PANGUITCH LAKE
2022 TREND NET SURVEY

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BACKGROUND: Panguitch Lake is a natural lake, enlarged by a dam, and has been one of southern Utah's most popular trout fisheries since the late 1800s. The lake sits at 8,200 feet in elevation and covers 1,234 acres, with a maximum depth of 66 feet. Much of the land surrounding the lake is managed by the Dixie National Forest (DNF) and the area supports three DNF campgrounds, several private marinas/resorts, and a general store. Private cabins are also abundant in the area. Panguitch Lake is highly valued both by local anglers and by nonresidents (especially those from southern Nevada), who account for nearly 50% of the anglers surveyed during creel surveys (Hepworth et al. 2009, Braithwaite et al. 2020).

Basaltic geology gives Panguitch Lake a naturally high productivity, which produces exceptional growth among stocked trout. Additional nutrient input from upstream sources, including from livestock grazing, stream bank erosion, and cabin septic systems, has often negatively impacted water quality in Panguitch Lake. This additional input has yielded summer algae blooms, including harmful blue-green algae (cyanobacteria), as well as limited, localized winterkill attributed to low oxygen.

The most consistent threat to the Panguitch Lake trout fishery throughout its history has been the introduction of Utah chubs which, although native to the Sevier River, were not present in the lake prior to 1900. Since introduction, Utah chubs have consistently expanded to high density, competing with stocked trout – primarily rainbow trout (RBT) – for space and food, leading to extremely poor growth and survival by trout. The traditional solution to this problem was treatment of the lake with the piscicide rotenone and reestablishment of the trout fishery. This practice, conducted in 1956, 1973, and 1991, produced positive results for many years after a treatment. However, chubs eventually reestablished, either due to incomplete removal or illegal reintroduction, and negatively impacted the trout fishery again.

Utah chubs reached high density in the early 2000s, comprising over 90% of the fish biomass in Panguitch Lake by 2004. Survival by stocked trout was minimal and growth was nonexistent. New management strategies – including the addition of Bear Lake cutthroat trout (BLCT) and tiger trout (TG) as chub predators, increases in size and quantity of stocked trout, and reduced harvest limits – were unsuccessful in improving the trout fishery. It was clear that the fishery needed significant adjustment and the Utah Division of Wildlife Resources (DWR) attempted a new strategy, recruiting an advisory committee to aid in crafting a new management plan for Panguitch Lake. The committee was comprised of anglers, local business owners, and representatives from DNF, Panguitch City, the Utah Wildlife Board, and the Southern Region Advisory Council (RAC). The committee proposed a new plan (Panguitch Lake Advisory Committee 2005) that included treatment of the lake to eradicate, or at least significantly reduce, Utah chubs. BLCT and TG would be stocked and protected by restrictive harvest limits, in order to establish and maintain a population of predators that could control Utah chub density if/when they returned. RBT would continue to provide a family-friendly, harvestable fishery.

The management plan also recommended four measurable objectives that would allow DWR to monitor the Panguitch Lake fishery and evaluate the success of management actions:

1. Maintain an average catch rate of 50 trout per net-night in annual trend net surveys.
2. Maintain at least 10% of RBT captured in annual trend net surveys as 2-yr-old or older fish (at least 15 inches in length).
3. Increase predator trout (BLCT and TG) to 25% of the total catch in annual trend net surveys.
4. Produce mean angler catch rates of at least 0.5 trout per hour, as measured during angler (i.e. creel) surveys.

DWR accepted the plan recommended by the advisory committee and Panguitch Lake was treated with rotenone in May 2006. Trout stocking began immediately and the sport fishery rebounded rapidly, producing exceptional survival and growth. Harvest limits enacted in 2006 – trout limit 4, all trout between 15 and 22 inches must be immediately released – had to be modified after a few years because RBT grew more rapidly than expected and most fish caught by anglers had to be released. Since 2009, the harvest limit at Panguitch Lake has been:

- Limit 4 trout (a combined total).
- No more than 2 may be cutthroat or tiger trout under 15 inches, and no more than 1 may be a cutthroat or tiger trout over 22 inches.
- All cutthroat and tiger trout from 15 to 22 inches must be immediately released.

RBT are not included in the harvest length restriction and, therefore, more available to anglers that prefer to harvest.

Annual stocking rates have been adjusted occasionally at Panguitch Lake since 2006, but now stand at 120,000 eight-inch RBT (split equally between spring and fall), 25,000 eight-inch BLCT, and 20,000 three-inch TG (Table 1). Excess trout produced by hatcheries have also been occasionally stocked – including all three requested species, as well as brook trout. Excess RBT and TG stocked in 2018 experienced exceptional survival due to improved water levels in 2019, resulting in increased abundance in subsequent years.

The greatest challenge faced by the Panguitch Lake trout fishery during the last 15 years stemmed from the malfunction of the dam outlet in 2011. Despite a high snowpack, the lake drained nearly to the natural level (about 50% capacity) before a coffer dam could be built and the outlet repaired. The ensuing drought years prevented the lake from filling and it maintained between 40% and 60% of capacity until 2019. BLCT and TG generally survived well during the low water levels, though RBT were often less abundant than had been observed previously. Water quality issues were exacerbated by the low water, with algae and cyanobacteria blooms prevalent, and small-scale winterkill occasionally observed. The winter of 2018-19 finally produced a snowpack sufficient to fill Panguitch Lake and trout abundance – as measured by trend net catch rate – has improved remarkably in the ensuing years.

Utah chubs were not documented in Panguitch Lake for more than 10 years after the 2006 rotenone treatment. Though secondhand reports of chubs were received occasionally, none could be positively corroborated. The first confirmed catch of Utah chubs occurred during the 2020 spring trend net survey. Chubs have been consistently observed during the netting surveys since 2020, though the catch rate has remained extremely low (<3 chubs per net-night). The 14-year gap between chub sightings makes it unlikely that some were missed during the 2006 treatment, and it is assumed that they were reintroduced illegally. Utah chubs persisted in Panguitch Creek below the lake and, while they could not bypass the dam into the lake, the close proximity provided a vector for assisted reintroduction.

METHODS: Four experimental gill nets (two floating and two diving) were set in Panguitch Lake on May 2, 2022, and were allowed to fish overnight. Nets measured 6 ft x 125 ft, with five panels of increasing mesh size (0.75”, 1”, 1.25”, 1.5”, 2”) and were set at shoreline locations that have been generally consistent for more than 30 years of sampling (Figure 1). Fish caught were removed from nets on the morning of May 3, measured to the nearest millimeter (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]):

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

Results of the 2022 survey were compared with those from historic trend net surveys.

RESULTS: The four nets set in Panguitch Lake caught a total of 341 trout on May 3, 2022, for a catch rate of 85 trout per net-night (Table 2). This rate was much higher than the long-term mean (56 per net-night) and the management plan objective (50 per net-night), and continued a trend of high trout catch observed since 2019 (Table 3, Fig. 2). Trout made up 97% of the total net catch and 99% of the total biomass collected (Table 2).

RBT were the most prevalent species in the trend net catch (57% total catch) (Table 2) and spanned several size classes (Fig. 3). RBT averaged 330 mm (13.0 in) in total length (TL), 422 g (0.9 lb) in weight, with a mean condition (K_{TL}) of 1.12. RBT ranged in size up to 530 mm (20.9 in) and 1,283 g (2.8 lb). 19% of RBT observed exceeded 15 inches (380 mm) in length, well above the management plan objective of 10% (Fig. 4). TG made up 23% of the catch and averaged 451 mm (17.8 in), 893 g (2.0 lb), with a mean K_{TL} of 0.88. TG spanned the most size classes (Fig. 5), up to 756 mm (29.8 in) and 4,200 g (9.3 lb) (title page). BLCT made up 15% of the catch and averaged 371 mm (14.6 in), 487 g (1.1 lb), with a mean K_{TL} of 0.93. BLCT ranged in size up to 515 mm (20.3 in) and 1,002 g (2.2 lb). Combined, TG and BLCT accounted for 38% of the total net catch, also well above the management plan objective of 25% (Fig. 6). Two brook trout made up the remainder of the trout catch (Table 2).

Ten Utah chubs were collected in the 2022 Panguitch Lake survey, for a catch rate of 2.5 fish per net-night. This was similar to the low chub catches observed since 2020 (Table 3). In 2022, the chub catch spanned three to four cohorts (145-255 mm) (Fig. 7).

DISCUSSION: Trout abundance, as measured by trend net catch rate, has been consistently high since Panguitch Lake refilled in 2019 (Fig. 2). The increases in RBT and TG catch are attributed to both improved survival due to the high water level, as well as stocking of excess fish in 2018 (Table 1). The excess stocking of TG likely had a longer-lasting effect on abundance (Fig. 5), since they are more long-lived and less harvested than RBT. BLCT, on the other hand, have been less abundant since 2019 (Fig. 2). It is unclear why BLCT trend net catch has been lower, whether it is due to a real decrease in abundance or just a change in behavior that yielded poorer catch efficiency. (Anecdotal fishing reports from 2019 to 2021 corroborated the lower net catch of BLCT.) Catch of predators in trend net surveys has maintained at an acceptable level since 2019 (Fig. 2), though this has been accomplished thanks to the excess stocking of TG in 2018. The reappearance of Utah chubs in Panguitch Lake makes maintenance of a predator population vital to the future sustainability of the trout fishery. Accordingly, the requested BLCT quota will be increased from 25,000 to 35,000 in 2024. The performance of excess TG stocked in 2018, as well as their popularity among anglers, indicate that increased stocking of TG would also be acceptable, whether through excess lots or an increased quota.

The Panguitch Lake management plan has been deemed successful, as gauged by the results of surveys in comparison to plan objectives. Trout catch rate in trend net surveys from 2007 to 2022 (16 surveys) averaged 56 trout per net-night and failed to achieve the objective of 50 trout per net-night only six times (Fig. 2). (Four of these occurred during the low-water years between 2011 and 2018.) Percent of RBT exceeding 15 inches in length averaged 31%, more than three times the objective of 10%, and failed to achieve the objective only once, in 2019 (Fig. 4). (This shortcoming was attributed to an exceptionally high catch of younger RBT in 2019, rather than to a reduced catch in larger fish. An extra 51,000 RBT were stocked in 2018.) Percent of predators (BLCT and TG) in the trout catch averaged 37% and failed to achieve the objective of 25% only three times (Fig. 6). (Two of those instances, 2019 and 2021, are at least partially attributed to high RBT catches since the refilling of the lake in 2019.) Angler catch rate just

missed the objective of 0.5 trout per hour in 2008 (Hepworth et al. 2009), but well surpassed it to 0.88 trout per hour in 2019 (Braithwaite et al. 2020). In addition, Utah chubs were absent from the trend net catch from 2007 to 2019. Since their confirmed return in 2020, chub catch rate has remained very low – less than 3 chubs per net-night, compared to the pre-treatment mean of 243 per net-night (Table 3). Fishery management plans often benefit from a full review and adjustment after about 10 years. Due to the current performance of the Panguitch Lake fishery, such a review is not recommended at this time. More time is required to observe the dynamics of Utah chub and predator abundance. If this balance changes to a negative direction in the future, reconvening a committee and revising the management plan will be beneficial.

The Brian Head Fire burned over 70,000 acres across the Markagunt Plateau in summer 2017, including much of the Panguitch Lake watershed. Bunker, Deer, and Clear Creeks experienced significant flooding after the fire. Ash flow from these streams dropped out quickly when it reached the lake and no significant effects to the trout fishery were observed in the lake, despite the ongoing low water level in 2017. Continued erosion in the headwater tributaries does pose a risk to the fishery, however, through the potential addition of nutrients to the already eutrophic lake. Water quality will likely be the greatest challenge to the Panguitch Lake fishery in the future. Activities that could mitigate nutrient loading – including stream bank stabilization, grazing practice changes, and alteration of the outlet to shunt accumulating nutrients downstream – may be expensive, complex, and potentially unpopular politically, but will also provide the best opportunity to maintain a healthy trout fishery in the future.

RECOMMENDATIONS:

1. Maintain requested stocking quotas of rainbow trout, Bear Lake cutthroat trout (increase approved for 2024), and tiger trout at Panguitch Lake. Continue stocking of excess trout when available and reasonable.
2. Conduct trend net surveys annually in the spring to monitor trout and Utah chubs. Set four nets (2 floating and 2 diving) of the "DWR" design (6 x 125 ft, five graduated panels).
3. Investigate opportunities to mitigate nutrient loading in Panguitch Lake (stream channel work in burned tributaries, responsible grazing management, alteration of dam outlet).

LITERATURE CITED

Braithwaite, N. R., M. J. Hadley, and R. D. Hepworth. 2020. 2019 Panguitch Lake trend netting and angler survey. Utah Department of Natural Resources, Division of Wildlife Resources, Cedar City.

Hepworth, R. D., J. Warner, M. J. Ottenbacher, and M. J. Hadley. 2009. Panguitch Lake: an evaluation of the sport fishery management plan. Publication 09-04. Utah Department of Natural Resources, Division of Wildlife Resources, Salt Lake City.

Panguitch Lake Advisory Committee. 2005. Panguitch Lake sport fishery management plan. Utah Department of Natural Resources, Division of Wildlife Resources, Cedar City.

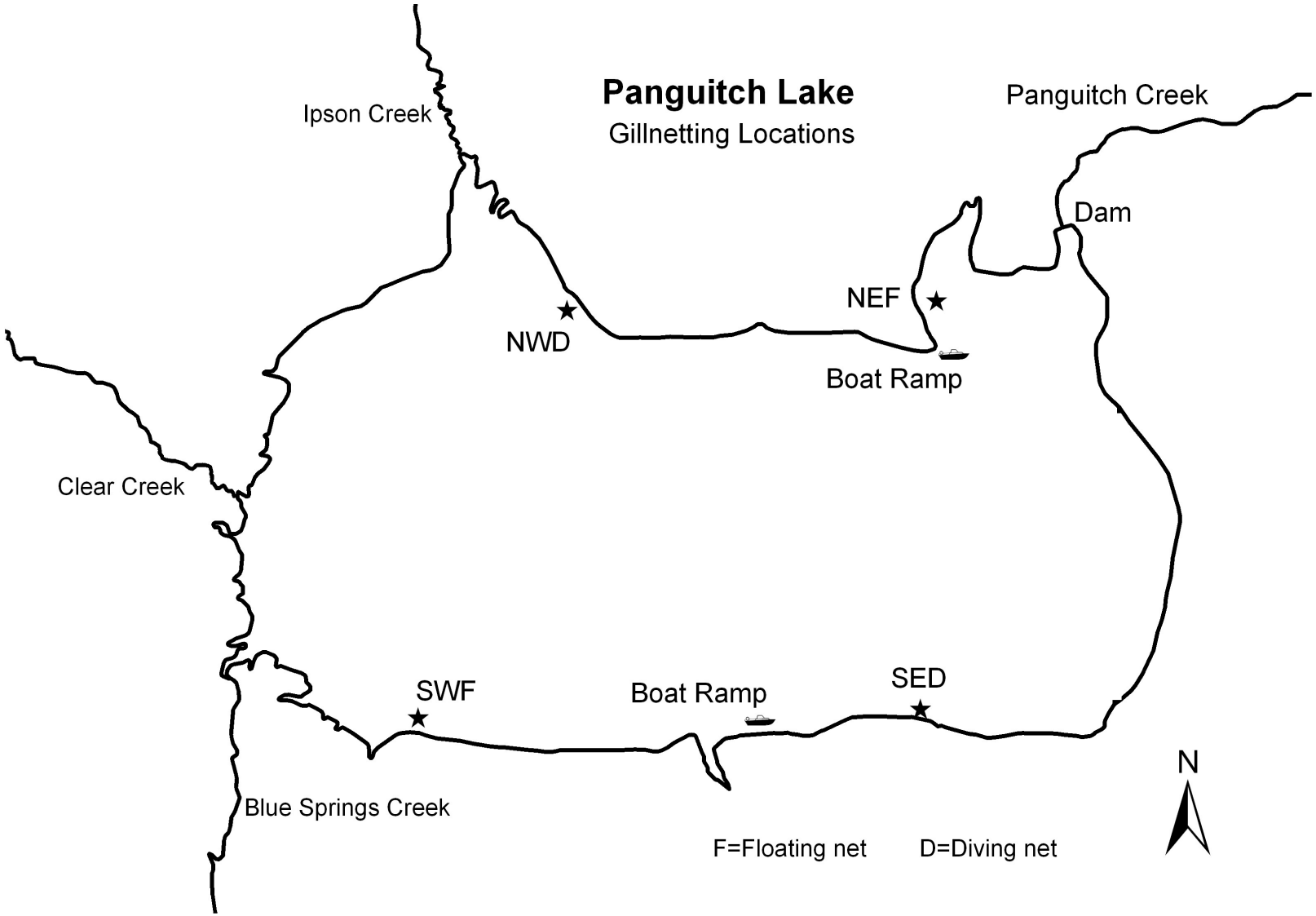

Figure 1. Locations of gill nets set at Panguitch Lake during the 2022 trend net survey.

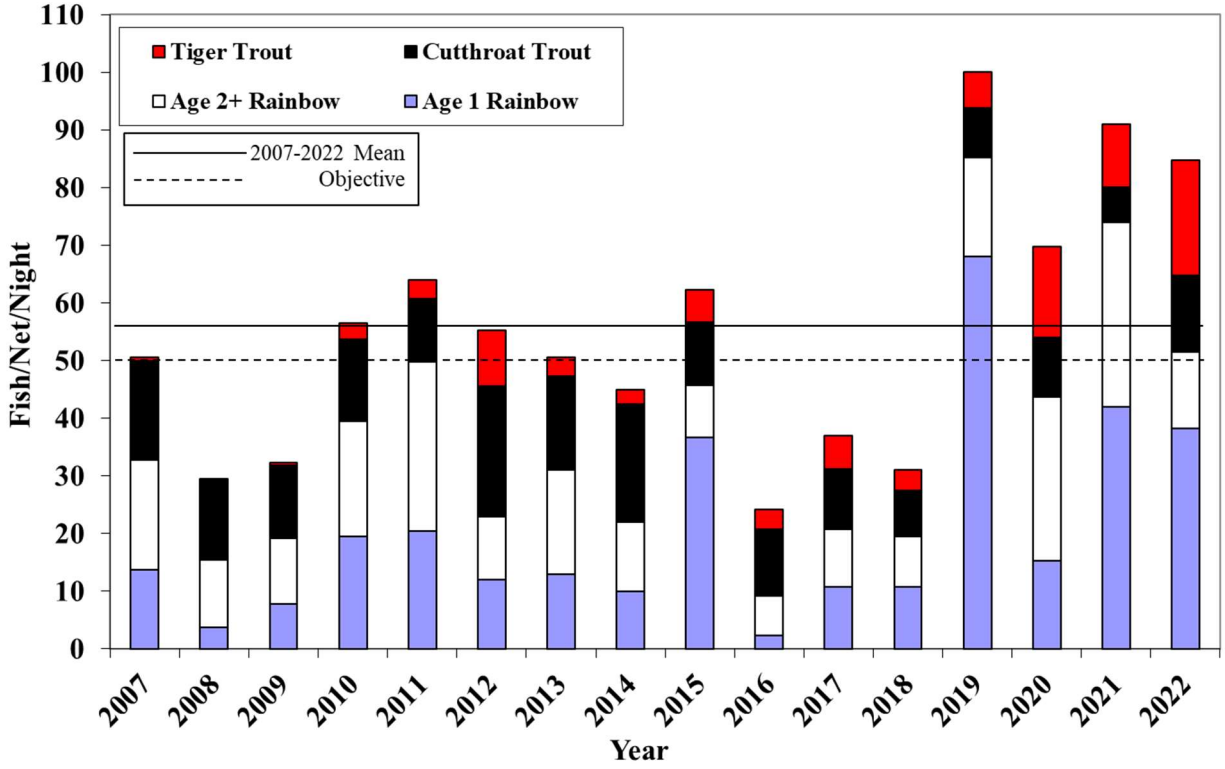

Figure 2. Trout catch rate during trend net surveys at Panguitch Lake, 2007-2022.

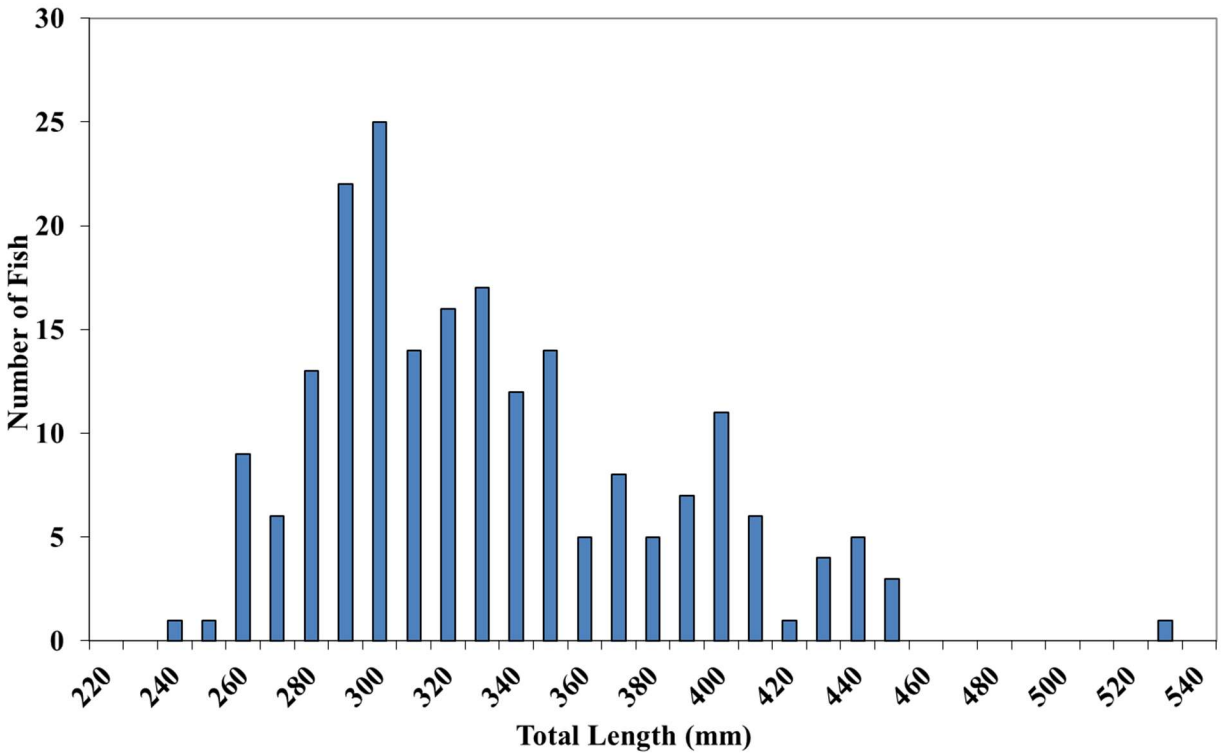

Figure 3. Length distribution of rainbow trout collected at Panguitch Lake on May 3, 2022.

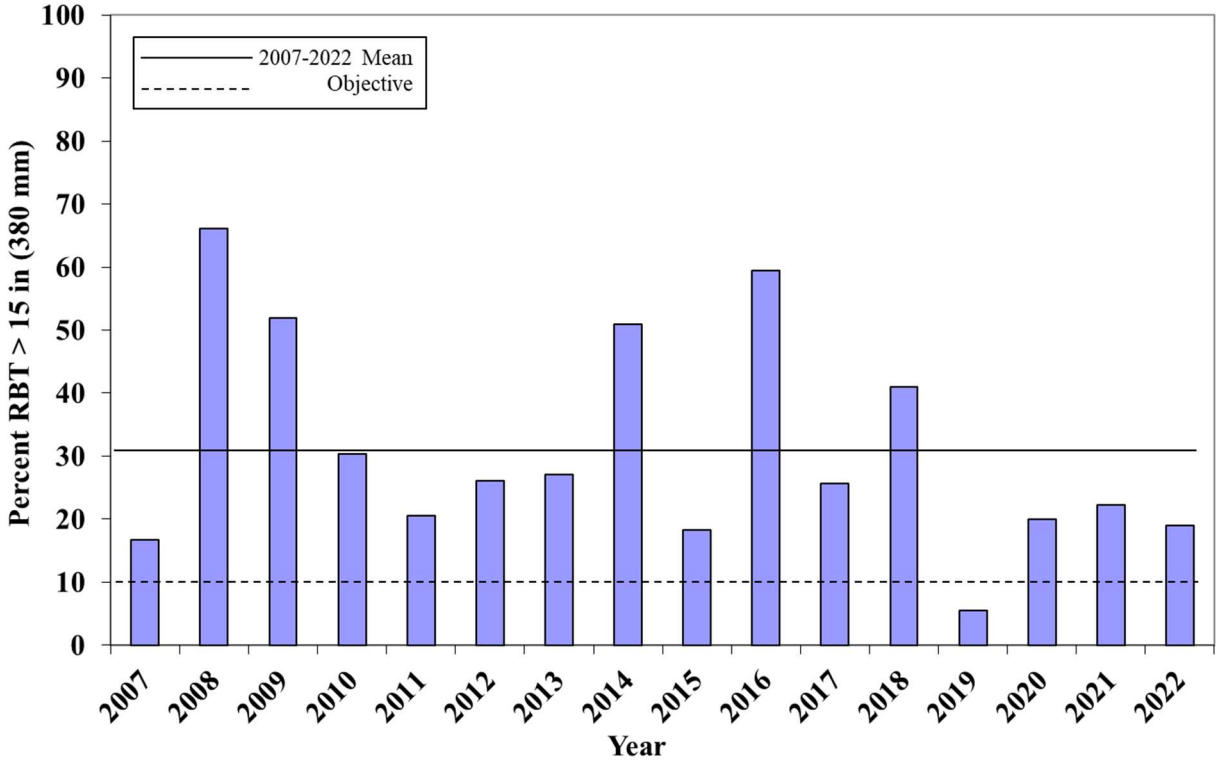

Figure 4. Percent of rainbow trout collected in trend net surveys at Panguitch Lake, 2007-2022, which exceeded 15 inches (380 mm) in total length.

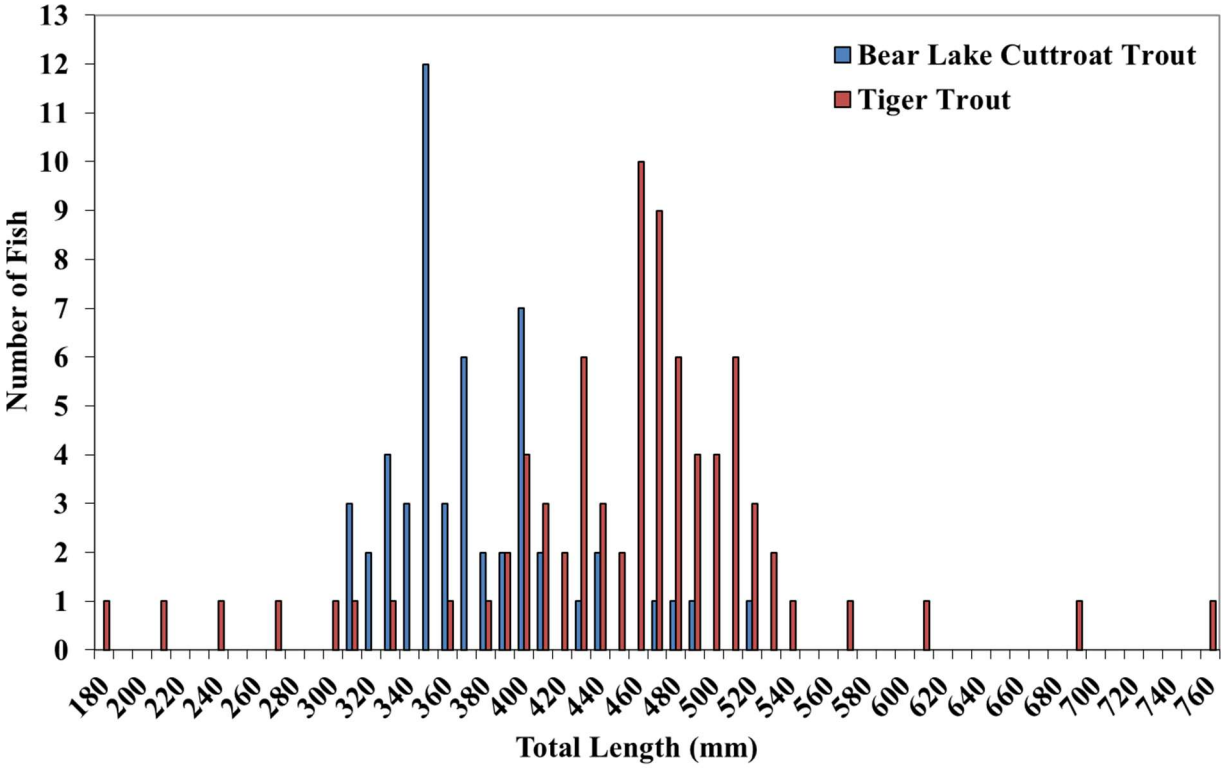

Figure 5. Length distribution of Bear Lake cutthroat and tiger trout collected at Panguitch Lake on May 3, 2022.

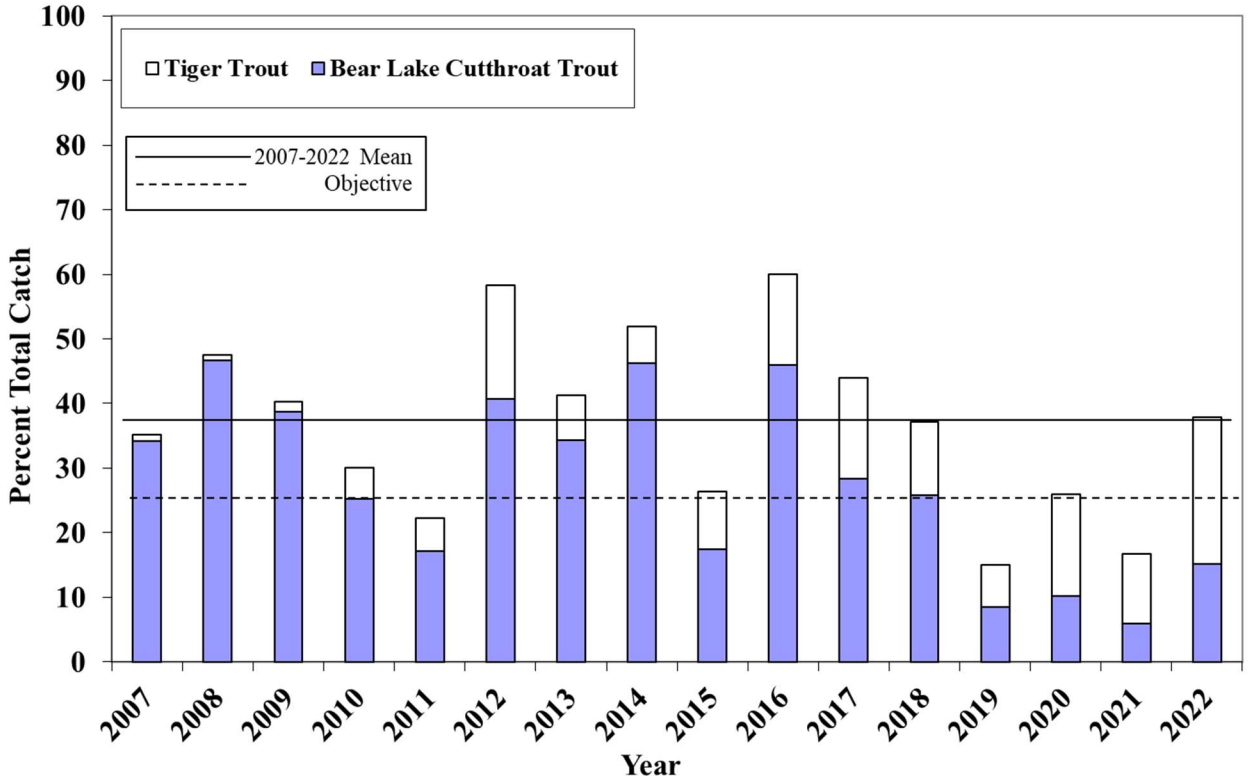

Figure 6. Percent of trend net survey catch at Panguitch Lake comprised of predators (Bear Lake cutthroat and tiger trout), 2007-2022.

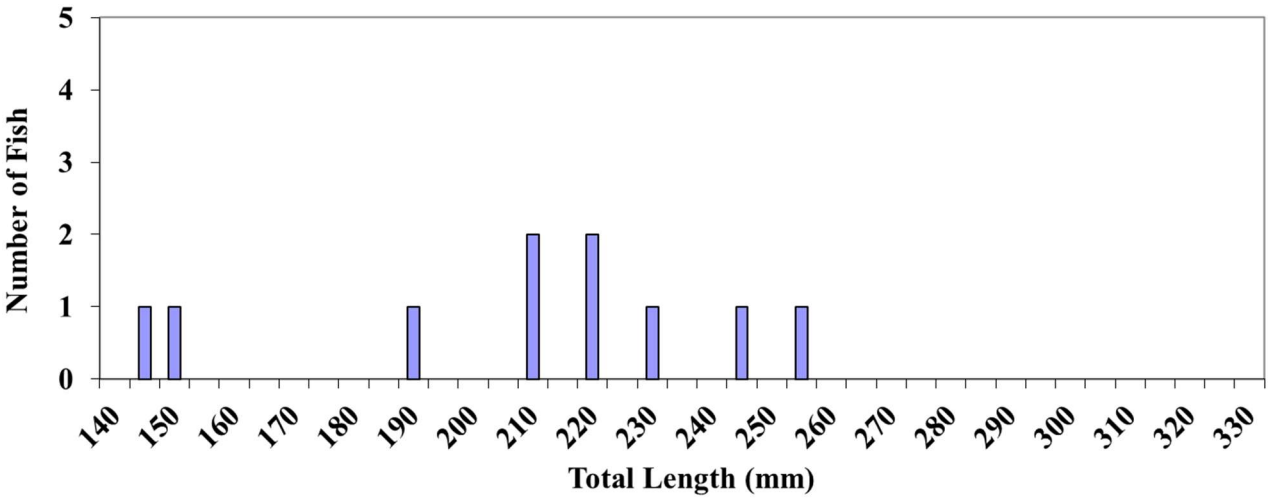

Figure 7. Length distribution of Utah chubs collected at Panguitch Lake on May 3, 2022.

Table 1. Record of trout stocking in Panguitch Lake for the five years prior to the 2022 trend net survey. Bold text identifies the regularly scheduled annual quota.

	Rainbow Trout			Cutthroat Trout		Tiger Trout		Total Excess			
Year	Number	Size (in)	Timing	Number	Size (in)	Number	Size (in)	Rainbow	Cutthroat	Tiger	Brook
2017	1,750 **124,469**	10.4 6.7	Summer Fall	**25,000**	8.2	**19,996**	3.6	1,750	---	---	---
2018	**49,014** **65,265** 51,313 122[a]	8.9 8.3 7.0 12-20	Spring Fall Fall Winter	**24,990** 5,001	7.0 7.2	**19,353** 8,265 10,005	2.9 2.1 7.0	51,435	5,001	18,270	6,690
2019	**58,752** **61,803** 36[a]	9.3 8.3 13.3	Spring Fall Winter	**26,445**	6.1	**17,010**	2.8	36	---	---	3,787
2020	**60,000** **62,658**	9.0 8.7	Spring Fall	**27,390**	8.6	**20,106**	2.3	---	---	---	---
2021	**64,653** **60,481** 8,705	7.2 9.4 3.2	Spring Fall Summer	**25,615** 625	8.6 10.4	**15,000** **11,010**	3.3 2.6	8,705	625	---	5,100
2022 *Quota*	*60,000* *60,000*	*8.0* *8.0*	*Spring* *Fall*	*25,000*	*8.0*	*20,000*	*3.0*	---	---	---	---

[a] – Brood tagged and stocked for Panguitch City ice fishing contest.

Table 2. Summary of the results from the 2022 trend net survey at Panguitch Lake.

Water:	Panguitch Lake					**Catalog #:**	VI 336										
Date Set:	5/2/2022	**Time:**				**Weather:**											
Date Pulled:	5/3/2022	**Time:**				**Water Temp:**											
# Nets:	DWR design - 2 Floaters, 2 Divers					**Collectors:**	M. Hadley, M. Roundy, N. Braithwaite, T. Whitesell, D. Brown										

Summary for Trout

		Total	fish per	Total Length (mm)			Weight (g)			Condition (Ktl)			% total	% total	% total	% trout
Species	**N**	**Weight (kg)**	**net/night**	**Mean**	**SE**	**Range**	**Mean**	**SE**	**Range**	**Mean**	**SE**	**Range**	**catch**	**biomass**	**trout**	**biomass**
Rainbow Trout	206	86.89	51.50	330	3.50	231-530	422	13.0	137-1283	1.12	0.01	0.80-1.41	56.69	46.50	60.41	46.81
Bear L Cutt. Trout	53	25.81	13.25	371	6.38	310-515	487	22.8	275-1002	0.93	0.01	0.73-1.16	15.10	13.81	15.54	13.91
Tiger Trout	80	71.42	20.00	451	9.55	175-756	893	61.9	48-4200	0.88	0.01	0.71-1.15	22.79	38.22	23.46	38.48
Brook Trout	2	1.50	0.50	420	5.00	415-425	748	66.0	682-814	1.01	0.05	0.95-1.06	0.57	0.80	0.59	0.81
RBT 2021	153	50.62	38.25	305	2.17	231-360	331	6.74	137-543	1.14	0.01	0.80-1.41	43.59	27.09	44.87	27.27
RBT 2020 & Prev	53	36.27	13.25	401	4.31	360-530	684	20.5	479-1283	1.06	0.02	0.82-1.39	15.10	19.41	15.54	19.54
Trout	341	186.85	85.25	365	4.21	175-756	544	19.9	48-4200	1.03	0.01	0.71-1.41	97.15	99.34	---	---

Summary for Non-Sport Fish

		Total	fish per	% total	% total	TL (mm)
Species	**N**	**Weight (kg)**	**net/night**	**catch**	**biomass**	**Range**
Utah Chub	10	1.23	2.50	2.85	0.66	145-255

Table 3. Trend net survey results at Panguitch Lake, 1974-2005.

					Rainbow trout			Rainbow trout			Cutthroat Trout			Tiger Trout				
				Trout	stocked 2 yrs. or more			stocked previous year			all ages			all ages			Chub	
	Nets Set		Total	per	Mean TL	Mean W	Mean	Mean TL	Mean W	Mean	Mean TL	Mean W	Mean	Mean TL	Mean W	Mean	per	
Date	Flo	Div	Trout	net-night	(mm)	(g)	Ktl	(mm)	(g)	Ktl	(mm)	(g)	Ktl	(mm)	(g)	Ktl	net-night	Comments
7-May-74	1	1	69	35													0	Treated 1973
20-May-75	1	0	108	108													0	
13-May-76	1	1	114	57													0	
3-May-77	1	1	39	20													0	
3-May-78	1	2	65	22													0	
14-May-79	2	1	78	26													0	
19-May-80	2	1	51	17													0	
12-May-81	2	1	112	37													0	
12-May-82	1	2	220	73													11	
17-May-84	2	1	381	127	360	480	0.99	263	202	1.08	336	369	0.92				350	
1-May-85	2	1	325	108	340	385	1.03	278	221	1.02	371	480	0.92				685	
8-May-86	2	1	130	43	371	473	0.93	317	342	1.08	377	514	0.98				200	
7-May-87	3	0	189	63	390	551	0.93	291	261	1.04	353	417	0.89				462	
6-May-88	2	0	105	53	362	496	1.04	314	337	1.08	325	338	0.91				35	
5-May-89	3	0	108	36	416	769		319	383	1.22	403	654	0.99				200	
10-May-90	3	0	45	15	460	933		334	438		382	598	0.98				372	
6-May-91	3	0	92	31	410	680	0.98	279	223	1.01	369	471	0.86				350	
7-May-92	3	2	234	47				197	84	1.08							18	Treated Fall 1991
11-May-93	3	1	184	46	343	477	1.16	254	190	1.13							7	1 Brook trout
11-May-94	3	1	180	45	448	1019	1.13	343	493	1.22							54	7 Brook trout
16-May-95	3	1	275	69	420	774	1.03	303	319	1.14							192	4 Brook, 1 Cutt
15-May-96	3	1	314	79	388	631	1.06	312	342	1.12	324	325	0.95				183	6 Ctt, 1 Brook
13-May-97	2	1	90	30	387	628	1.07	312	354	1.16	350	416	0.94				137	10 Ctt, 3 Brook
21-May-98	3	1	228	57	373	540	1.05	307	336	1.16	364	471	0.91				189	32 Ctt, 2 Brook
4-May-99	1	1	48	24				306	318	1.1	349	514	0.93				95	4 CT, 1 BK; Algae problem
24-Apr-00	3	1	130	33	397	703	1.13	337	452	1.16	371	532	0.93				859	47 CT, 3 Brook
5-May-01	4	0	172	43	417	833	1.14	312	325	1.06	425	773	0.92				489	20 CT, 7 BK
30-Apr-02	4	0	192	48				309	339	1.14	370	511	0.89				222	12 CT, 1 BK
29-Apr-03	4	0	86	22	405	749	1.12	258	195	1.1	464	1051	0.96				949	10 CT
5-May-04	4	0	18	5	408	709	1.04	335	377	1							520	1 CT
17-May-05	4	0	50	13				311	308	1.02	336	425	0.94				940	9 CT

Table 3 (contd.). Trend net survey results at Panguitch Lake, 2007-2022.

					Rainbow trout			Rainbow trout			Cutthroat Trout			Tiger Trout				
				Trout	stocked 2 yrs. or more			stocked previous year			all ages			all ages			Chub	
	Nets Set		Total	per	Mean TL	Mean W	Mean	Mean TL	Mean W	Mean	Mean TL	Mean W	Mean	Mean TL	Mean W	Mean	per	
Date	Flo	Div	Trout	net-night	(mm)	(g)	Ktl	(mm)	(g)	Ktl	(mm)	(g)	Ktl	(mm)	(g)	Ktl	net-night	Comments
8-May-07	2	2	202	51	375	670	1.26	334	481	1.28	358	489	1.05	210	72	0.78	0	Treated Spring 2006
6-May-08	2	2	118	30	435	972	1.16	237	173	1.14	446	859	0.95	195	70	0.94	0	
12-May-09	2	2	129	32	437	1111	1.29	223	125	1.06	442	1042	0.98	358	530	1.08	0	
11-May-10	2	2	226	57	393	743	1.18	244	168	1.13	406	685	0.93	284	357	0.96	0	
19-May-11	2	2	256	64	372	576	1.09	267	199	1.01	431	765	0.89	408	702	0.88	0	Outlet malfunction
8-May-12	2	2	221	55	388	716	1.20	242	176	1.17	431	793	0.96	371	626	0.96	0	
7-May-13	2	2	202	51	378	602	1.08	286	240	1.00	415	658	0.84	461	1033	0.94	0	
6-May-14	1	1	90	45	397	736	1.16	302	323	1.17	409	651	0.88	489	1067	0.89	0	
28-Apr-15	2	1	190	63	416	825	1.13	283	234	1.03	441	769	0.88	391	743	0.96	0	
3-May-16	2	2	100	25	417	817	1.12	278	226	1.04	475	978	0.89	476	1262	0.91	0	
9-May-17	2	2	148	37	394	706	1.13	290	296	1.19	452	861	0.90	412	779	0.94	0	
1-May-18	2	2	124	31	435	965	1.16	284	246	1.06	436	800	0.95	479	1074	0.96	0	
7-May-19	2	2	401	100	367	564	1.10	252	194	1.17	439	794	0.91	415	836	0.94	0	Full and spilling
9-May-20	2	2	283	71	372	582	1.11	263	216	1.15	402	596	0.89	305	386	0.95	2	
4-May-21	2	2	368	92	390	639	1.06	272	217	1.05	414	679	0.88	428	848	0.95	0.25	
3-May-22	2	2	341	85	401	684	1.06	305	331	1.14	371	487	0.93	451	893	0.88	3	
Long-term mean since 2007				56	391	698	1.13	272	237	1.12	420	737	0.93	401	752	0.93	0.30	
	Long-term mean			49										Long-term mean prior to 2007			243	