

California Department of Fish and Game  
North Central Region  
Sierra District

Summary of the Largemouth Bass and Smallmouth Bass Population Estimate  
For Pardee Reservoir  
2012

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## Introduction

This report presents estimates of population size with 95% confidence intervals, for largemouth bass *Micropterus salmoides* (LMB) and smallmouth bass *Micropterus dolomieu* (SMB) 300mm (12 inches) and greater in Pardee Reservoir (Pardee). The estimate with accompanying confidence intervals are based on a single, initial marking and one recapture survey effort.

## Location

Pardee Reservoir was formed by the damming of the Mokelumne River. The reservoir is operated by East Bay Municipal Utility District and is located approximately 10 miles southwest of the city of Jackson (Figure 1). Pardee sits at an elevation of approximately 568 feet above sea level in the western foothills of the Sierra Nevada Mountain Range. At maximum pool the lake occupies 2,100 surface acres and has 197,950 acre-feet of water storage. Pardee was first filled in 1930 and now supports a significant warmwater fishery in addition to a hatchery and wild trout fishery.

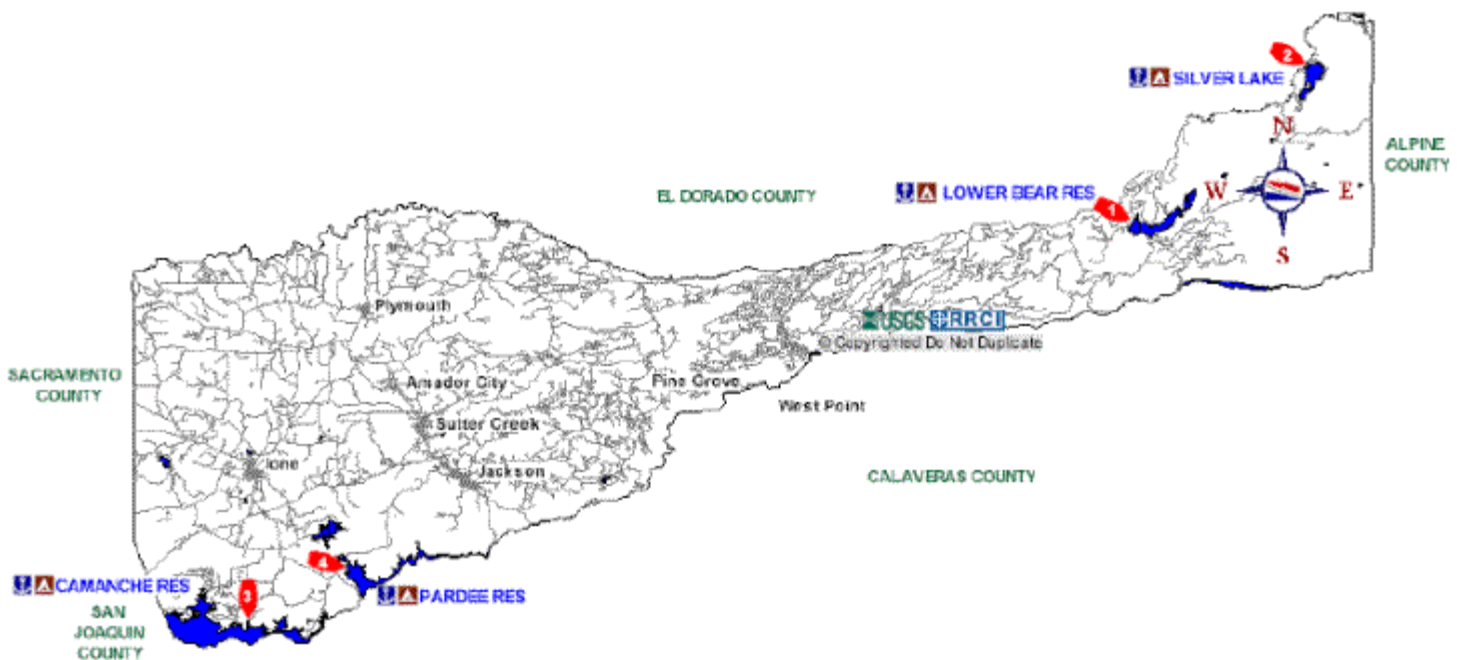


Figure 1. Map of Pardee Lake in relation to Jackson.

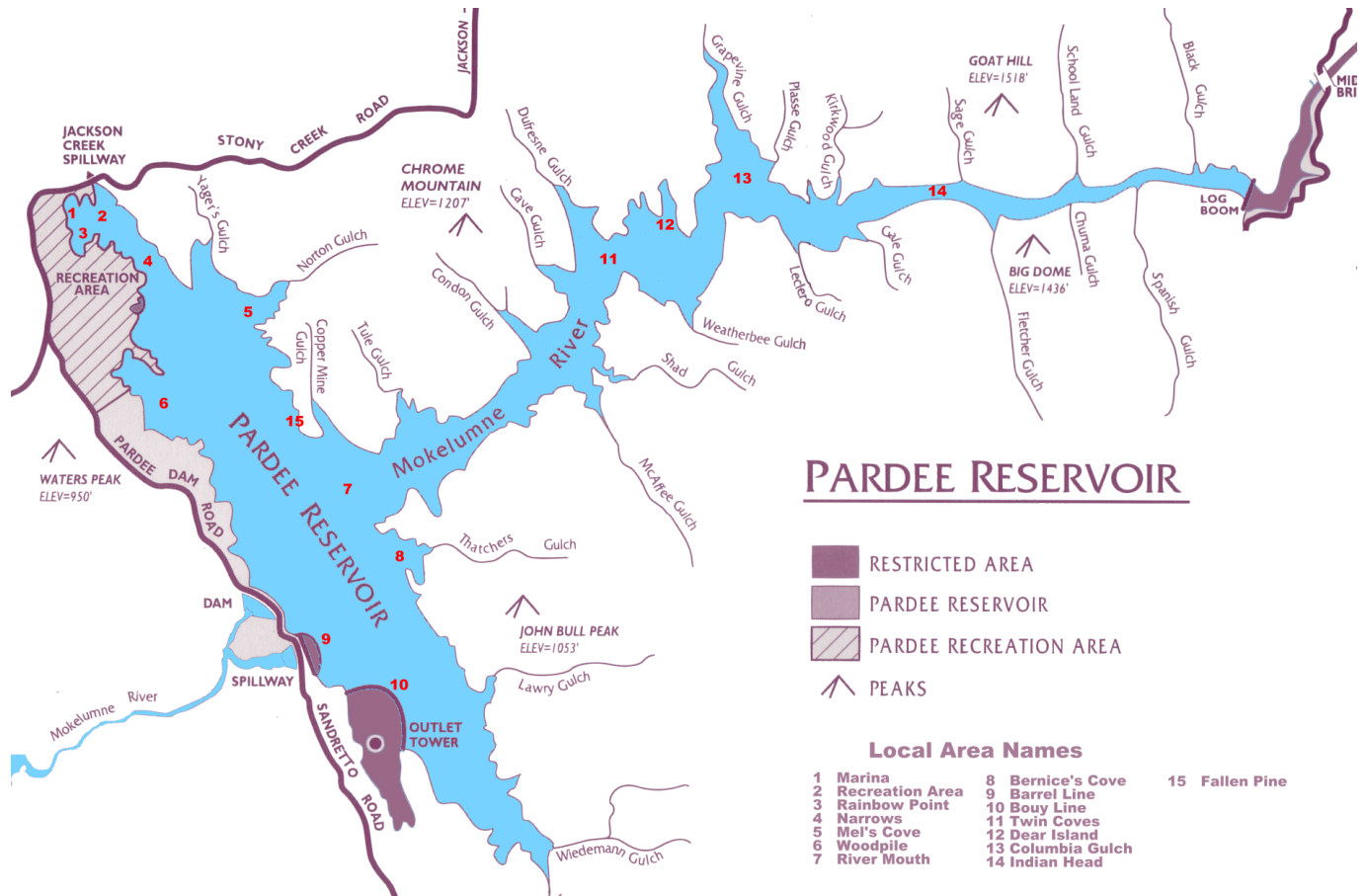


Figure 2. Map of Pardee Reservoir.

## Methods

In estimating the population of LMB and SMB in Pardee we considered the populations to be “closed”. According to, Anderson and Newman, 1996; Krebs 1999; and Seber 1982; the following assumptions have to be true for the estimates to be reliable.

- The population is closed, so that  $N$  (the population) is constant.
- All animals have the same probability of being caught in the first sample
- Marking does not affect the catchability of an animal.
- The second sample is a simple random sample, i.e. each of the possible samples has an equal chance of being chosen.
- 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 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. Using this method all the fish can be marked with the same type of mark. The recapture effort must be random with all fish having an equal chance of being collected. At Pardee, a single pass with the boat electrofisher was used for the mark and recapture efforts. The bass were released into the same area where they were collected during the initial and recapture sampling effort. The data collected from this study was:

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.

N = Size of the population at time of marking

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

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

Binomial Confidence Intervals were used for the fraction of marked animals (R/C) in this estimate. These confidence intervals are obtained from the sample and population proportion Figure 2.2 (Krebs 1999) and applying it to the number of total bass collected in the initial marking.

A total of two sampling efforts were conducted to mark and recapture bass. Each electrofishing sampling effort took a total of two nights using two boats. With the two boats and two nights a large part of the shoreline of Pardee was sampled. Electrofishing was completed using two 18 ft. Smith-Root SR electrofishing boats. Pulsed DC current (8-12 amps) was used to “stun” the fish. The crew consisted of two forward netters, 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. LMB and SMB under electronarcosis were netted and placed in a holding tank. An effort was made to capture all shocked fish; however, sometimes LMB and SMB eluded capture on the outer edge of the electrical field.

All LMB and SMB in the 2012 estimate were marked with a left pelvic fin clip (removal) removed. This marking combination identifies a marked bass as being part of this year’s estimate.

**Results and Discussion**

In 2012, sampling was initiated and finished in May. The statistical method used in determining the 2012 population estimate was the Peterson method (PM). For each sampling effort, Table 1 provides the following data. Identifier = ID gives the sample’s chronological order: Values 1 – 2 correspond respectively to dates 5/2-3 and 5/14-15. 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. The relevant data for spring, 2012 is summarized below.

Table 1. Mark-recapture sample data for 2012. (see following text for nomenclature)

I.D.		Ct	Rt	Ut	Mt
1	LMB	234		234	
	SMB	72		72	
2	LMB	270	58	212	234
	SMB	33	7	26	72

The 2012 electrofishing estimate for LMB using the Petersen method was  $PM = 1,089$  (95% C.I. 867 and 1,377).

The 2012 electrofishing estimate for SMB using the Petersen method was  $PM = 339$  (95% C.I. 267 and 424).

The population for both LMB and SMB appears to have been significantly less than what was expected. The small population numbers directly reflect the low capture rate during the survey. The low capture rate can be attributed to two factors: the lake shoreline gradient and the amount of shoreline surveyed. A large proportion of Pardee's east arm shoreline has a very steep gradient. Not only are bass not likely to inhabit such areas, the electrofishing boats can not generally reach bass in water greater than 10 feet of depth. Due to staffing issues, time, and the large amount of shoreline at Pardee, approximately 2/3 of the reservoir's shoreline was sampled during the survey. Ideally, the entire shoreline needs to be sampled to confidently estimate the whole population in the lake. In past surveys where lake population estimates have been extrapolated from random transects, the estimates tended to overestimate the population size, had extremely wide confidence intervals, and are considered unreliable (Giusti 2004, 2005, 2007). The wide confidence intervals were likely formed because the population ( $n$ ) was calculated by an unreliable theory. This survey did not extrapolate the population from a given amount of shoreline sampled. Since the Department has no control over the lake shoreline gradient aspect, in future surveys an effort will be made to cover the entire lake shoreline to gather the population estimates of LMB and SMB.

It is possible, provided an adequate number of tournaments and participants are held at Pardee each year that tournament-caught and marked bass combined with electrofishing marked bass will be used to provide estimates of the LMB and SMB population. In 2012, only a few small tournaments were scheduled for Pardee so tournament-caught bass were not sampled. It was found when the low number of tournament caught LMB were combined with the high number of electrofishing caught LMB, the confidence intervals for the electrofishing/tournament combined population estimate were very wide (Ewing 2010).

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