State of California
California Department of Fish and Wildlife
North Central Region

Indian Creek Reservoir, Alpine County

Summary Report of Roving Creel Surveys (2009, 2011-2013) and Angler Survey Box Analysis (2015 – 2018) at Indian Creek Reservoir

Photo courtesy of M. Mamola

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Introduction

Indian Creek Reservoir (ICR) is approximately three miles north of Markleeville off Highway 89 in eastern Alpine County (Figure 1). ICR is within the East Fork Carson River watershed and was originally constructed between 1968-1970 to store tertiary treated wastewater exported from the Lake Tahoe basin by South Tahoe Public Utility District. In 1989, the input of this treated wastewater ceased, but ICR is still a recreational sport-fishing destination due to continued stocking efforts from California Department of Fish and Wildlife (CDFW) and the Alpine County Fish and Game Commission (Alpine County). ICR has a maximum estimated depth of 50 feet and sits at an elevation of 5600 feet above mean sea level. In average water years ICR has a surface area of 110 surface acres. ICR has no large, natural tributaries, receiving most of its inflow from a diversion from the West Fork Carson River. ICR supports various fish species including: non-native Rainbow Trout (*Oncorhynchus mykiss*, RT) and Brown Trout (*Salmo trutta*, BN) as well as Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi*, LCT) which are native to the eastern Sierra Nevada. Other native fish found in ICR include the Tui Chub (*Gila bicolor*), Mountain Whitefish (*Prosopium williamsoni*), Mountain Sucker (*Catostomus platyrhynchus*), Lahontan Redside (*Richardsonius egregius*) and the Tahoe Sucker (*Catostomus tahoensis*). Largemouth Bass (*Micropterus salmoides*, LMB) also occur in ICR. Brook Trout (*Salvelinus fontinalis*, BK) were previously stocked at ICR in 2002 by CDFW, but have not been reported in the last eight survey years.

Both CDFW and Alpine County currently stock ICR. Both entities stock RT, only CDFW stocks LCT. Stocked sizes include fingerling, sub-catchable, catchable, and super-catchable (trophy) fish. Fingerling and sub-catchable trout are stocked under a put and grow management strategy, while catchable and trophy trout are stocked under a put and take management strategy. CDFW is implementing a put and grow strategy with the fingerling and sub-catchable LCT. Rapid growth is expected from the fingerling and sub-catchable size trout due to the high productivity of ICR.

Methods

Anglers were asked to complete a voluntary survey form about their fishing experience at one of the two angler survey boxes (ASB) at ICR. The survey asked anglers for information regarding hours fished, type of gear used, angling method, and the number of landed fish. Anglers were also asked the size and species of the fish landed and whether they kept or released their catch. Finally, anglers were asked three questions, and their answers were recorded on a scale of -2 to +2, with “+2” representing most satisfied and “-2” representing

least satisfied. The questions pertained to satisfaction of overall angling experience, size, and number of fish. The back of the survey form was reserved for anglers who had additional comments. The 2009, 2011-2013 data used for comparison in this report were gathered using the roving creel survey in which a CDFW scientific aide interviewed anglers about their angling experience (Hood 2013).

Figure 1. Indian Creek Reservoir, Alpine County, with Angler Survey Box Locations indicated by green dots.

Results

Fifty-six anglers responded to the survey in 2018. The eight-year average, including anglers who responded to the 2009 and 2011 – 2013 roving creel surveys was 77 (Hood 2013) (Table 1). Cumulatively, these anglers landed an average of 174 fish annually and averaged 251.0 hours of fishing (0.62 catch/hour). The 2018 catch per angler average increased from 2016 and 2017, but was well below the highest catch per angler seen in 2015 (4.78). The catch per hour also increased from the 0.40 average prior to 2015, but decreased from 1.22 in 2015 to 0.84 in 2018, a 31% decrease in catch per hour.

Table 1. Collection of average effort and catch statistics recorded from the roving creel surveys in 2009 and 2011-2013 and the 2015- 2018 angler survey box (ASB) results from Indian Creek Reservoir.

Year	Respondents	Hours Fished	Fish Landed	Catch per Hour	Catch per Angler
2009	143	361.5	242	0.67	1.69
2011	45	134.0	11	0.08	0.24
2012	10	32.5	14	0.43	1.40
2013	98	248.0	103	0.42	1.05
2015	81	318.5	387	1.22	4.78
2016	115	436.5	270	0.62	2.35
2017	71	269.5	191	0.71	2.69
2018	56	207.3	175	0.84	3.13
Average	77	251.0	174	0.62	2.17

Like 2015 and 2016, fly anglers (n = 23) caught the greatest number of fish (44.0%) in 2018 (Table 2). Prior to 2015, bait anglers caught the greatest number of fish (37.8 %). Multiple method anglers (n = 7) caught the lowest percentage of fish in 2018 (3.4 %). Multiple methods continue to be the least successful gear method at ICR.

Table 2. The number of fish landed by the type of gear from 2009, 2011 - 2013, and 2015 - 2018.

	Number of Fish				
Year	2009, 2011 - 2013	2015	2016	2017	2018
Angling method					
Bait	140 (37.8%)	153 (39.5%)	96 (35.6%)	94 (49.2%)	67 (38.3%)
Lure	17 (4.6%)	5 (1.3%)	8 (3.0%)	14 (7.3%)	25 (14.3%)
Fly	107 (28.9%)	193 (49.9%)	141 (52.2%)	64 (33.5%)	77 (44.0%)
Multiple	106 (28.6%)	15 (3.9%)	6 (2.2%)	7 (3.7%)	6 (3.4%)
Not recorded	0	21 (5.4%)	19 (7.0%)	12 (6.3%)	0
Total	370	387	270	191	175

In 2018, anglers caught less fish (n=175) than in 2017 (n=190), 2016 (n = 270), and 2015 (n = 387) (Table 3). In 2018, 68% of fish landed were RT, 16.6% were LCT, 9.1% were BN, 5.7% were suckers, and less than 1% were unknown fish species. The catch rates correspond with CDFW and Alpine County stocking records as 4,200 lbs. of RT and 950 lbs. of LCT were stocked in 2018 (Table 4).

RT were caught in the greatest numbers in 2018, for the third consecutive year. Of the 119 RT caught in 2018, 70.6% were released, an increase from 50.8% in 2017. In 2018, 75% of all fish species caught were released, compared to 51% in 2017 and 69% in 2016.

Table 3. Kept and released fish at Indian Creek Reservoir in 2009, 2011 - 2013, and 2015 - 2018.

Year	Species	Kept	Released	Unknown whether Kept or Released	Total Caught	Percent of Total Catch	Percent Released
2009, 2011 - 2013	BN	7	10	NA	17	4.6%	58.8%
	LCT	8	14	NA	22	5.9%	63.6%
	RT	136	193	NA	329	88.9%	58.7%
	Unknown	0	2	NA	2	0.5%	100.0%
TOTAL 2009, 2011 - 2013		151	219		370		
2015	BN	6	2	NA	8	2.1%	25.0%
	LCT	52	160	NA	212	54.8%	75.5%
	RT	95	71	NA	166	42.9%	42.8%
	Unknown*	0	1	NA	1	0.3%	100.0%
TOTAL 2015		153	234		387		
2016	BN	2	0	NA	2	0.7%	0.0%
	LCT	4	45	NA	49	18.1%	91.8%
	RT	76	141	1	218	80.7%	65.0%
	Unknown	0	1	NA	1	0.4%	100.0%
TOTAL 2016		82	187	1	270		
2017	BN	2	4	NA	6	3.1%	66.7%
	LCT	2	3	NA	5	2.6%	60.0%
	RT	88	91	NA	179	93.7%	50.8%
	LMB	0	1	NA	1	< 1.0%	100.0%
TOTAL 2017		92	99	0	191		
2018	BN	1	15	NA	16	9.1%	93.8%
	LCT	5	24	NA	29	16.6%	82.8%
	RT	35	84	NA	119	68.0%	70.6%
	SKR	0	0	10	10	5.7%	NA
	Unknown	0	1	NA	1	0.6%	100.0%
TOTAL 2018		41	124	10	175		

* Unknown trout species

Table 4. CDFW and Alpine County stocking events from 2009 - 2018.

CDFW						Alpine County	
RT			LCT			RT	
Year	lbs.	Number	Year	lbs.	Number	Year	lbs.
2018	600	1020	2018	800	400	2018	3600
				150	1110		
2017	300	900	2017	83.3	750	2017	3600
	900	2970		83.3	750		
	100	370		300	150		
				90	756		
				90	756		
				500	250		
2016	0	0	2016	320	4192	2016	3600
				605	242		
				145	58		
2015	580	1508	2015	174	87	2015	3600
	1000	1500		200	100	2014	3600
2014	1600	3040	2014	600	300	2013	3600
2013	1220	2806		71.1	1209	2012	2800
	610	2013		2200	6160	2011	4950
2012	317.5	6000	2013	300	150	2010	3800
	2000	6000		300	150	2010*	1000
	625	2000		1376	14998	2009	16800
2011	674	5999	2012	1149	9996	2009*	2200
	1000	2000		220	110		
	3000	5400		380	190		
2010	1000	1500	2011	300	150		
	970	6014		300	150		
2009	599.7	4618	2010	600	300		
			2009	300	200		
	17096.2	55658		11636.7	43664		53150

*Denotes Brown Trout stocking

Twenty-three float tube anglers (41.1%) had the highest catch per angler average (3.35) in 2018 (Table 5). Twenty-seven shore/wading anglers (48.2%) had the second highest catch per angler average (3.07 catch/angler) in 2018. One multiple-method angler (1.8%) caught

three fish. Four anglers (7.1%) who did not record their angling method had a 2.75 catch per angler average. Lastly, one boat angler caught one fish in 2018.

Table 5. The number of anglers and catch per angler based on angling method at Indian Creek Reservoir.

Method	Year					
	2016		2017		2018	
	Number of Anglers	Catch per Angler	Number of Anglers	Catch per Angler	Number of Anglers	Catch per Angler
Boat	7	1.86	6	5.50	1	1.00
Float tube	10	5.30	28	2.32	23	3.35
Shore or Wading	4	0.75	30	2.30	27	3.07
Multiple	NA	NA	NA	NA	1	3.00
Not recorded	94	2.14	7	3.43	4	2.75

The modal size class for RT in 2018 (n = 50) and 2017 (n = 57) was the 12.0 – 13.9 inch (in.) length class (Figure 2). The modal size class for LCT in 2018 (n = 8) was the 12.0 – 13.9 in. length class compared to the 18.0 – 19.9 in. length class in 2017 (n = 3) (Figure 2). The modal size class for BN in 2018 (n = 16) was the 14.0 – 15.9 in. length class compared to the 6.0 – 7.9 in. length class in 2017 (n = 4) (Figure 2).

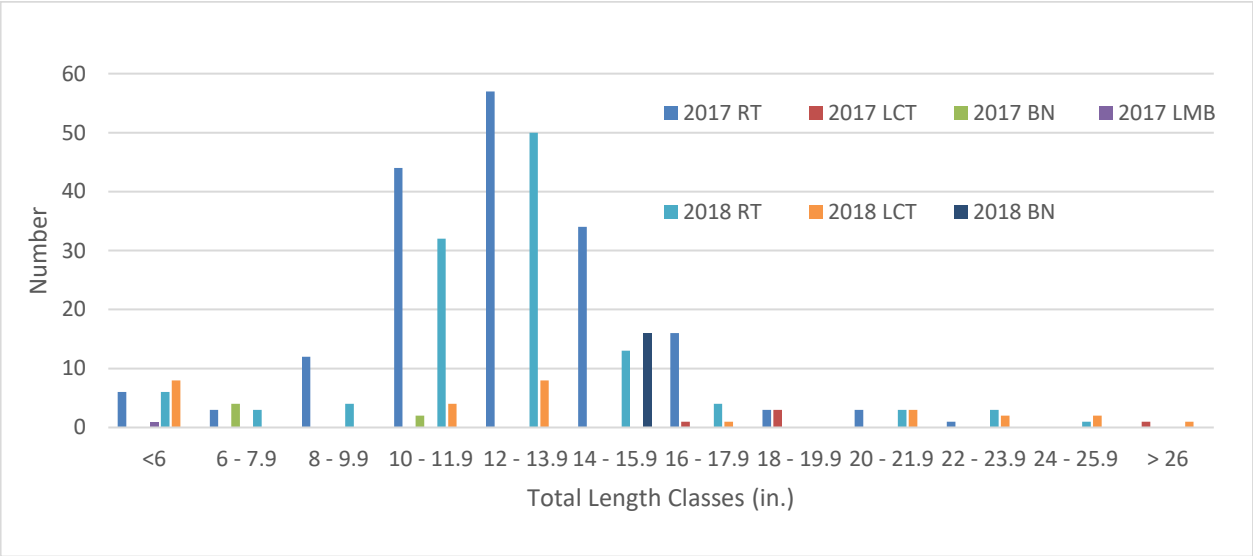

Figure 2. Frequency of identified fish in each size class that anglers reported landing at Indian Creek Reservoir in 2017 and 2018.

In 2018, anglers were satisfied with their overall angling experience for the second consecutive year (Tables 6). Anglers were satisfied with the size of fish over the entire eight-year sampling period, showing little variation across response years (Table 6). Anglers were satisfied with the number of fish caught in 2018 (0.41 average). This average was higher than both 2017 (0.38 average) and 2016 (0.00 average), but lower than 2015 and before.

Table 6. Angler satisfaction response averages for the Indian Creek Reservoir fishery from 2009, 2011-2013, and 2015 - 2018.

Year	Overall angling experience	Size of the fish	Number of fish
2009, 2011-2013	1.43	1.03	1.01
2015	0.66	0.94	0.76
2016	-0.30	1.05	0.00
2017	0.77	1.00	0.38
2018	0.64	1.00	0.41
Average	0.64	1.00	0.51

Discussion

The ICR ASB shows anglers catching over two fish per trip on average for a fourth consecutive year, likely considered successful for many anglers. The CPUE in 2018 was the highest in the last three years. However, the overall catch in 2018 continues to decrease since the ASBs were installed in 2015. The decrease in fish caught may be due to the decrease in respondents in 2018, since catch rates increased during this same time.

For a second consecutive year, the greatest number of RT caught were in the 12.0– 13.9 in. size class. This corresponds with anglers being satisfied with the size of their catch for an eighth consecutive sampling year. There may be a sustainable balance between number of fish and available resources in ICR, thus allowing trout in ICR to grow larger. Anglers were also satisfied with the number of fish caught in 2018. This is an increase from both 2017 and 2016, but down from 2015 and prior. There may be a difference in the feedback when anglers respond to CDFW staff during a creel survey and a voluntary written comment. This increase could have occurred because catchable RT were not stocked in 2016 by CDFW due to drought. RT were stocked again in 2017 and 2018.

More LCT were caught in 2018 than 2017 (Ewing 2018). This could be due to the large number of stocked LCT from 2016 – 2018. In recent years, CDFW has stocked broodstock (2lbs)

LCT from Heenan Lake (Alpine County) into ICR. However, prior to 2018, anglers did not report catching many of these larger fish. For example, only one LCT over 20 in. was reported caught in 2017, none in 2016, and only three in 2015. In 2018, eight LCT over 20 in. were caught. Some of these broodstock may have still been in spring spawning mode. During early spring and early summer of 2018, LCT gathered in large numbers by the inlet to ICR, which allowed shore anglers easier access to the congregating LCT (Figure 3). These consistent flows by the inlet may have contributed to angler catch success compared to the lack of flows during previous drought conditions.

Figure 3. An angler with LCT caught at ICR in 2018. (Photo courtesy of M. Mamola)

Because LCT were stocked during their spawning season, a portion of broodstock LCT could also be swimming downstream into the afterbay. LCT may exhibit some of the same behaviors as BN. A study found that the movement behavior of BN varies with fish size and life stage (Jonsson 1985; Huusko et al. 1990), and hatchery-reared, lake-run BN may show movement behavior similar to that of wild fish (Huusko et al. 1990). CDFW will continue to stock ICR with LCT broodstock in 2019. If the inlet at ICR continues to flow like the past two years, more of these trophy-sized LCT may become available for anglers. During drought years, the inlet flows minimally, which may cause LCT to go into the afterbay, which is on private property.

It is often difficult to manage a fishery to satisfy both high catch rates and large size of fish caught. This is because larger- size fish demand a greater amount of food than smaller-size fish. With a certain amount of available food, either the fishery can hold many, smaller-size fish or less, larger-size fish. ICR has provided both large fish and high catch rates over the eight years of this study. The longer growing season, large amounts of baitfish, and large allotments may be some of the reasons why ICR has been able to satisfy anglers in both numbers and sizes.

Anglers released most of the trout caught at ICR in 2018, both in terms of total number and percentage of captures, depending on species. Every year's ASB survey shows that LCT are being released at a higher percentage than RT. Anglers also continued to release a large percentage of fish species in general caught at ICR. In recent years, fishing clubs and many outdoor writers have promoted the idea of catch and release fishing. They argue that catching a fish is the most valuable component of the recreational fishing experience, and if fish are released unharmed, they might be available for recapture on a future fishing trip (Clark 1983). Mortal hook wounds in smaller fish may persuade some anglers in keeping smaller-sized fish rather than releasing them. Anglers may also release smaller fish in hopes of catching a larger fish to harvest. Alpine County stocks RT from a private aquaculturist in which the RT's meat is a pink color and has been an angler favorite according to Alpine County (T. Sadaro, Pers. Communication). It is possible that anglers like the taste of RT more than LCT, suggesting why more RT are harvested.

ICR also has a LMB population (Figure 4) where anglers have caught LMB over five pounds, but only one has been reported in the last two years. Factors influencing the yield of stocked salmonids include predation (Larsson 1985; Blackwell and Juanes 1998; Dieperink et al. 2001). It is possible that LMB could be predating on RT and LCT, especially the fingerling-sizes, but the actual percentage is unknown.

For a second consecutive year, shore angling was the most frequent method of angling. This may be a result of increased quality shoreline access after a record 2016/2017 and average to above-average 2017/2018 precipitation. ICR is a highly eutrophic reservoir that has large amounts of aquatic vegetation covering the water surface during the summer months. In 2016, vegetative cover may have impeded fishing success for shore anglers when compared to float tube anglers.

Figure 4. Angler with LMB caught at ICR. (Photo courtesy of M. Mamola)

In 2018, the overall fishing experience for anglers at ICR was positive for the third time in four years. It is possible the overall angling experience was positive in 2018 because both the number of fish and size of the fish had positive average values. Anglers have only had a negative average angling experience response once in eight years' of surveys. This suggests that the fishery has provided a satisfactory experience for a majority of the survey period.

The number of respondents in the 2018 survey was 56, which is a fair number for an ASB, but the lowest for ICR. There were a large number of nearby wildfires in California in 2018. The poor air quality in much of California, including Alpine County, may have persuaded some anglers to stay indoors rather than fish.

Recommendations

- Keep ASBs at ICR for one more year.
- Continue same stocking efforts for RT and LCT.

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