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THE RESOURCES AGENCY

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
NORTH CENTRAL REGION

LOWER BEAR RIVER RESERVOIR, AMADOR COUNTY
2013 CREEL SURVEY AND
CATCHABLE TROUT EVALUATION STUDY

By Lanette R. Richardson
Scientific Aid

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Abstract

Lower Bear River Reservoir is a water storage reservoir located in Amador County on the Bear River, as part of the Mokelumne watershed. The reservoir has historically been stocked with lake trout (*Salvelinus namaycush),* brown trout (*Salmo trutta)*, and rainbow trout (*Oncorhynchus mykiss*) and is currently being stocked with various size classes of rainbow trout. This study examined angler catch and preferences. The data used was information given by anglers fishing the reservoir through a standardized angler survey method. Most anglers were local or lived within a couple hours' drive from the reservoir. Anglers had the highest catch rates overall using boats, but shore based anglers using lures had a measure of success as well. High angler satisfaction was given despite an average catch per unit of effort. Most fish caught were recently stocked fish from 2013 plants. The survey indicated some catch of over-wintered trout of all species and various sizes. A more accurate recommendation could be obtained through marking stocked fish and repeating the survey.

List of Figures and Tables

Introduction

Lower Bear River Reservoir (LBRR) was stocked by California Department of Fish and Wildlife (CDFW) in May through August of 2013 with fingerling and catchable size RT (Table 1). All stocked fish from CDFW came from the American River Hatchery. In addition, the Bear River Lake Resort located at LBRR received a stocking allotment of approximately 350 trophy RT from the private aquaculturist American Trout & Salmon on June 6, 2013 (McFarland, 2014).

Table 1 Stocking data for Lower Bear River Reservoir 2012-2013. California Department of Fish and Wildlife. Rancho Cordova, CA

Date	Species	Year Class	Size	Fish/Lb	Pounds	Number
8/19/2013	RT	2011	Catchable	2.5	1880	4700
7/23/2013	RT	2011	Catchable	3	670	2010
6/18/2013	RT	2011	Catchable	2.5	550	1375
6/18/2013	RT	2011	Catchable	2.4	450	1080
6/5/2013	RT	2013	Fingerling	611	65.5	40000
5/22/2013	RT	2011	Catchable	2.5	1000	2500
9/5/2012	RT	2011	Catchable	2.9	690	2001
8/14/2012	RT	2012	Fingerling	59	435	25665
8/10/2012	RT	2012	Fingerling	59	412	24308
8/7/2012	RT	2010	Catchable	2	1000	2000
7/6/2012	RT	2011	Catchable	2	800	1600
6/7/2012	BN	2011	Fingerling	91	165	15015
5/15/2012	RT	2010	Catchable	1.8	4000	7200

The objectives of this creel survey are to examine LBRRs' overall fishery, determine whether anglers were satisfied with their experience, and whether stocked fingerlings are surviving and returning to anglers in large enough numbers to justify their continued release into LBRR.

Background

Lower Bear River Reservoir (LBRR) in Amador County is located in the El Dorado National Forest off Highway 88 (Carson Pass) approximately 40 miles east of Jackson. The reservoir is divided from Upper Bear River Reservoir (Upper Bear) by a dam creating an upper and lower lake. Upper Bear is cut off from public access roads, making that water more difficult to access. LBRR has roads following parts of the shoreline, as well as several campgrounds, and a resort next to the lake, which results in LBRR receiving the majority of the fishing pressure. All creel information in 2013 was gathered from LBRR. The dam that creates LBRR was built in 1952 and is composed of rock fill. Lower Bear can hold up to 52,025 acre feet of water and covers an area of 710 surface acres (U.S. Geological Survey, 2008) (Department of Water Resources, 2014). There are approximately nine miles of shoreline and at full pool sits at an elevation of 5,824 feet above mean sea level. The reservoir is managed by Pacific Gas and Electric for storage, diversion, domestic use, irrigation, power generation and recreation (Department of Water Resources, 2014).

The main sport fish at LBRR are rainbow trout (*Oncorhynchus mykiss*) (RT), brown trout (*Salmo trutta) (*BN), and lake trout (*Salvelinus namaycush)* (LT). Occasionally Tui chub (*Gila bicolor*) are reported by anglers. While crayfish are regularly caught at LBRR, only fish were included as catch in the angler survey.

During the past 10 years LBRR has received stocking allotments of catchable and/or fingerling size RT, and BN (Appendix 1). Since 2010, fingerling RT have been stocked yearly to grow to a catchable size within the lake, giving LBRR a potential put-and-grow component to the fishery (Hopelain, 2003). These trout have a better overall appearance and can be more disease and parasite resistant than stocked catchable size fish subjected to overcrowding in hatchery raceways. Since the cost of feeding fingerlings is less than raising trout to a catchable size in hatcheries, fingerlings are less labor intensive and a more economical choice to stocking reservoirs that have the ability to grow them (Rowan, 2014).

Methods

The survey attempted to utilize a two stage sampling design in which the sampling period was first stratified into weekend/weekday then AM/PM (Malvestuto, 1996). However, there was bias as the date selection was not purely random, but was dependent on staff availability. The 2013 survey consisted of 34 days (27 weekdays; 7 weekend days) selected from late May through the beginning of November. The number of days surveyed varied from month to month as staff availability allowed. The sampling conducted in the 2013 angler survey was performed in the same manner as the 2012 angler survey conducted on LBRR (Hickey, 2012).

Anglers were interviewed and fish were examined to determine:

- Angler origin
- Angling effort
- Catch rate
- Angler satisfaction
- Size of fish
- Species caught.
- Source (Recently stocked/non-holdover, holdover/wild)

Zip codes were collected from surveyed anglers to determine the distance they had traveled to fish at LBRR. Anglers were then categorized by county and displayed on a map of California.

Angler effort was determined by time spent actively fishing on the day surveyed. This was compared to the number of fish caught. A ratio-of-means or total-ratio was used to estimate angler success (Murphy & Willis, 1996). The catch per unit of effort (CPUE) in this survey was based on the number of fish caught per hour of fishing using hook and line (Pacific Fishery Management Council, 2013).This index of was used to measure how economically efficient LBRRs' fishery was in 2013. Gear type and technique (boat vs. shore) was used in conjunction with CPUE to determine which fishing methods were most effective.

Each angler was asked between one and three standardized “yes or no” questions to determine angling satisfaction. Every angler interviewed was asked the question: “Were you satisfied with your angling experience today?” If an angler reported catching one or more fish, they were asked two follow-up questions: “Were you satisfied with the number of fish caught?” and “Were you satisfied with the size of fish caught?” (Hickey, 2012).

Kept fish were measured by total length in millimeters (mm) and broken up into size categories. Lengths and sources were not collected for the fish released by anglers. Species and the total number of fish caught were recorded for all fish whether kept or released.

In addition, kept fish were examined to determine if they were holdover, non-holdover, or unknown (source identification) (Figure 1). Holdover fish were considered to be hatchery fish that have been stocked into LBRR in years prior to 2013 as either catchable size fish or fingerlings. As neither BN nor LT were stocked in 2013, all BN and LT caught in 2013 were classified as “Holdover”. Non-holdover fish were hatchery reared catchable size fish that were stocked in LBRR in 2013. Unknown fish were trout whose source could not be identified or the trout was not available to be examined.

To determine the difference between a holdover and non-holdover, the trout’s physical condition was examined. Determination was based on characteristics shown in Figure 1. Trout were considered non-holdover (hatchery) fish if the fins were rounded or missing and/or the trout had a rounded face or visible abrasions. These physical attributes come from being reared in a concrete raceway where their bodies are constantly in contact with the hard and rough-edged enclosure and in close proximity to other fish where nipping of fins and disease can cause fin erosion.

Holdover (hatchery carry-over) fish were characterized by longer, sharper fins where regrowth had occurred. There were some RT holdover fish that had noticeably long, sharp fins with good physical coloration. Although these fish were listed as wild during the angler survey as they met the physical description shown in Figure 1, these fish may have been holdovers, stocked as fingerlings that had been residing in LBRR longer than a year.

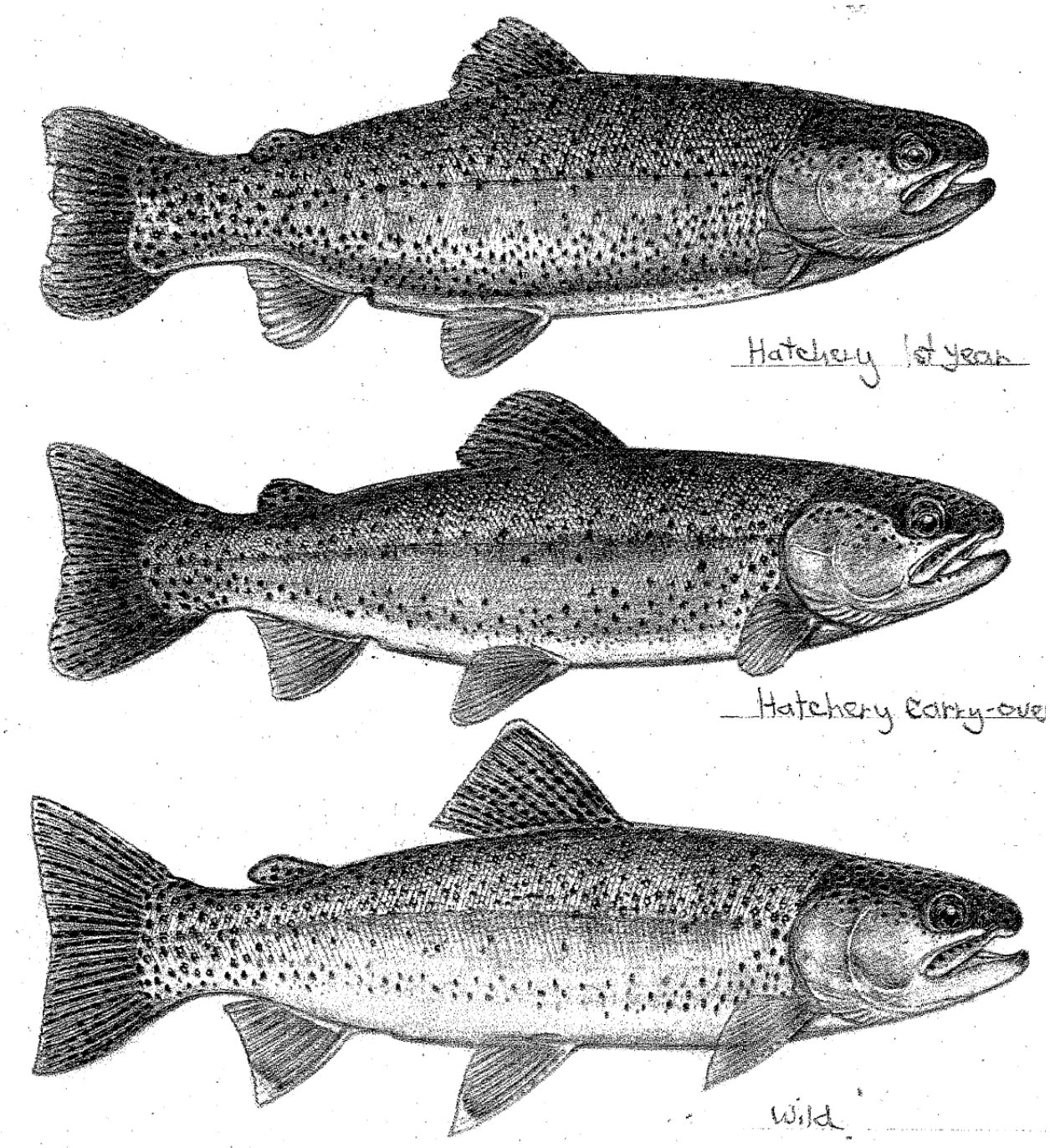

Figure 1. *Oncorhynchus mykiss* physical variations. California Department of Fish and Wildlife. Rancho Cordova, CA

Results

Angler zip codes were analyzed and presented by county (Figure 2). The county with the most anglers was Amador with 154, followed by San Joaquin and Sacramento County with 88 and 84 anglers respectively. Overall, Figure 2 shows a trend where the majority of anglers at LBRR originate along the Highway 50/80 corridor. Not included on the map are anglers from out of state including; five anglers from Nevada, one from Colorado, and two from Idaho.

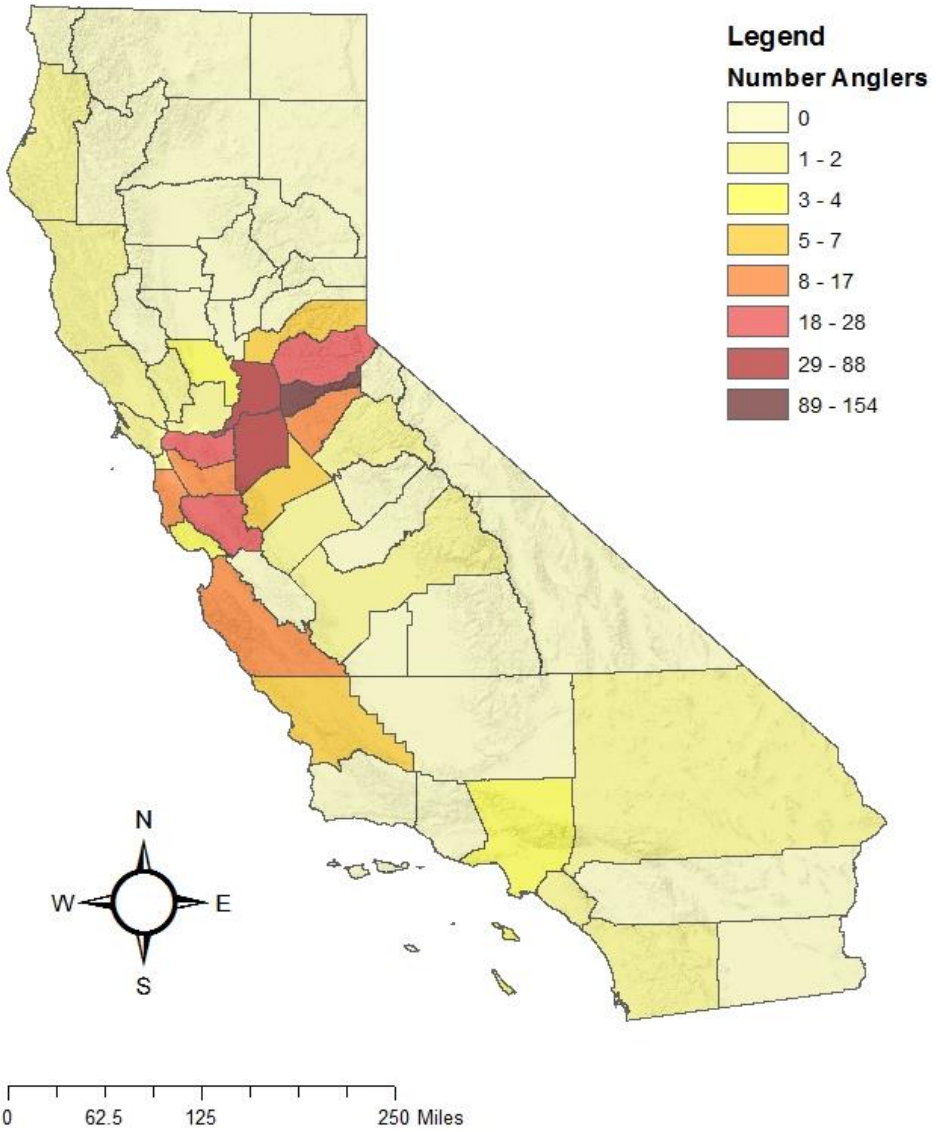

Figure 2. Lower Bear River Reservoir angler density by county. Creel 2013 California Department of Fish and Wildlife, Rancho Cordova, CA.

During the 2013 fishing season, CDFW staff surveyed 533 anglers that fished a total of 1435.5 hours for an average of 2.69 hours of fishing time per angler. A total of 407 fish were reported caught during the survey period for a CPUE of 0.28 fish per hour (Table 2). Seventy-two percent of the anglers were shore based, and twenty-eight percent of surveyed anglers were in boats. Anglers who fished in boats tended to have a higher catch rate than shore based anglers. Shore anglers averaged 0.64 fish per angler. Anglers in boats averaged 1.36 fish per angler. Table 3 demonstrates that while shore based anglers using lures had the highest overall CPUE at 0.42, boat based anglers had a higher average CPUE at 0.33. In comparison, shore based anglers averaged a CPUE of 0.26.

Table 2 General catch statistics at Lower Bear River Reservoir. 2013 California Department of Fish and Wildlife, Rancho Cordova, CA.

Number Anglers	533
Total Fish	407
Number of Fish per Angler	0.77
Total Hours	1433.50
Average CPUE	0.28

Table 3 Catch statistics by technique and gear type at Lower Bear River Reservoir. 2013 California Department of Fish and Wildlife, Rancho Cordova, CA.

Technique	Gear	# Anglers	Hours fished	Fish Caught	Fish per Angler	CPUE
Shore	Bait	246	514.2	112	0.46	0.22
	Bait/Lure	112	242.9	73	0.65	0.30
	Lure	22	50.0	21	0.95	0.42
	Fly	2	9.0	1	0.50	0.11
Boat	Bait	44	170.0	48	1.09	0.28
	Bait/Lure	65	302.9	116	1.78	0.38
	Lure	35	133.5	32	0.91	0.24
	Fly	3	12.0	5	1.67	0.42

Not reflected in the creel survey data was a trout derby held at LBRR on June 8th 2013. The reservoir was stocked two days prior by a private aquaculturist for the Lower Bear Reservoir resort operator (McFarland, 2014). The derby ran for 20.5 hours, hosted 70 anglers, and 25 RT were caught.

To get a broader view on angler preferences and attitudes toward the fishery, all surveyed anglers were asked how they were enjoying their fishing experience that day. Approximately 84% of anglers were satisfied with their fishing experience. Out of the anglers who caught at least one fish, 70.9% were satisfied with the number of fish caught, and 62.3% were satisfied with the size of the fish they caught (Table 4). While the overall satisfaction is almost the same as the previous year, there is a dramatic increase in satisfaction with number and size of fish from 2012 (Table 5). In 2013, if an angler did not catch a fish they were not asked their satisfaction with number and size. In 2012, anglers who had not caught fish were often asked if they were satisfied with their number and size of fish, resulting in an overall 29.5% and 30.2% rating respectively (Hickey, 2012).

Table 4. Angler Satisfaction in Lower Bear River Reservoir 2013 California Department of Fish and Wildlife, Rancho Cordova, CA. L Richardson

Question	Yes	No	Unknown	Percent Satisfied
Satisfaction with Overall Fishing Experiences	444	86	1	83.6%
Satisfaction with Number of Fish Caught	122	50	0	70.9%
Satisfaction with Fish Size	109	66	0	62.3%

Table 5. Angler satisfaction in Lower Bear River Reservoir 2012 California Department of Fish and Wildlife, Rancho Cordova, CA. K Hickey

Question	Yes	No	Unsure	Percent Satisfied
Satisfaction With Overall Fishing Experience	372	71	4	83.20%
Satisfaction With Number of Fish Caught	132	181	1	29.50%
Satisfaction With Fish Size	135	179	0	30.20%

There was a wide range of size classes within the kept RT. Measured RT ranged from 206 mm to 560 mm. Figure 4 grouped these fish in size categories and compared them to data from 2012. This figure indicates that the majority of fish kept were between 250-299 mm in total length. There were also bigger fish measured in 2013 than there was in 2012.

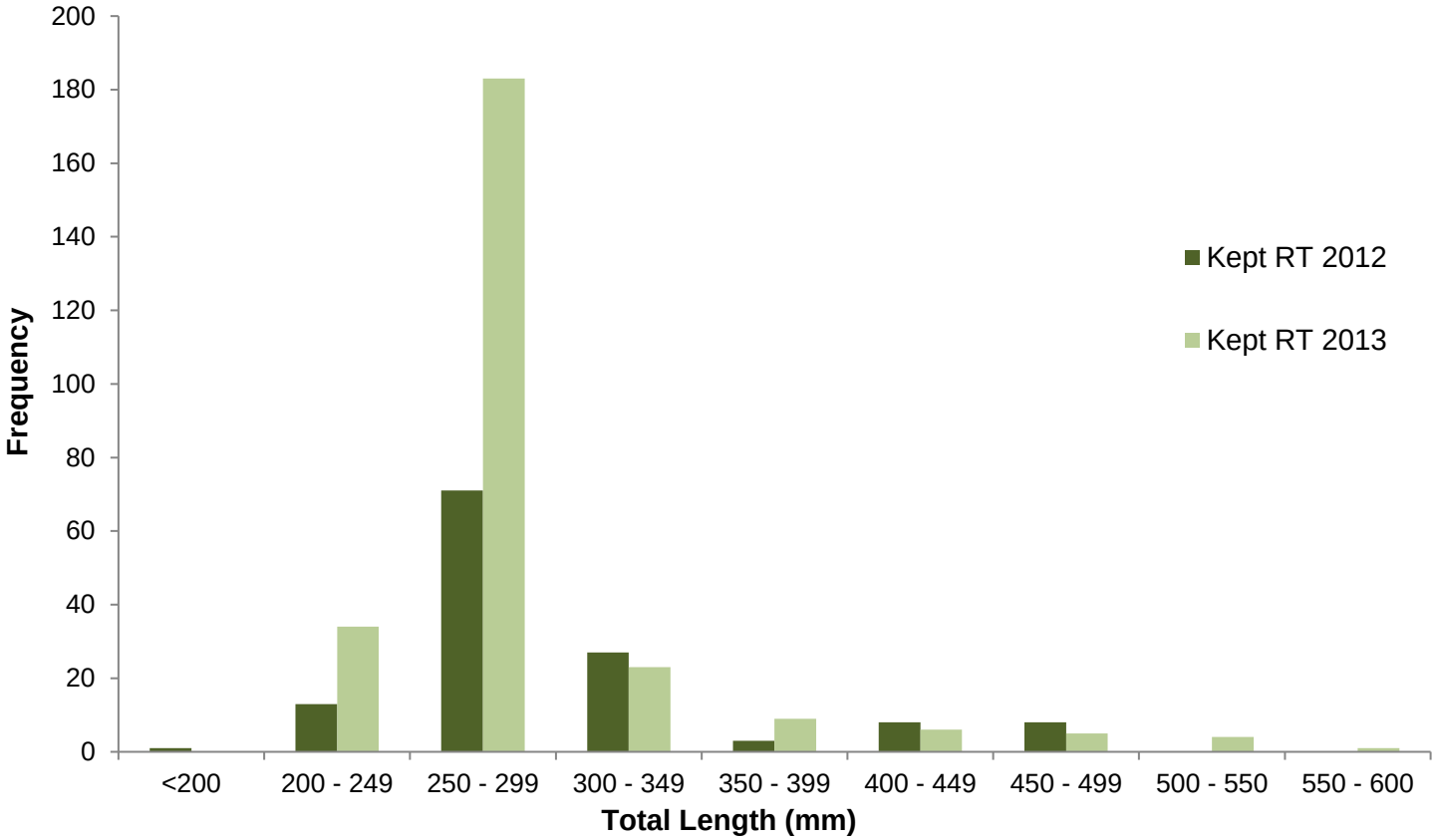

Figure 3 Length frequency histogram of kept *Oncorhynchus mykiss* (RT) in Lower Bear River Reservoir 2012 and 2013. California Department of Fish and Wildlife, Rancho Cordova, CA.

The most frequently caught fish during the survey period was non-holdover rainbow trout. In total there were 286 RT kept by anglers with 266 RT physically available to measure lengths (Table 6). The 20 unmeasured RT along with 15 measured RT were listed as part of the "Unknown" category in Figure 4. A total of 197 fish measured were non-holdover fish, while 53 appeared to be holdover or wild (Figure 4).

Table 6 Lower Bear River Reservoir fish caught. Creel 2013 California Department of Fish and Wildlife, Rancho Cordova, CA.

Species	Count
Rainbow Trout Kept	285
Rainbow Trout Released	111
Brown Trout Kept	1
Brown Trout Released	3
Lake Trout Released	4
Tui Chub Released	1
Unknown Trout Released	2

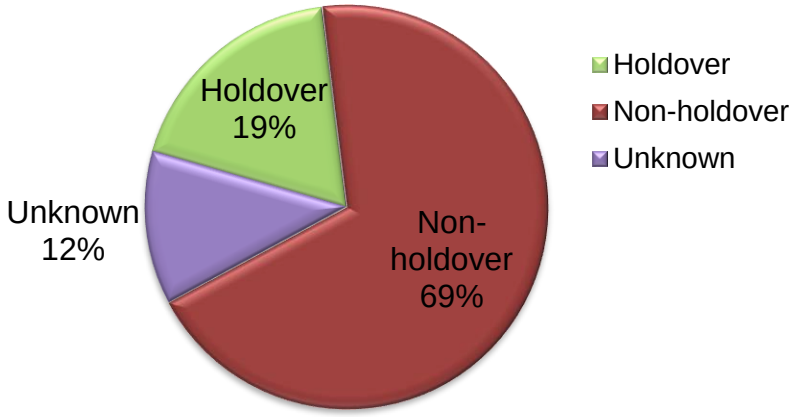

Figure 4 Classification percentages of measured *Oncorhynchus mykiss* (RT) in Lower Bear River Reservoir 2013. California Department of Fish and Wildlife, Rancho Cordova, CA.

The composition of fish caught changed over time. From May to August, anglers caught and kept fish that were classified as non-holdover, holdover, and unknown. After the middle of August, no fish classified as holdover was found in the creel. Holdover fish had a range of lengths while most non-holdover fish caught were between 200-300 mm (Figure 5). The largest fishes found in this creel were caught in late May to mid-June. While there are low numbers of holdovers compared to non-holdovers throughout the year, many of the largest fish are listed as holdover.

Stocking events were compared to the composition of caught trout in 2013 (Figure 6). Daily CPUE is shown with the assumption that all species of trout was caught with equal effort (Murphy & Willis, 1996). After each stocking event, the CPUE initially increases. As time progresses and more of the hatchery trout are caught, the CPUE lowers. Figure 6 shows that anglers were most likely to catch holdover trout in the beginning of the season, but as time progressed anglers were more likely to catch non-holdover RT.

Figure 5 ***Oncorhynchus mykiss*** **(RT) kept by anglers in Lower Bear River Reservoir 2013. Measurement in total length (TL). Stocked fish in 2013 classified as Non Holdover. Stocked fish from previous years classified Holdover. Unknown sourced fish classified as Unknown. California Department of Fish and Wildlife, Rancho Cordova, CA.**

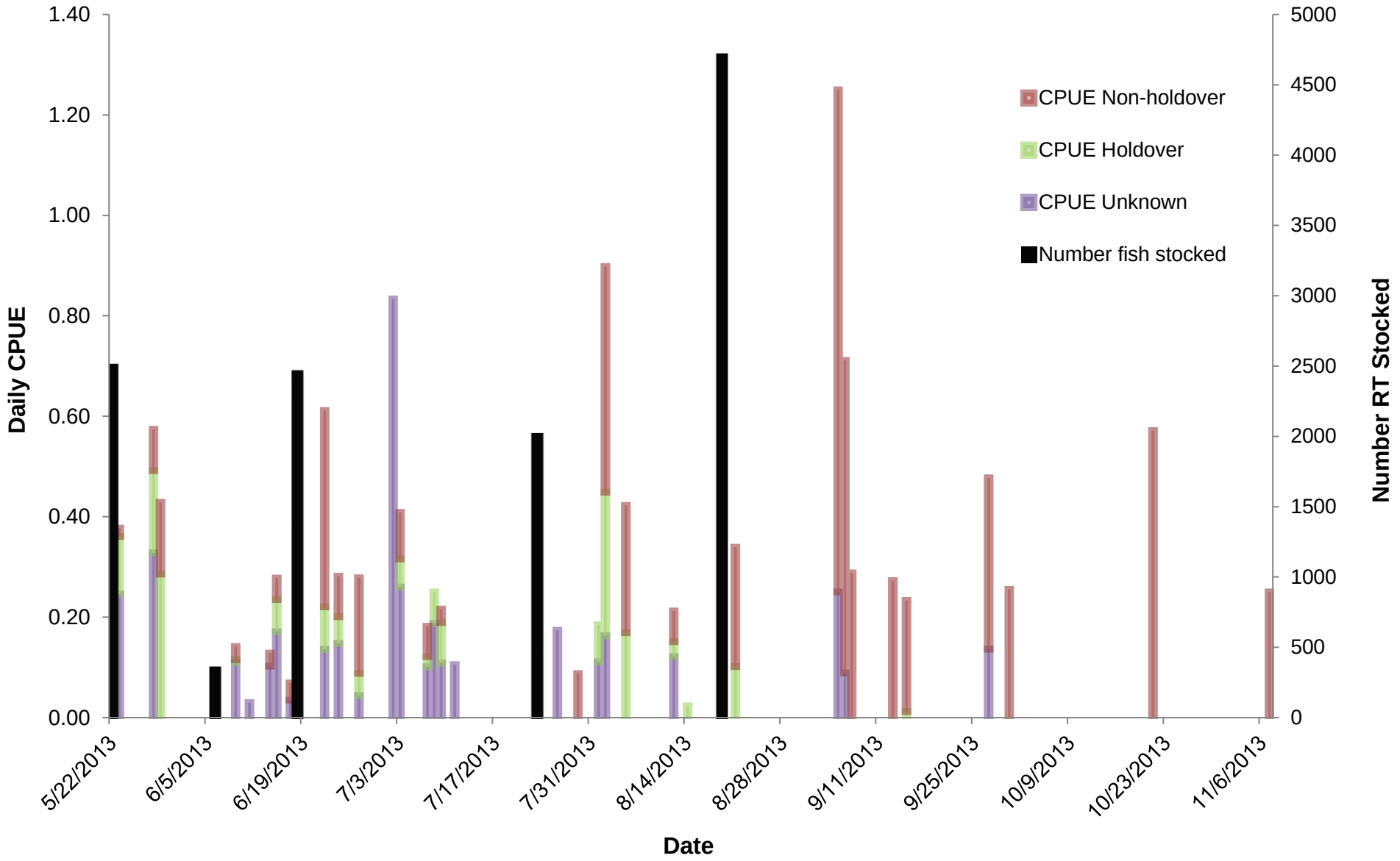

Figure 6. Daily Catch Per Unit Effort (CPUE) in Lower Bear River Reservoir (LBRR) between May and November 2013. Stocked salmonid species within 2013 categorized as "non-holdover". "Holdover" includes all Salmonids including holdover *Oncorhynchus mykiss* (RT), *Salmo trutta* (BN) and lake trout *Salvelinus namaycush* (LT). Unknown species, including all released *Oncorhynchus mykiss* (RT) are categorized as "Unknown". All stocking events except 6/6/2013 consisted of *Oncorhynchus mykiss* (RT) of catchable size, released by the American River Hatchery. 6/06/2013 stocking event consisted of *Oncorhynchus mykiss* (RT) of trophy size, released by American Trout and Salmon. California Department of Fish and Wildlife, Rancho Cordova, CA.

Discussion

When comparing California counties, the majority of anglers were from Amador County. These results show that the reservoir is used more by local residents and those familiar with the Highway 50/80 corridor. This is consistent with the previous year's data (Hickey, 2012).

The majority of anglers fished from the shore and used bait, or a combination of bait and lures (Table 3). Shore based anglers were most productive using lures. Anglers in boats were most productive by either fly fishing although this is a limited data set, or using a combination of lures and bait (Table 3). Boat based anglers had the most fish per angler, as well as the highest average CPUE.

While the average total CPUE was 0.28 fish per hour (Table 2), angler satisfaction with the overall fishery in LBRR is almost identical to the previous year at 83.6% (Table 4). This implies that while it takes a fair amount of effort on average to catch fish, most anglers are still enjoying their angling experience at LBRR.

A total of 11,665 catchable RT and 40,000 fingerling RT were planted in LBRR by CDFW from May through August of 2013. An additional stocking of 350 trophy RT by a private aquaculturist was made in June. Although only four LT were caught (and subsequently released), CDFW does not feel that it necessarily indicates a lack of LT in the lake. Generally LT are very elusive and occupy deep water (18 - 53 m) that makes them harder to catch than other trout in the lake (Page & Burr, 1991).

There was a total of four BN caught, which is a concern since CDFW planted 15,015 BN fingerlings in 2012 (See appendix). The previous year's creel results yielded few (four) caught BN as well (Hickey, 2012). BN are similar to LT in that they are difficult to catch and require specialized techniques. (Rowan, 2014). Most catches of BN normally occur late in the fall or early in the spring when there is low angler pressure. As there were no anglers listed as fishing specifically for BN, the fishery for BN remains inconclusive.

Of all the fish measured in 2013 (266), nineteen percent were considered holdovers. This suggests that stocked fingerlings and catchable trout are surviving in LBRR over the winter and grow large enough to be caught in the beginning of the fishing season. As the season progresses there are less holdover fish caught and by August only recently stocked non-holdover fish are seen in the creel (Figure 5).

After each stocking event, the daily CPUE increases sharply, and then falls. The lowest daily CPUE's falls right before the next stocking event (Figure 6). The percentage of non-holdover fish best follows this trend. This demonstrates how stocking the lake may temporarily improve odds of catching non-holdover fish.

All holdover fish tended to have a wider variation of size classes, ranging from 207mm to 515mm. The largest hatchery stocked trout appear right after the trout derby on June 8th, which likely came from the stocked trophy RT from American Trout & Salmon. Otherwise; most non-holdover trout ranged around 200mm - 300mm (Figure 5). This implies that while the majority of fish caught are hatchery fish, larger fish are more likely to have been a holdover from a previous year.

Continued stocking of catchable sized RT is recommended, as most fish caught were considered non-holdovers. It appears that there are some holdover fish, potentially from fingerling plants entering the creel, although at a lower rate than catchable stocked fish, which is expected.

Fish described as holdover or even "wild" had to conform closely to~~-~~ Figure 1~~Figure 1~~. Fish that had worn, rounded fins were automatically assumed to be a non-holdover. Determinations were not always easy to make, and it is assumed that the classifications were not entirely accurate. Fish classified as a holdover tended to be larger fish with a better overall appearance than the majority of the catchable size stocked hatchery fish.

If the classifications (holdover vs. non-holdover) are accurate then LBRR can maintain a put-and-grow component to its fishery. However, without clear markings it is difficult to assume these classifications are accurate. A plant of marked fish would have facilitated distinguishing holdovers vs. non holdover fish. It is recommended that future plants of tagged or fin clipped fish be used to clearly mark fingerling stocked fish. This would identify whether LBRR has a successful put-and-grow fishery and whether stocking RT fingerlings should continue.

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Appendix 1 Lower Bear River Reservoir Stocking data 2004-2013

Year	Species	Size	Weight (lbs)	Number
2004	RT-H	Sub-Catchable	1600	10240
2004	BN-S	Catchable	2250	6525
2004	RT-S	Catchable	4000	8000
2004	RT-C	Catchable	5000	8900
2004	RT-H	Catchable	1000	1600
2005	RT-S	Catchable	4800	8440
2005	RT-C	Catchable	4000	8000
2005	BN-S	Catchable	2250	5625
2006	BN-S	Catchable	2250	6975
2006	RT-C	Catchable	5500	10300
2006	RT-H	Catchable	2000	3800
2007	RT-W	Catchable	1000	1600
2007	RT-S	Catchable	2000	4000
2007	RT-C	Catchable	4000	7200
2007	BN-S	Catchable	2250	5850
2007	ELT-H	Catchable	1000	1500
2008	BN-S	Catchable	3050	7625
2008	RT-S	Catchable	7000	17200
2008	RT-C	Catchable	1000	2000
2009	RT-S	Catchable	4995	14886
2009	RT-C	Catchable	2000	5200
2010	RT-C	Catchable	500	1000
2010	BN-S	Catchable	2000	5200
2010	RT-C	Fingerling	1820	40040
2010	RT-H	Catchable	9000	20000
2010	RT-S	Catchable	3000	4500
2011	RT-S	Catchable	6500	13350
2011	RT-H	Catchable	4000	7200
2011	RT-C	Catchable	2000	4300
2011	BN-S	Fingerling	47	10011
2012	BN-S	Fingerling	165	15015
2012	RT-TL-(TRP)	Catchable	4000	7200
2012	RT-S-(TRP)	Fingerling	412	24308
2012	RT-S-(TRP)	Catchable	800	1600
2012	RT-C-(TRP)	Catchable	1000	2000
2013	RT-C-(TRP)	Catchable	1880	4700
2013	RT-C-(TRP)	Catchable	670	2010
2013	RT-C-(TRP)	Catchable	550	1375
2013	RT-C-(TRP)	Catchable	450	1080
2013	RT-S-(TRP)	Fingerling	66	40000
2013	RT-C-(TRP)	Catchable	1000	2500