



**NEWCASTLE RESERVOIR
2020 TREND NET SURVEY**

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BACKGROUND: From the early 1980s to 2005, Newcastle Reservoir was managed as a two-tiered fishery comprised of trout and smallmouth bass. Golden shiners were illegally introduced in the early 1990s and trout growth and survival suffered while the shiner population increased. Several adjustments in the stocking quota of rainbow trout (RBT) were made during the 1990s and 2000s in an attempt to improve survival. Piscivorous Bear Lake cutthroat trout were also stocked from 1999 to 2007 in hopes that they would utilize golden shiners as forage, but poor survival made this stocking unsustainable. The challenges faced by trout in the presence of golden shiners were further exacerbated by the eutrophic nature of Newcastle Reservoir. During the drought period in the early 2000s, summer kills of trout occurred when anoxic conditions in the hypolimnion forced trout into the epilimnion where competition with shiners made survival difficult in water over 70° F in temperature.

While smallmouth bass utilized golden shiners as forage, the generally pelagic nature of shiners prevented smallmouth from being able to control their numbers. Beginning in 2005, hybrid wipers (white bass x striped bass) were introduced to Newcastle Reservoir with the intent that these pelagic predators would be more effective in controlling golden shiner abundance. Wipers showed exceptional survival and growth and have established a very popular fishery. Various adjustments to stocking rate have been made over time and the annual quota has been set most recently at 3,500 2-inch fish (Table 1). Due to statewide shortages in wiper production, the quota was not stocked in 2018 or 2019, and the 2020 request was reduced to 2,000.

Since 2009, the golden shiner population in the reservoir has been significantly reduced by wiper predation. RBT showed a positive response to reduced shiner numbers, with better survival and return to the angler creel. Prior to 2015, stocking quotas were maintained at 3,000 catchable-sized RBT in the spring and 15,000 sub-catchable fish in the fall. With the improved performance of RBT, the quotas were combined in 2015 to one annual stocking of 20,000 sub-catchable fish in fall (Table 2).

Beginning in 2007, annual trend net surveys were commenced at Newcastle to closely evaluate the early establishment of the wiper fishery. It was determined after the 2012 survey that biennial monitoring would be sufficient to monitor the population in the long term. Although a survey was conducted in 2018, the data were lost and no summary report was written that year.

METHODS: Four experimental gill nets (two floating and two diving) were set in Newcastle Reservoir on March 30, 2020, and were allowed fish overnight (Figure 1). All nets measured 6 ft x 80 ft, with eight panels of randomly-arranged mesh size (1.5", 2.25", 1", 0.75", 2.5", 1.25", 2"). Fish caught were removed from nets on the morning of March 31 and all fish were measured to the nearest mm (total length) and weighed to the nearest gram. Trout body condition was measured by the calculation of Fulton's K_{TL} (generated from total length [TL]):

$$K_{TL} = (Weight/Length^3) \times 100,000$$

Wiper body condition was measured by relative weight (W_r), given by:

$$W_r = (W/W_s) \times 100$$

where W = the weight of an individual fish and W_s = the standard weight for a fish of similar length. W_s is computed by the equation:

$$\log_{10}(W_s) = a + b(\log_{10}TL)$$

where *a* and *b* are constants defined by species-specific length-weight relationships (Anderson and Neumann 1996). Results of the 2020 survey were compared with those from historic trend net surveys.

RESULTS: RBT made up 68% of the net catch and 52% of the biomass of fish sampled at Newcastle Reservoir (Table 3, Fig. 2). A total of 100 RBT was collected, for a catch rate of 25 fish per net-night, the highest rate observed since 2006 (Table 4, Fig. 3). 64% of the RBT collected were stocked at 7.2 inches (182 mm) in fall 2019 (Fig. 4) and averaged 261 mm in total length (TL), 212 g in weight, with an average condition (K_{TL}) of 1.17 (Table 3). The 2019 cohort of RBT grew at a mean rate of 0.45 mm/day over the winter. Mean length, weight, and growth were similar to long-term means since the bulk of stocking shifted to the fall (Table 4), while condition was amongst the highest values observed (Fig. 5). The remainder of the RBT caught were stocked prior to 2019 (Fig. 4) and averaged 442 mm (17.4 in), 1,038 g (2.3 lbs), with an average K_{TL} of 1.17 (Table 3). All values were amongst the highest observed for older RBT in nearly 40 years of regular monitoring (Table 4) (weight was the highest ever observed by a wide margin) and reflected a significant contribution from larger cohorts typically not observed at Newcastle (Fig. 4). In most previous surveys RBT over 420 mm (16.5 in) in TL were found in low abundance, while 23% of the 2020 catch surpassed this mark. RBT ranged up to 527 mm (20.7 in) in length and up to 1,790 g (3.9 lbs) in weight (Fig. 2).

Thirty-five wipers were caught in 2020, for a catch rate of nine fish per net-night. This rate matched the long-term mean rate for AFS nets (2010-2020) (Table 4, Fig. 6), despite the absence of the 2018 and 2019 cohorts (Fig. 7, 8). Wipers averaged 446 mm TL (17.6 in), 1,330 g (2.9 lbs), with a mean relative weight (W_r) of 94 (Table 3). Mean length and weight were higher than long-term means, though slightly lower than values observed since 2012 (Table 4, Fig. 9). Relative weight was the highest observed since 2008. Wipers ranged in size up to 606 mm (24 in) and 3,210 g (7.1 lbs).

Twelve golden shiners were caught in the four nets, marking the first time they had been observed in a netting survey since 2010 (Fig. 10). Shiner catch has been much reduced since the introduction of wipers in 2005, while relative biomass of shiners has also been extremely low (Fig. 11).

DISCUSSION: Results of the 2020 trend net survey demonstrated that RBT continue to experience improved growth and survival since wipers were introduced to Newcastle Reservoir. Prior to this introduction, when golden shiners were abundant, survival beyond one year was fairly low for RBT. Previous surveys demonstrated that first-year RBT were experiencing exceptional condition and growth, which led to improved survival of older fish. This survival and growth was boosted even more by improved environmental conditions resulting from the exceptional snowpack of 2018-19, yielding not only exceptional survival of the 2019 cohort (Fig. 3), but also a much greater contribution to the fishery from larger RBT cohorts (Fig. 4). The length distribution observed at Newcastle in 2020 was very similar to those observed in Minersville and Otter Creek reservoirs, which are considered two of the highest quality RBT fisheries in the state.

The gill net design recommended by AFS and employed in surveys at most southern region waters since 2010 has generally been found to yield trout catch rates about 50% of the design previously used by DWR for decades. The AFS net catch rate at Newcastle Reservoir has been higher than that 50%, while annual variance in catch rate has been lower (Table 4, Fig. 3).

This time period (2010-20) also corresponds to a period of improved trout survival due to reduced shiner concentration, which likely explains the higher than expected long-term mean rate for the newer net design.

Wiper catch rate has fluctuated slightly during recent netting surveys (Fig. 6), though it is expected that it will eventually stabilize at a lower level than was observed in the initial years of wiper stocking. Variations in stocking have likely led to the changes in trend net catch rate. After the reduction in golden shiner density in the early 2010s (Fig. 10), wipers shifted their primary diet to crayfish. This shift appeared to also lead to a decrease in mean condition (relative weight) (Fig. 9), though growth rates have still been sufficient to produce trophy-sized wipers. The increase in golden shiners noted in 2020 likely resulted from higher water level and an extended period of flooded vegetation in 2019. The 2020 increase of relative weight in wipers also signals increased shiner predation. Large schools of golden shiner fry were observed in Newcastle Reservoir during summer 2020, further demonstrating that shiner abundance has increased since 2019. It is recommended that the annual wiper quota be increased again to 3,500 to ensure that golden shiner density can be controlled. The current RBT population shows that Newcastle Reservoir can sustain multiple high quality fisheries (trout, wiper, smallmouth bass) if golden shiners can be kept in check.

RECOMMENDATIONS:

1. Maintain current stocking rate of rainbow trout (20,000 7-inch fish in the fall). Stock 3,500 2-inch wipers annually.
2. Conduct trend nets surveys on alternate years to monitor trout and wipers.
3. Conduct electrofishing surveys on alternate years to monitor smallmouth bass.
4. Analyze scales from both wipers and smallmouth bass for age and growth.

LITERATURE CITED

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques: second edition. American Fisheries Society, Bethesda, Maryland.

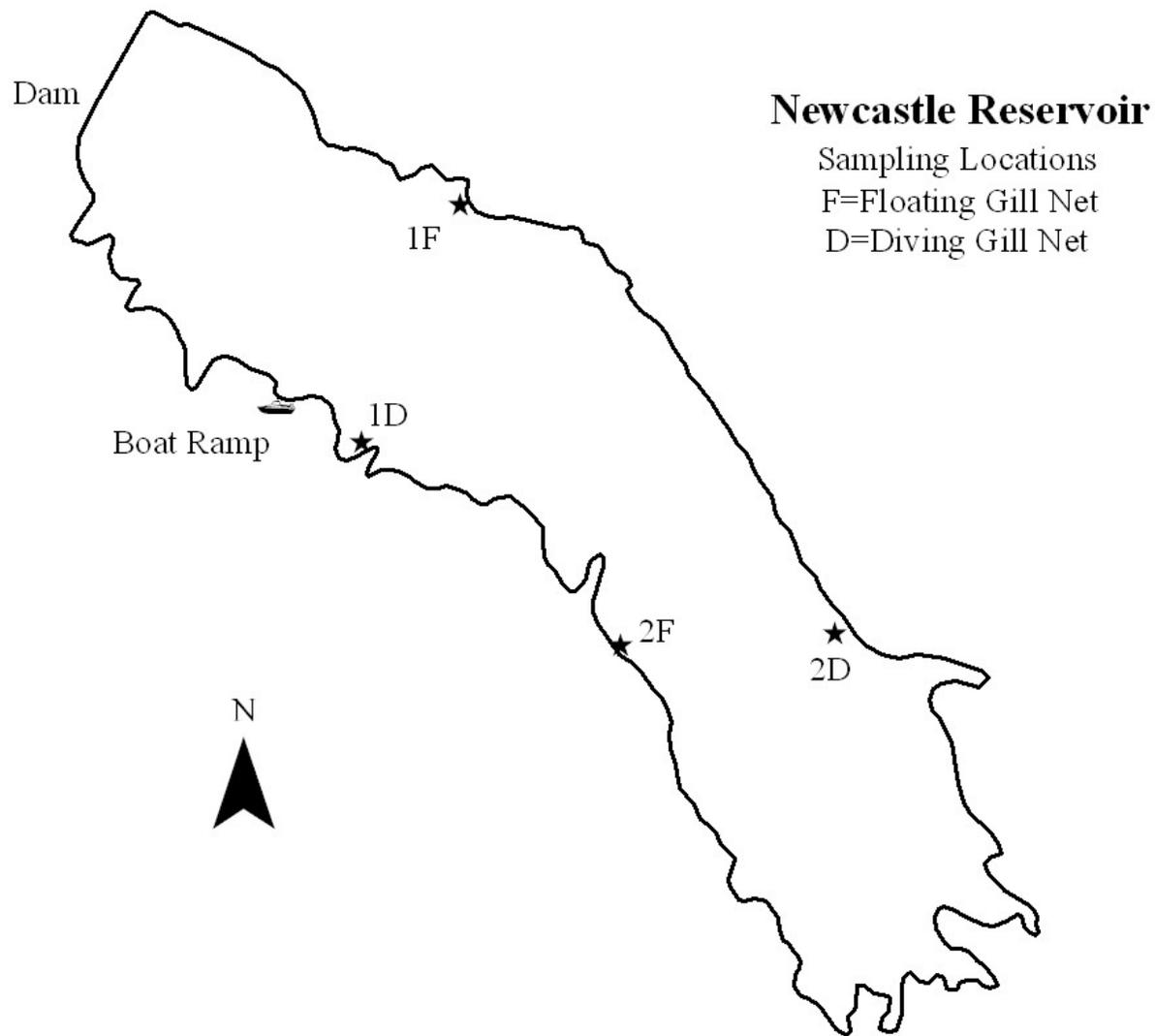


Figure 1. Locations of gill nets set at Newcastle Reservoir during the 2020 trend net survey.



Figure 2. Rainbow trout collected at Newcastle Reservoir on March 31, 2020.

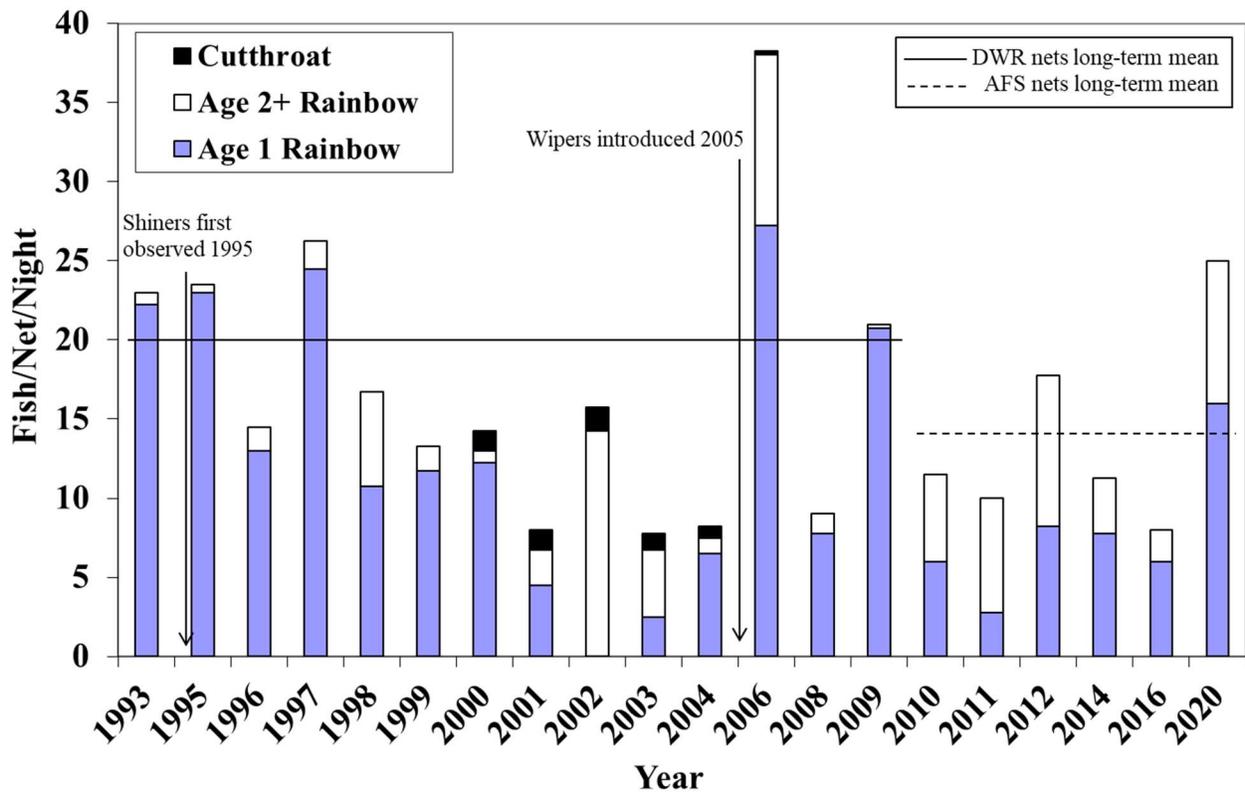


Figure 3. Trout catch rate during trend net surveys at Newcastle Reservoir, 1993-2020.

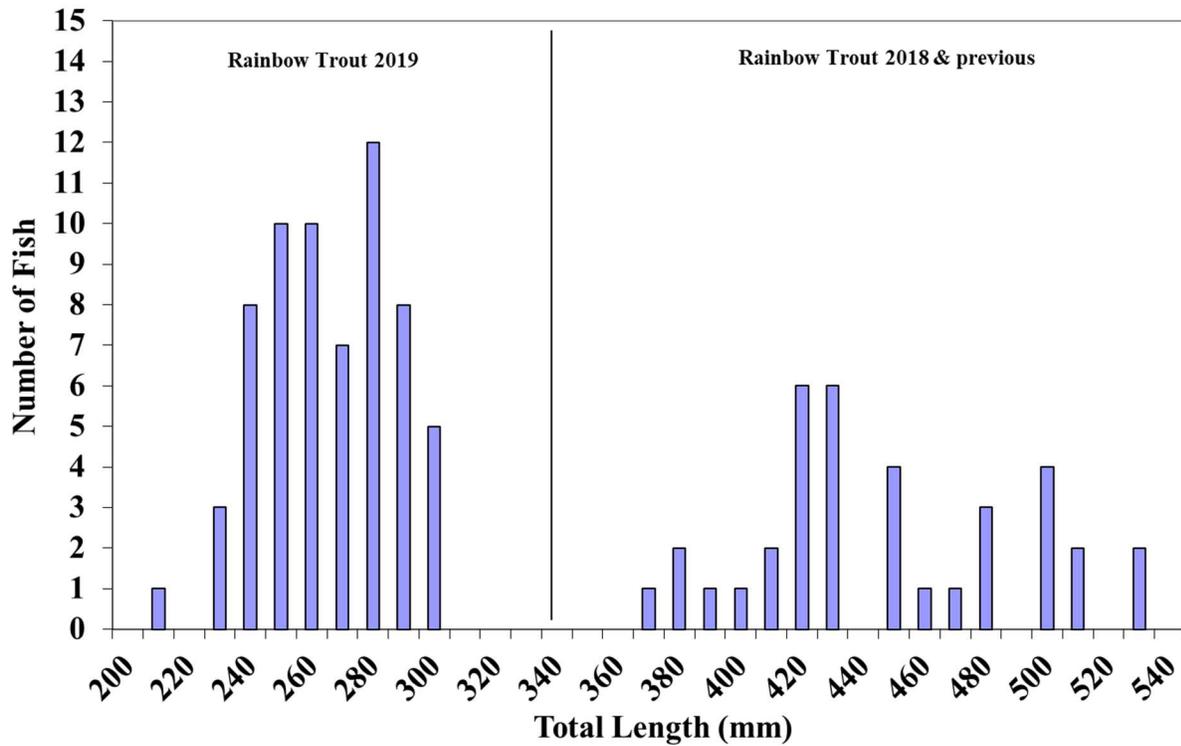


Figure 4. Length distribution of rainbow trout collected at Newcastle Reservoir on March 31, 2020.

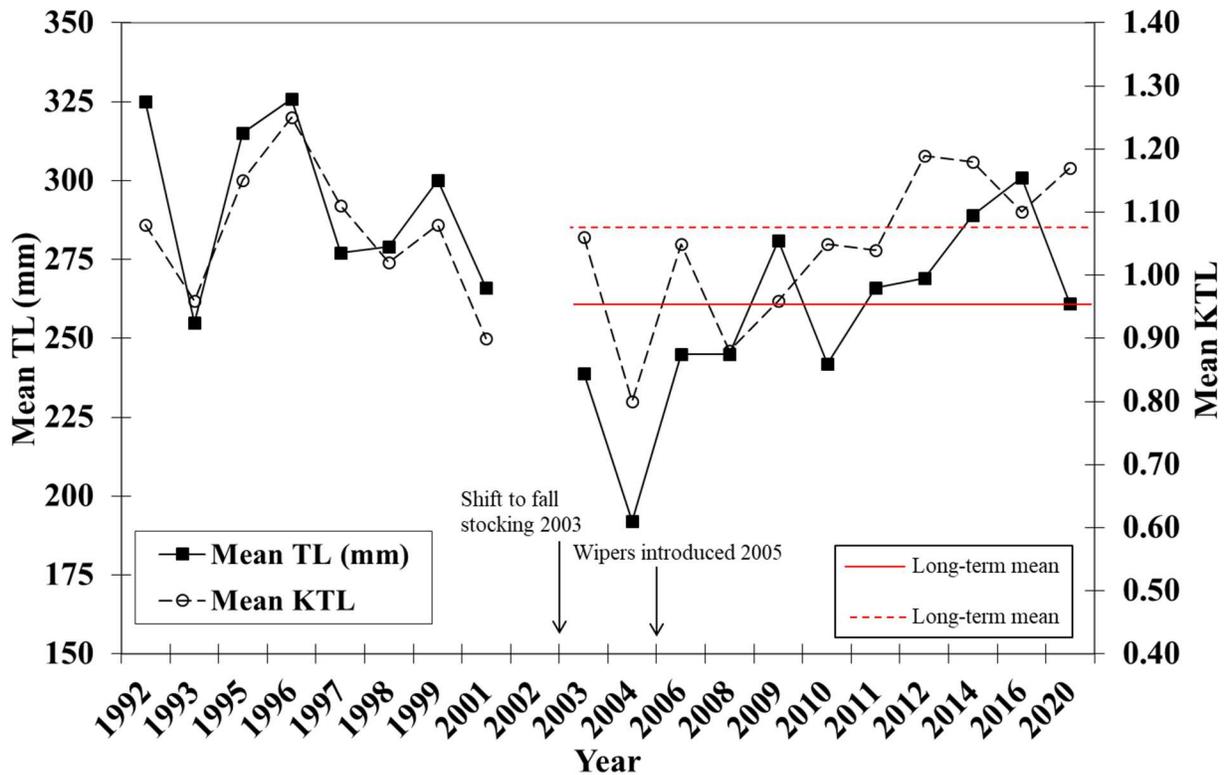


Figure 5. Mean total length (mm) and condition (K_{TL}) of rainbow trout stocked the previous year and collected during trend net surveys at Newcastle Reservoir, 1992-2020.

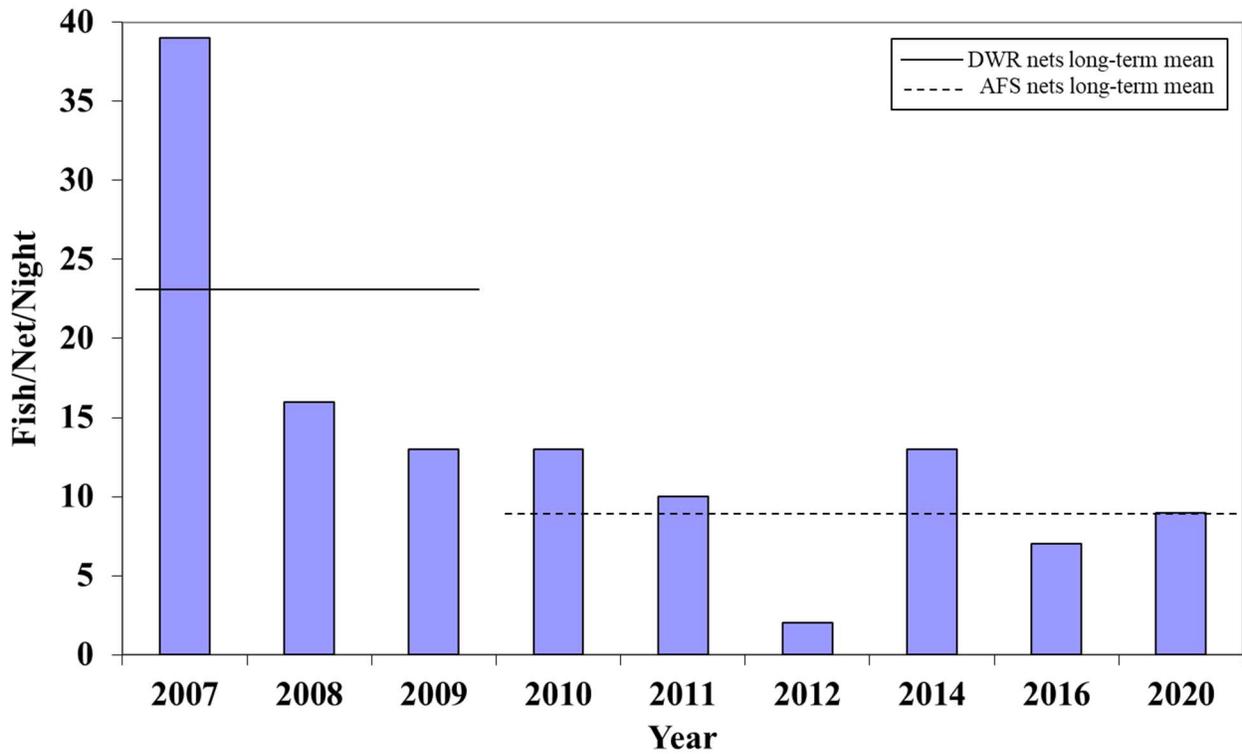


Figure 6. Wiper catch rate during trend net surveys at Newcastle Reservoir, 2007-2020.

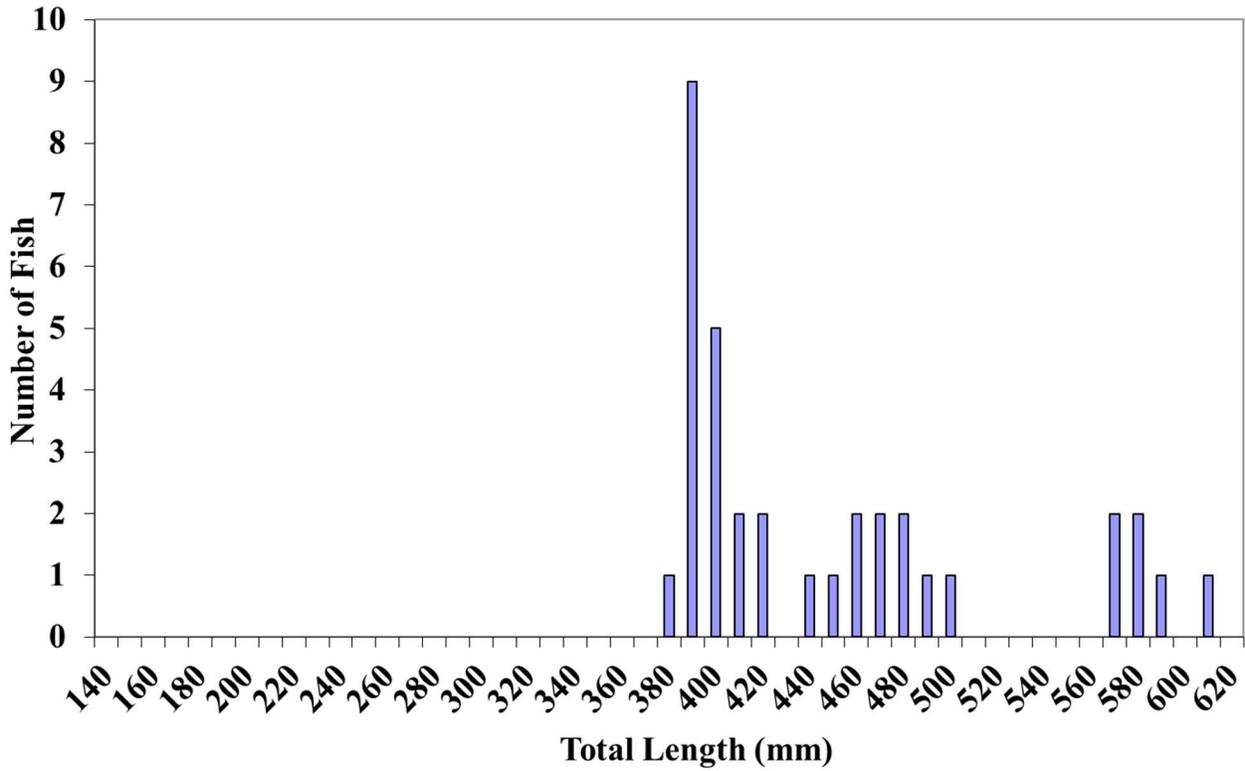


Figure 7. Length distribution of wipers collected at Newcastle Reservoir on March 31, 2020.



Figure 8. Wipers collected at Newcastle Reservoir on March 31, 2020.

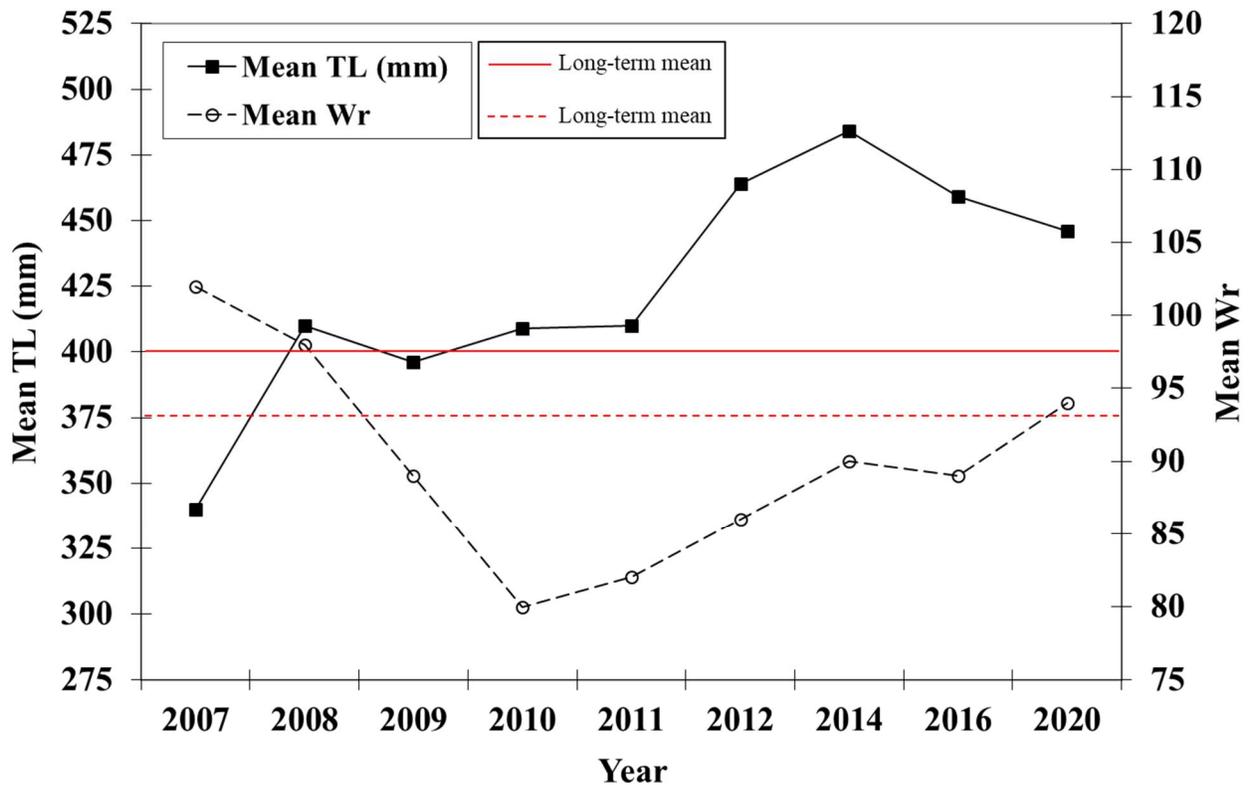


Figure 9. Mean total length (mm) and relative weight (W_r) of wipers collected during trend net surveys at Newcastle Reservoir, 2007-2020.

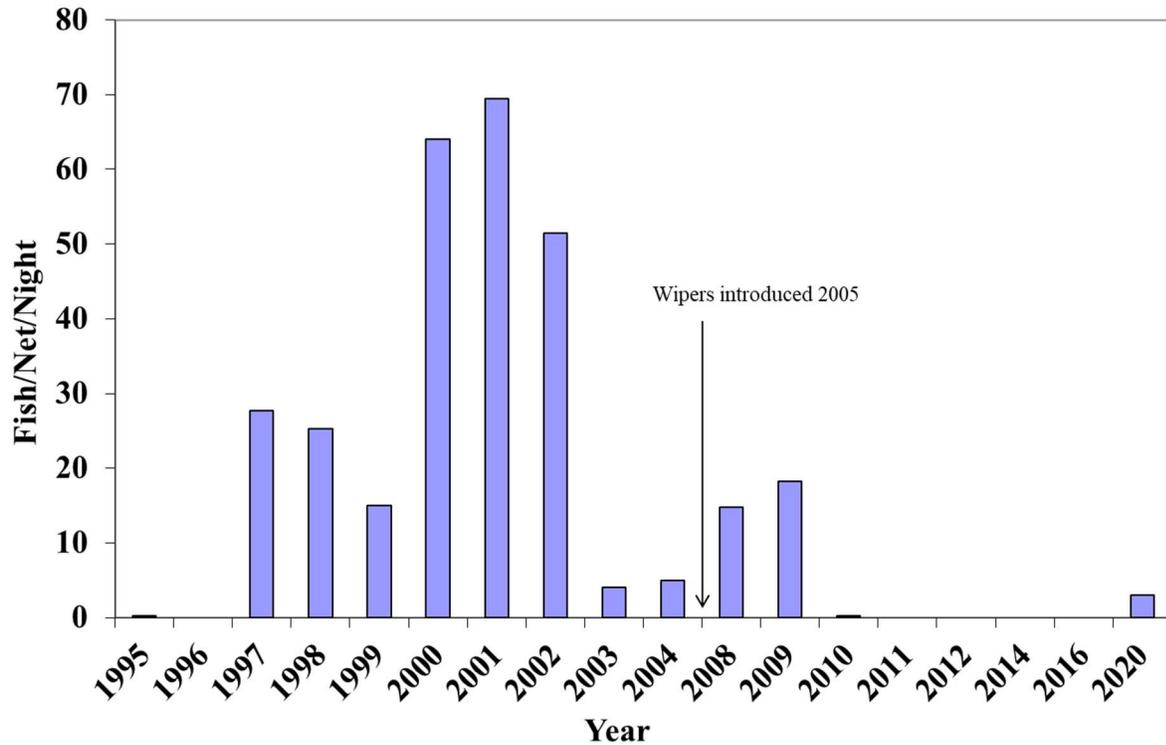


Figure 10. Golden shiner catch rate during trend net surveys at Newcastle Reservoir, 1995-2020.

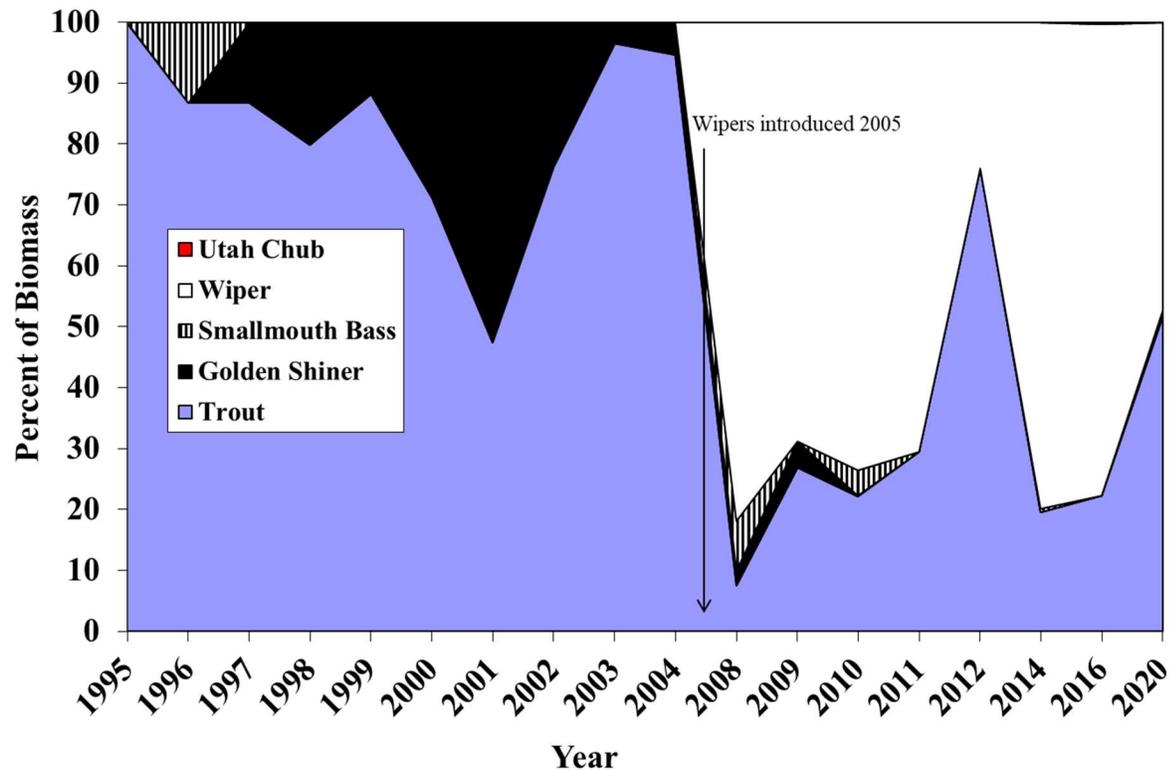


Figure 10. Relative biomass of fish species collected during trend net surveys at Newcastle Reservoir, 1995-2020 (period of golden shiner presence). Note: Smallmouth bass are occasionally sampled in trend surveys, but were not generally weighed prior to 2008.

Table 1. Record of wiper stocking in Newcastle Reservoir for the five years prior to the 2020 trend net survey.

<u>Year</u>	<u>Number Stocked</u>	<u>Size (in)</u>
2015	3,500	1.7
2016	4,007	1.5
2017	3,501	2.1
2018	---	---
2019	---	---
<i>2020</i>	<i>2,000</i>	<i>2.0</i>
<i>Quota</i>		

Table 2. Record of rainbow trout stocking in Newcastle Reservoir for the five years prior to the 2020 trend net survey.

<u>Year</u>	<u>Number</u>	<u>Size (in)</u>	<u>Timing</u>
2015	20,528	7.8	Oct
2016	20,422	7.6	Sep
2017	18,506	7.4	Oct
2018	1,512 ^a	9.4	Aug
	20,257	7.1	Oct
2019	25,606	7.2	Oct
<i>2020</i>	<i>20,000</i>	<i>7.0</i>	<i>Oct</i>
<i>Quota</i>			

^a – Excess.

Table 4. Trend net survey results at Newcastle Reservoir, 1976-2009.

Date	Net Sets		Total Trout	Trout per Net-Night	Rainbow Trout Stocked 2 years +			Rainbow Trout Stocked previous year				Wiper per Net-Night	Wiper All sizes			Total Nongame per Net-Night	Comments
	Flo	Div			Mean TL (mm)	Mean W (g)	Mean Ktl	Mean TL (mm)	Mean W (g)	Mean Ktl	Growth (mm/day)		Mean TL (mm)	Mean W (g)	Mean Wr		
14-Apr-76	1	0	48	48													
26-Apr-77	1	1	54	27													
25-Apr-78	1	1	17	9													
30-Apr-79	1	1	12	6													
29-Apr-80	1	1	61	31													Res drained Fall 1980
22-Apr-81	2	1	4	1													
6-Apr-82	1	1	69	35													
1-Apr-83	2	0	24	12													
12-Apr-84	2	1	103	34	280	204	0.92	212	95	0.98	0.48						
16-Apr-85	2	1	79	26	315	307	0.98	264	201	1.08	0.49						
4-Apr-86	2	0	55	28	374	577	1.09	235	152	1.10	0.42						3rd Yr after reduced quota
21-Apr-87	3	0	96	32	405	635	0.97	305	294	1.04	0.58						
30-Mar-88	2	1	55	18	389	618	1.05	317	373	1.17	0.63						
14-Apr-89	2	2	111	28	399	577	0.89	281	255	1.13	0.42						
5-Apr-90	2	1	19	6	460	742	1.17	323	396	1.15	0.59						
9-Apr-91	2	1	73	24	360	530	1.13	316	377	1.19	0.54						
2-Apr-92	2	2	109	27	426	731	0.94	325	370	1.08	0.60						
6-Apr-93	2	2	92	23	396	542	0.87	255	163	0.96	0.37						
5-Apr-94	2	2						323	387	1.14	0.63						Algae in nets
20-Mar-95	2	2	94	24	422	778	1.04	315	360	1.15	0.61					0.25	
4-Apr-96	1	1	29	15	402	732	1.13	326	473	1.25	0.62					0	
8-Apr-97	2	2	105	26	417	812	1.02	277	238	1.11	0.44					27.75	
15-Apr-98	2	2	67	17	354	511	1.12	279	227	1.02	0.48					25.25	
9-Apr-99	2	2	53	13	405	827	1.24	300	303	1.08	0.52					15	
4-Apr-00	2	2	57	14												64	RBT cohorts indistinguishable
4-Apr-01	2	2	32	8	331	376	0.99	266	179	0.90	0.40					69.5	
9-Apr-02	2	2	63	16	343	524	1.20									51.5	
3-Apr-03	2	2	31	8	381	604	0.99	239	148	1.06	0.34					4	
13-Apr-04	2	2	33	8	325	402	1.01	192	58	0.80	0.20					5	Wipers introduced 2005
31-Mar-06	2	2	153	38	344	485	1.16	245	160	1.05	0.43					abundant	Shiners not counted
24-May-07	3	1										39	340	587	102		Wiper netting in May
1-Apr-08	2	2	36	9	356	513	1.06	245	131	0.88	0.20	16	410	1106	98	15	
1-Apr-09	2	2	84	21				281	215	0.96	0.48	13	396	914	89	18	

Table 4. Trend net survey results at Newcastle Reservoir, 2010-2020.

Date	Net Sets		Total Trout	Trout per Net-Night	Rainbow Trout Stocked 2 years +			Rainbow Trout Stocked previous year				Wiper per Net-Night	Wiper All sizes			Total Nongame per Net-Night	Comments	
	Flo	Div			Mean TL (mm)	Mean W (g)	Mean Ktl	Mean TL (mm)	Mean W (g)	Mean Ktl	Growth (mm/day)		Mean TL (mm)	Mean W (g)	Mean Wr			
23-Mar-10	2	2	46	12	361	432	0.91	242	150	1.05	0.39	13	409	870	80	1	start using AFS nets	
30-Mar-11	2	2	40	10	336	419	1.07	266	198	1.04	0.48	10	410	858	82	0		
21-Mar-12	2	2	71	18	391	673	1.12	269	235	1.19	0.41	2	464	1315	86	0		
26-Mar-14	2	2	45	11	418	815	1.11	289	286	1.18	0.55	13	484	1591	90	0		
31-Mar-16	2	2	32	8	408	655	0.97	301	304	1.10	0.59	7	459	1549	89	0.25	1 Utah chub	
31-Mar-20	2	2	100	25	442	1038	1.17	261	212	1.17	0.45	9	446	1330	94	3	Golden shiners	
Long-term mean				19	358	519	1.05	276	244	1.08	*	14	400	971	93	17		
Fall stocking, 2004 to present								259	193	1.05	0.43							
AFS nets (2010-present)				14				AFS nets (2010-present)				9	Since wiper intro (2005)			5		
DWR nets (before 2010)				20				DWR nets (before 2010)				23	Before wipers			26		

* -- 1984-2003 (spring stocking) -- 0.49 mm/day