals captured in the second sample.

R = Number of individuals in second sample that are marked.

$\hat{N}$ = Estimated size of the population at time of marking

From this data we can estimate the population using the formula (Krebs 1999):

$$\hat{N} = \frac{CM}{R}$$

Poisson Confidence Intervals were used for the fraction of marked animals (R/C) in this estimate Table 2.1 (Krebs 1999).

A total of two sampling efforts were conducted to mark and recapture HCH. The initial marking sampling effort took two days (March 7 and 8, 2019) to complete. The recapture effort on March 21, 2019 took one day to complete. With one electrofishing boat, the entire shoreline of Thurston was sampled. Electrofishing was completed using an 18 ft. Smith-Root SR electrofishing boat. Pulsed DC current (2-8 amps) was used to "stun" the fish. The crew consisted of two forward netters (**Figure 2**), at least one person marking/checking for recaptures at the livewell, and one boat operator. The boat navigated in a continuous line parallel to shore. HCH under

galvanotaxis (involuntary movement toward an electrical field) were netted and placed in a holding tank. Netters tried to capture all shocked HCH; however, sometimes HCH 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 the same time for each effort. All HCH collected were measured in total length (inches, in.) regardless of size (**Figure 3**). HCH that were 5.0 in. (127 mm) and greater in total length were given a single hole punch on the upper caudal fin using a single, handheld paper hole puncher. HCH that were less than 5.0 in. total length received a small, caudal fin clip. This alternative marking method for young HCH was done to reduce injury that could result from using the hole punch on very small fish. The mean total length, catch per unit effort (CPUE), relative population estimate, and numbers of HCH collected were calculated.

Results

For each sampling effort, Table 1 provides the following data.

Table 1. HCH mark-recapture sample data for 2019. Identifier = ID gives the sample's chronological order. Value 1 corresponds to dates 3/7 and 3/8. Value 2 corresponds to date 3/21. Ct = total number of individuals caught in sample t; Rt = number of individuals already marked when caught in sample t; Ut = number of individuals marked for the first time and released in sample t; Mt = number of marked individuals in the population just before sample t is taken.

I.D.	Ct	Rt	Ut	Mt
1	74	0	74	0
2	184	1	183	74

A total of 258 HCH were collected, with an average total length of 4.7 in. (119.4 mm). The 2019 electrofishing estimate for HCH using the PM was 13,616 (95% C.I. 2,193 and 13,201). CPUE was 0.6 fish per minute.

Discussion

The HCH population appears to be doing well, with evidence of successful recruitment and survival into later age classes. In nearby Clear Lake, HCH use the

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tributaries in the spring to spawn in. At Thurston, Thurston Creek is the only tributary to the lake. Much of Thurston Creek is mainly made up of mud, with little to no spawning gravel which can be found in Clear Lake tributaries. Kimsey (1960) states that HCH are not obligatory stream spawners, but use Clear Lake tributaries for spawning to avoid egg predation from non-native fish such as Common Carp (*Cyprinus carpio*). There has been no documentation of Common Carp in Thurston Lake. This may explain why HCH have been able to survive in Thurston for many decades.

It is likely the Department was not able to collect more HCH during the survey for at least two reasons. First, Thurston is a very turbid lake (**Figure 4**) with water clarity that is consistently observed to be less than six inches. It is likely more HCH would have been caught if visibility were better. Second, wind conditions during sampling posed a challenge. There was a heavy wind present during the initial marking period in early March. With the high winds, it is possible HCH had sought refuge in deeper water, making them unavailable to sample by the electrofisher. Due to limited staff and time, the Department only completed a single mark and recapture effort in 2019. Ideally, the Department would have preferred to perform a multiple mark and recapture effort to better estimate the whole population in the lake. The wide confidence intervals in the population estimate were a direct result of having only recaptured a single marked HCH. If the Department is able to perform future population surveys on HCH at Thurston, an effort will be made to sample multiple times during the sampling period.

References

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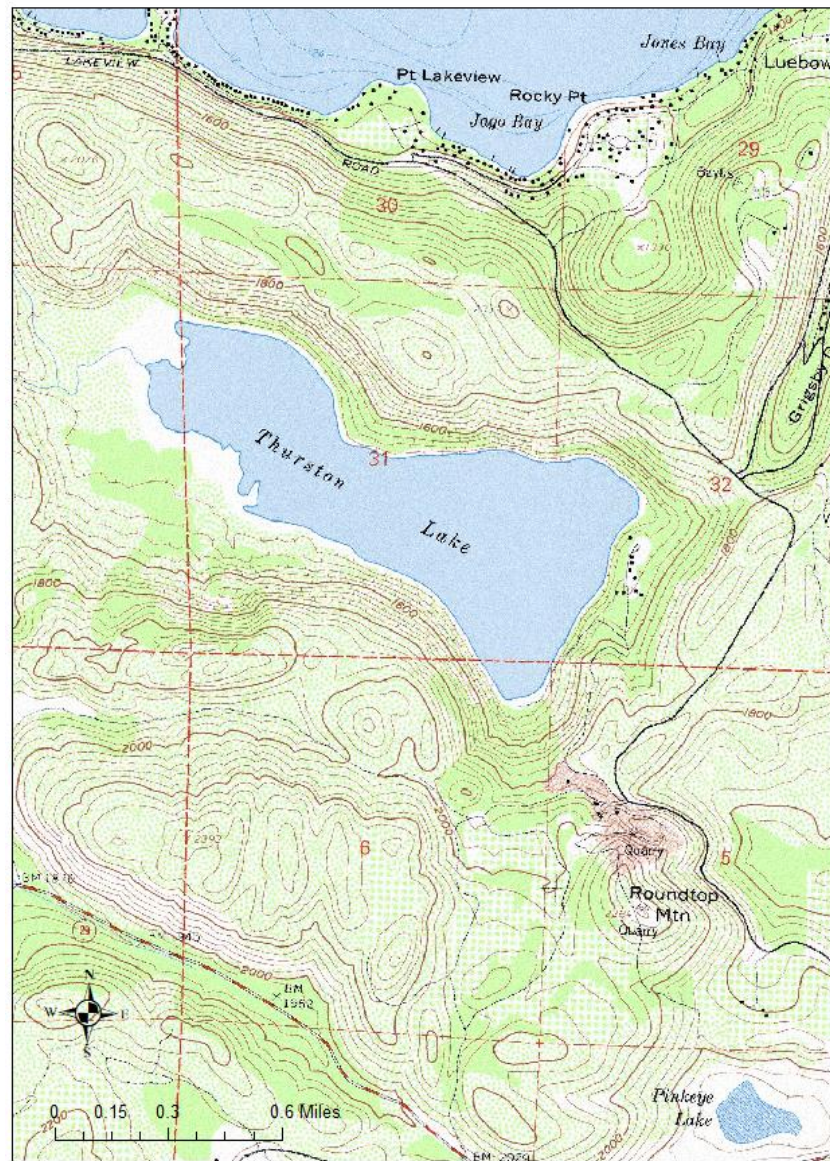
Figure 1. Thurston Lake, Lake County.

Figure 2. CDFW netters at Thurston Lake (3/21/2019) (I. Chellman).

 Figure 3. HCH being measured from Thurston Lake (7/29/2015)
(J. Torres).

Figure 4. Thurston Lake (3/21/2019) (I. Chellman).