



Lynx Lake Fisheries Management Plan 2019 – 2029

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Date: 6/6/19

Location

Lynx Lake is located in Game Management Unit 20A within the Prescott National Forest in the Bradshaw Mountains, Yavapai County at an elevation of 5,530 feet above mean sea level. The lake is approximately 75 miles north of Phoenix, and approximately 4 miles southeast of the city of Prescott (Figure 1).

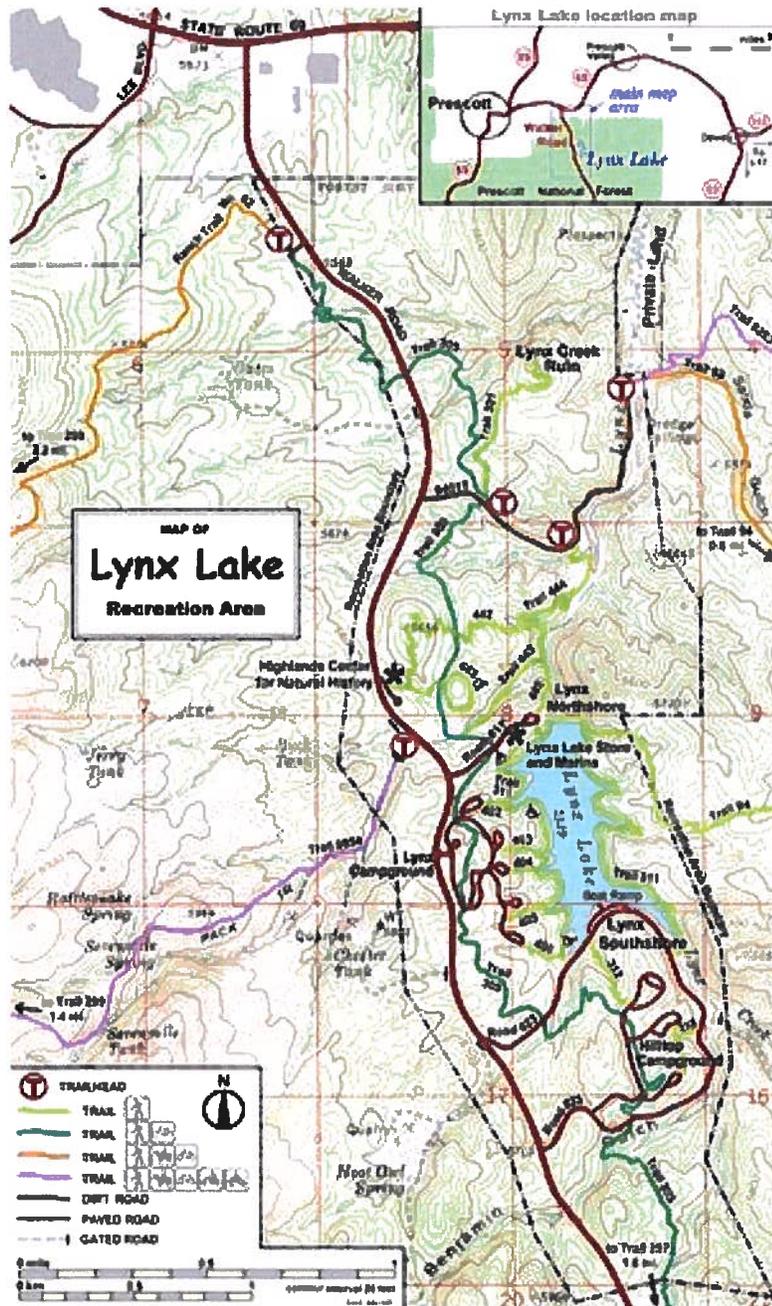


Figure 1. Location Map of Lynx Lake.

Management Prescription

Lynx Lake is a 55 surface-acre impoundment of Lynx Creek (Fig. 1). Fisheries management at Lynx does not focus on a single species but instead on well-rounded fish populations that provide multiple species opportunities for all anglers. This includes an Intensive Use concept per the Coldwater Vision document (AGFD 2019a) for Rainbow Trout *Oncorhynchus mykiss* and a General Opportunity concept fishery per the Warmwater Vision document (AGDF 2019b) for both Channel Catfish *Ictalurus punctatus* fishery and Largemouth Bass *Micropterus salmoides* during the summer months. Management strategies to meet objectives are identified in Table 1.

Objective 1: Maintain an Intensive Use Rainbow Trout fishery during months where water quality allow.

Objective 2: Maintain an Intensive Use concept warmwater fishery for Channel Catfish using stockings of catchable sized fish.

Objective 3: Maintain a General Opportunity concept warmwater fishery for Largemouth Bass with periodic stockings, supplementing limited reproduction and growth.

Objective 4: Maintain a level of at least 80% of the anglers interviewed on Lynx Lake during creel census rate the fishing as fair, good, or excellent.

Table 1. Lynx Lake Objectives and Adaptive Management Strategies:

Objective 1: Maintain an Intensive Use Rainbow Trout fishery during months where water quality allows.			
Parameters	Objective Guideline	Trigger point to address unmet Objectives	Strategies if Objectives are Unmet
Angler Catch Rates	Maintain an angler catch rate of 0.5 fish/hour.	Catch rates drop below 0.5 fish/hour during creel surveys.	<ul style="list-style-type: none"> • Increase number and species of trout stocked to meet demand. • Increase frequency of stocking. • Implement changes in daily bag limit. • Pursue actions to improve oxygen and general water quality to allow stockings throughout the year.

Objective 2: Maintain an Intensive Use concept warmwater fishery for Channel Catfish using stockings of catchable sized fish.

Parameters	Objective Guideline	Trigger point to address unmet Objectives	Strategies if Objectives are Unmet
Angler Catch Rates	Maintain an angler catch rate of 0.5 fish/hour.	Catch rates drop below 0.5 fish/hour during creel surveys.	<ul style="list-style-type: none"> • Increase number of catfish stocked to meet demand. • Increase frequency of stocking. • Implement changes in daily bag limit. • Increase the amount of artificial habitat.

Objective 3: Maintain a General Opportunity Largemouth Bass fishery.

Population Structure	Maintain a ≥ 50 fish/hour electrofishing of Largemouth Bass.	Two consecutive sampling events showing the population below management guidelines.	<ul style="list-style-type: none"> • Implement changes in daily bag limits for Largemouth Bass. • Implement changes in legal size restrictions for Largemouth Bass. • Stock catchable sized bass. • Increase the amount of artificial habitat. • Pursue ways in increase diversity of forage.
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Objective 4: At least 80% of the anglers interviewed during creel census rate the fishing as fair, good or excellent.

Angler Satisfaction	A minimum of 80% of anglers rate fishing as fair, good or excellent.	Creel census shows less than 80% of anglers rate fishing as fair, good or excellent.	<ul style="list-style-type: none"> • Increase stocking rates. • Increase size of trout stocked. • Increase or modify efforts for angler education, preferably at the lake.
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Background

Lynx Lake is within the Prescott National Forest (PNF) but the lake itself is owned and operated by the Arizona Game and Fish Commission. The 55-acre impoundment was created in 1963 and sits about 4-miles southeast of urban Prescott. The lake's main tributary, Lynx Creek begins off the northwest slopes of Mt. Davis in the Bradshaw Mountains at roughly 6,500 feet of elevation. The stream bed courses roughly 6-miles in a northerly path until it hits Lynx Lake. This segment is ephemeral in nature typically flowing in response to snow run-off or local thunderstorm events. Two sediment "check-dams" are situated on Lynx Creek immediately upstream from the lake. The two structures are designed to control sedimentation of the lake from the surrounding shallow watershed. The upper dam failed in August of 2001 and excess sediment from behind both dams washed into Lynx Lake. The PNF and the Arizona Game and Fish Department (Department) dredged and repaired both structures and they are currently functioning properly, but are in need of additional maintenance and dredging.

A downstream water right minimum of 250 acre-feet is typically pumped out of Lynx Lake annually. This water is only delivered if 250 acre-feet does not spill over the spillway in "normal" runoff years. The Department is not required to deliver the 250 acre-feet if the lake level is lower than 15-feet below the spillway. The water delivery must happen between May and August each year. On their own, the summertime releases from Lynx do not reach Fain Lake five miles downstream. These releases simply percolate into the substrates in Lynx Creek. The Department completed a drawn down in 2002 to complete a re-surfacing of the dam. Subsequently, in 2003 the lake was estimated at 18 feet below the spillway. This was its lowest level in 25 years.

Productivity/Water Quality

A past study of Lynx Lake suggested that low levels of nitrogen and phosphorus, as well as high levels of copper and zinc, limit primary productivity (Ziebell and Tash 1981). Partially due to this condition, dissolved oxygen levels fall to zero below depths of 15 feet in late summer. Anoxic conditions combined with surface water temperatures of 24-25°C have forced the Department to suspend trout stockings from July to late September. These factors had restricted the Department's management options to a seasonal put-and-take trout fishery and encouraged enhancing the lake to serve a more diverse angling group. The Department installed a hypolimnetic aeration system into the lake to attempt to ameliorate the summer anoxic conditions. This system was designed to bring cold hypolimnetic water to the surface, super-saturate it with oxygen, and then return it to the bottom. Although the system was turned on in April 2000, the system has been unable to change the anoxic conditions due to extremely low water conditions for three consecutive years and severely undersized equipment. The system is no longer in use and the Department is exploring the possibility of using other variations of the current infrastructure to increase aeration.

Forage/Prey

As recent as 2000, Golden Shiner *Notemigonus crysoleucas* were the predominant forage species. They were not only present, but made up 83% of the total catch at Lynx Lake during electrofishing surveys in June of 2000. During the next sampling of Lynx in 2005, no Golden Shiner were sampled. Since the 2005 electrofishing surveys Bluegill Sunfish *Lepomis macrochirus* have been

sampled during every effort and have been the primary forage species present. Northern Crayfish *Orconectes virilis* are also present as a forage species. No recent studies have been done to describe standing zooplankton abundance and diversity. A recent baseline study should be commissioned to establish standing zooplankton abundance and diversity in this lake.

Habitat

As man-made impoundments age, they tend to lose natural woody materials that serve as fish habitat (Tugend et al. 2002). These habitats are important to primarily Bluegill Sunfish, Largemouth Bass and Channel Catfish because they provide spawning cover, hiding places for young, forage areas, and they tend to congregate fishes so that anglers can find them easier.

In 2004, the Department completed an Environmental Assessment (EA) to initiate a fisheries habitat improvement project at Lynx Lake. Lynx Lake was approaching 30-years old and suitable habitat for sunfishes was limited. The completion of the EA included extensive coordination with the Prescott National Forest (PNF). The original proposal was to utilize cut juniper trees from nearby clearing projects. Juniper trees have been used in other lakes in central Arizona with great success. However, water quality measurements at Lynx Lake since the mid-1990's suggest the lake goes anoxic (no oxygen) below 15-feet during the summer months. This precludes the Department from stocking trout from July to mid-September annually. After coordination with the PNF and local wildlife managers it was decided to not put woody habitat in the lake since breakdown of these materials results in oxygen being taken from the water. It was feared this would further degrade water quality. PVC pipe wrapped with safety or "snow" fencing has also been used in various places in Arizona with equal success in attracting and holding fish. These "artificial" materials do not breakdown and use oxygen, yet still provide attachment sites for algae and plankton. Artificial habitat seemed to be the better choice for Lynx Lake.

The majority of shoreline at Lynx is too steep to hold habitat structures without significant anchoring. During 2002-03, Lynx Lake water levels reached 18-feet below the spillway. These conditions allowed the Department to see large areas of lake bottom and determine suitable areas for habitat placement (Figure 2). The lake filled during the winter of 2004-05. Regional efforts ensued in June 2005 and 8, 4x4x8 PVC frames with orange safety fence were installed at 4 locations around Lynx Lake (Figure 3). Two structures were placed at or near the thermocline (15-feet) in four of the flatter areas of lake bottom that could be found. Fiberglass sheets were installed on the bottoms of the structures to minimize sinking in the bottom sediments. The sheets and weights at each corner allowed the structures to sink straight despite coming off the boats less than straight (Figure 4).

In August 2006, Department biologists observed the structures using SCUBA. Two of the four areas were observed. The first area turned out to be deeper than the thermocline and hence was in about 20-feet of very dark, cold water. No fishes were observed. The second location was in about 10-feet of water and large numbers of sunfish and a few Largemouth Bass were observed using the habitat.

More structures have been added to the four locations in 2006, 2008, 2009, and 2010. A total of 7 structures have been placed at each of the original four locations with the exception of the site

closest to the boat launch ramp. This location only has 6 structures. The structures placed in 2008 and 2009 were a slightly different configuration but still consisted of PVC pipe and snow fence (Figure 2). Twelve additional structures were added at two additional sites in 2015. Nine on the south shore and three on the east shore (Figure 2). These structures were made of polypropylene tubing and concrete (Figure 6). All these structures were placed at less than 15-feet in depth.

The benefits of this habitat are three-fold. First, the habitats provide refugia for small Bluegill Sunfish, Largemouth Bass and Channel Catfish, enhancing recruitment of juvenile fishes. This habitat was currently lacking in the fishery. Second, the habitat tends to concentrate fishes in a localized area that anglers can target. These concentrations attract larger fish and make them more available to anglers. Thirdly, the structures provide attachment sites for primary producers such as algae and phytoplankton leading to increases in nutrients and zooplankton.

Species

Rainbow Trout and other trout

Lynx Lake is a “two-story” fishery with both coldwater and warmwater species stocked. Rainbow Trout and Channel Catfish are the most frequently stocked. Lynx Lake was originally stocked in 1963 with catchable sized Rainbow Trout, however in subsequent years it was found that due to poor zooplankton production the size of the trout caught depended on the size of the trout stocked. The lake was managed as a “put and take” cold water fishery until 2005, supported by stocking as many as 51,000 Rainbow Trout annually. Prior to the 2008-2009 creel survey which revealed Rainbow Trout being caught in every month of the year, including summer months, there was no evidence of Rainbow Trout over-summering at Lynx.

Consequently, other species of trout were stocked to determine if they might fare better at near lethal temperature limits for trout. Brown Trout were stocked from 2003 to 2005. This species did not initially appear to handle summer conditions any better than the Rainbow Trout, but more recent stockings of Brown Trout have yielded up to 14” fish in years following the stockings. In 2007, Brook Trout stockings began, but returns on these fish have been limited largely due to the fingerling size that they are stocked. Almost 20,000 Rainbow Trout are requested annually from state hatcheries for stocking from roughly September to June. Brown and Brook Trout will be requested depending on hatchery capacities.

Channel Catfish

Around 1,000 Channel Catfish are stocked annually typically in June and July to augment the fishery when trout are not stocked. Channel Catfish are not typically sampled effectively by electrofishing, and high mortality can occur on trout when using netting methods. Therefore, objectives for the Channel Catfish fishery are centered on angler catch rates. Trap netting specifically for catfish may be utilized periodically to survey catfish population dynamics.

Largemouth Bass

The Largemouth Bass population at Lynx Lake consists primarily of small fish. The mean length from fall electrofishing in 2018 was only 116mm, but the maximum length was 550mm. Data from this also showed that Largemouth Bass had spawned successfully and are the dominant species (Table 2). However, only three of the 117 Largemouth Bass was of minimum stock length of 200mm (Anderson and Neumann 1996). Table 3 shows the maximum and minimum lengths and weights of the sample. The proportional size distribution (Table 4) are shown but are not complete due to the sample size and the absence of size classes. Largemouth Bass were the only species to have representatives in a size class of preferred or memorable. The relative weights (Table 5) indicate that the fish present are in good condition. All species had relative weights of over 100.

In 1964, Largemouth Bass and Bluegill Sunfish were first sampled in the lake and these species remained a secondary angler attraction until 2005. Yellow Bullhead *Ameiurus natalis*, Channel Catfish, Common Carp *Cyprinus carpio*, Goldfish *Carassius auratus* and Green Sunfish *Lepomis cyanellus* round out the warm water component of Lynx Lake as of 2018. Crayfish are also present locally in high numbers. Black crappie *Pomoxis nigromaculatus* and Golden Shiner were plentiful in netting and electrofishing surveys through 2000. Those species have not been sampled since that year, but Black Crappie were caught in the 2008-2009 creel survey in low numbers. Since 2005, Largemouth Bass, Channel Catfish and Bluegill Sunfish have been stocked.

The results of the 2018 survey provided information on species composition and relative abundance. The lack of cover in Lynx Lake is believed to be one of the primary reasons for the low survival rate of forage species like Bluegill and young of the year and age-1 Largemouth Bass. The ongoing habitat project for Lynx Lake was designed to provide cover for small fish and also to provide attachment sites for primary producers such as algae and phytoplankton leading to increases in nutrients and zooplankton leading to more fish overwintering. The increasing number of Bluegill, increasing number young of the year and age-1 Largemouth Bass, and relative weights all over 100, suggest that the habitat is having a positive effect on the overall fishery.

Access

The PNF completed renovations and site improvements in 2002 in response to the ever-increasing popularity of Lynx Lake. The lake can be accessed by the north shore or the south shore for day use. The north shore has a general store and restaurant operated by a concessionaire that is open seasonally as well as restrooms. The south shoreline has a fishing pier, restrooms, picnic areas, and a developed launch ramp for both motorized (not to exceed 10 horsepower) and non-motorized water craft. The lake can also be accessed by the developed campground on the west shore where overnight camping is allowed. Angling access is good because of a trail that contours the entire lake shore. No additional access projects are planned.

Catch

Catch rate goals established for this fishery are 0.5 fish an hour for Rainbow Trout and Channel Catfish during the stocking period. The most recent creel data is from 2008-2009, Catch per Unit Effort (CPUE) was calculated by quarter. Catch rates were highest (0.52) during the winter (November to January) when anglers were targeting Rainbow Trout. All other quarters fell short of the 0.5 fish per hour targeted goal. Several recommendations were made following the survey,

but two seem most likely to achieve the goal. We recommend Lynx be stocked twice a month instead of once a month. Catch rates drop off quickly after stocking. Stocking more frequently will increase angler success throughout the month. Second, it should be stocked with more trout. The creel survey estimates that 42% of the trout stocked were caught. If angler use and return to creel remain the same while increasing the number of fish stocked, we could increase the CPUE. Stocking the same amount of trout, but at a larger size may also be an option to increase CPUE. Creel data from other lakes in the state suggest larger trout (>14 inches) are caught more readily than are smaller trout. Also by stocking Channel Catfish consistently throughout the summer months we could have a more consistent overall CPUE. During the summer when trout are not stocked CPUE drops as low as 0.05 fish per hour.

The creel study in 2008-2009 estimated the total number of angler use days to be 35,318. The Statewide survey of 2013 Arizona Anglers estimated the annual angler use days to be 67,613 (Fisheries Branch 2015).

Only 2% of anglers targeted Largemouth Bass during the 2008-2009 creel survey. While this seems low, angler use is highest at Lynx Lake in the summer and 35% of all anglers surveyed said they were targeting anything, or just wanted to catch something. Trout cannot be stocked in the summer due to high surface water temperatures and catfish stocking are not frequent enough to meet the angler demands, so the Largemouth Bass fishery helps to fill the need when angler use is at its highest. The quality is not as important as their presence and quantity hence it's designation as a general use fishery for Largemouth Bass.

Satisfaction

During Creel surveys and interactions with anglers, creel staff will ask a standardized question regarding an angler's satisfaction with the fishery on a scale of 1-5. Satisfaction of 80% is the goal of the fishery. During the 2008-2009 creel survey 81% of anglers were either satisfied or extremely satisfied with their fishing experience (Figure 7).

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Tables and Figures

Table 2. Species composition, total number, percent of total catch, catch per unit effort (fish/15min), and standard error of fish sampled during fall surveys of Lynx Lake.

Species	Year	Number Sampled	Percent of Total %	CPUE	Standard Error
Channel Catfish	2014	8	3	11	1.78
	2016	4	2	5.4	0.72
	2018	1	0.7	1.32	0.27
Bluegill Sunfish	2014	7	3	9	0.72
	2016	42	19	56	4.64
	2018	27	18.6	36	5.09
Largemouth Bass	2014	205	89	273	21.09
	2016	169	77	225.3	5.62
	2018	117	80.7	156	24.57

Table 3. Total length (mm) and weight (g) by minimum, maximum, and mean, including standard error of all species of fish electrofished during fall surveys of Lynx Lake.

Species	Year	Total Length (mm)				Weight (g)			
		Min	Max	Mean	SE	Min	Max	Mean	SE
Channel Catfish	2014	435	690	552	36	652	4505	2098	509
	2016	450	620	568	39.5	888	2193	1579	293.9
	2018	550	550	550		1770	1770	1770	
Bluegill Sunfish	2014	95	120	111	3.2	19	35	28	2.1
	2016	55	138	102	301	3	56	23	2.1
	2018	88	140	111	3.74	19	64	44	2.8

	2014	75	241	112	2.1	4	233	23	2
Largemouth Bass	2016	50	215	97	1.1	1	123	16	1.3
	2018	70	550	116	5.33	3	2832	57	25.1

Table 4. Proportional Size Distribution (P=preferred, M=memorable, T=trophy) stock densities of selected species collected during fall electrofishing surveys at Lynx Lake.

Species	Year	PSD	PSD-P	PSD-M	PSD-T
Channel Catfish	2014	100	38	*	*
	2016	100	25	*	*
	2018	100	*	*	*
Bluegill Sunfish	2014	*	*	*	*
	2016	*	*	*	*
	2018	*	*	*	*
Largemouth Bass	2014	*	*	*	*
	2016	*	*	*	*
	2018	43	14	14	*

Note: * indicates no fish in those size indices.

Table 5. Overall average and structural indices categories (S=stock, Q=quality, P=preferred, M=memorable, T=trophy) of relative weight (W_r) for selected species electrofished during fall surveys at Lynx Lake.

Species	Year	W_r	W_r	W_r	W_r	W_r
		Overall	S	Q	P	M
Channel Catfish	2014	123	*	100	120	*
	2016	84	102	92	53	*
	2018	105	*	105	*	*
Bluegill Sunfish	2014	110	110	*	*	*
	2016	104	*	*	*	*
	2018	109	116	*	*	*
Largemouth Bass	2014	137	113	*	*	*
	2016	92	*	*	*	*
	2018	105	104	106	*	106

Note: * indicates no fish in those size indices.

Table 6. Catch per Unit effort (CPUE) and harvest per unit effort (HPUE), by season and secondary sampling unit from a roving creel survey, 2008-09. Effort is in hours.

Season	CPUE weekday	CPUE Weekend	Total CPUE	HPUE weekday	HPUE weekend	Total HPUE
Summer (June- July)	0.11	0.01	0.05	0.07	0.01	0.04
Autumn (Aug. to Oct.)	0.21	0.20	0.21	0.13	0.08	0.10
Winter (Nov. to Jan.)	0.83	0.49	0.52	0.17	0.43	0.41
Spring (Feb. to April.)	0.45	0.12	0.26	0.24	0.09	0.00
Summer (June- July)	0.17	0.14	0.15	0.13	0.08	0.09
Total	0.23	0.14	0.17	0.14	0.08	0.10

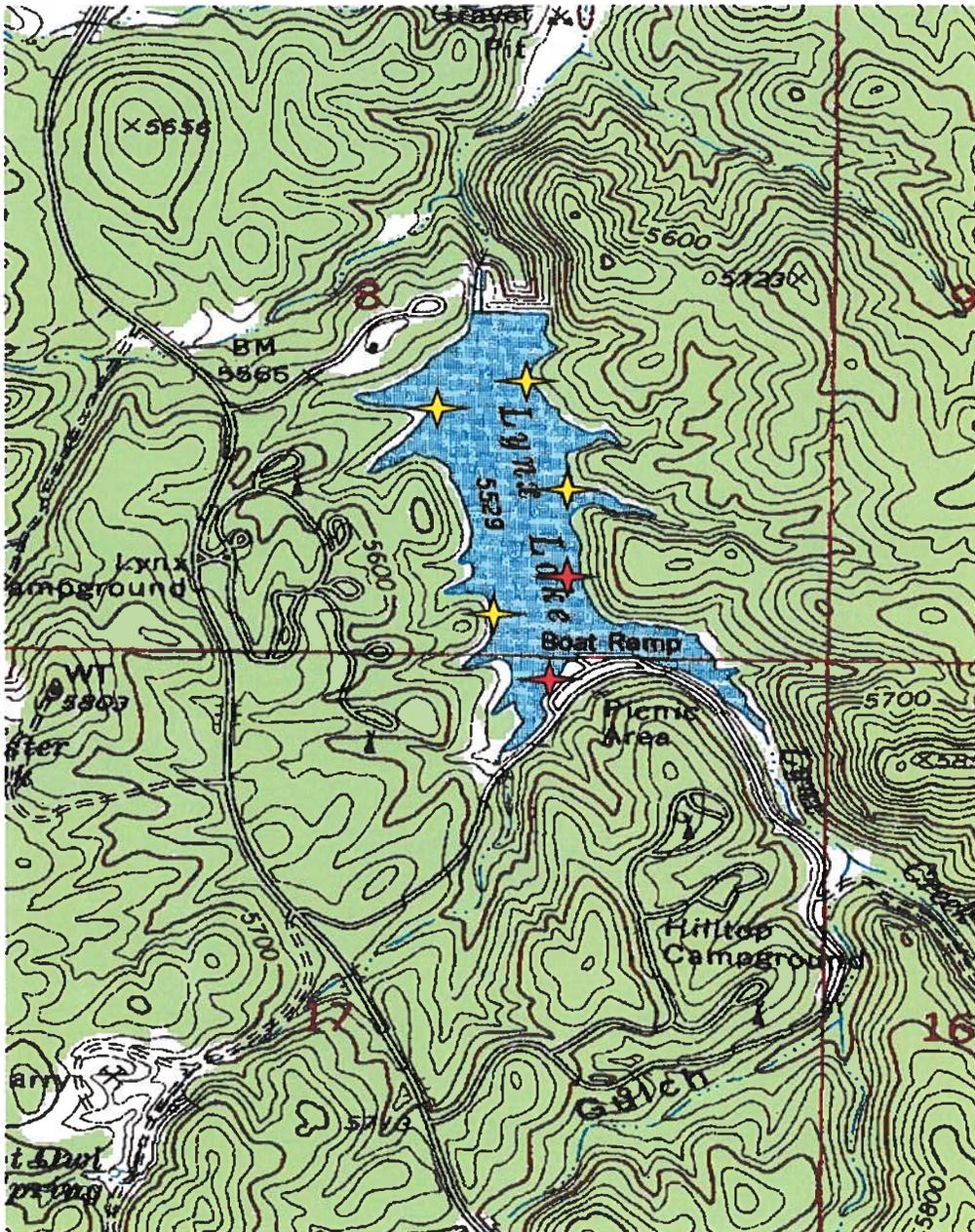


Figure 2. Yellow stars are habitat sites for 2005, 2006, 2008, 2009, and 2010. The red stars are the two additional habitat sites used in 2015.



Figure 3. Lynx Lake PVC habitat.



Figure 4. Installation of structures from boats.



Figure 5. PVC structures placed into Lynx Lake in 2008 and 2009.



Figure 6. Polypropylene structures placed into Lynx Lake in 2015.

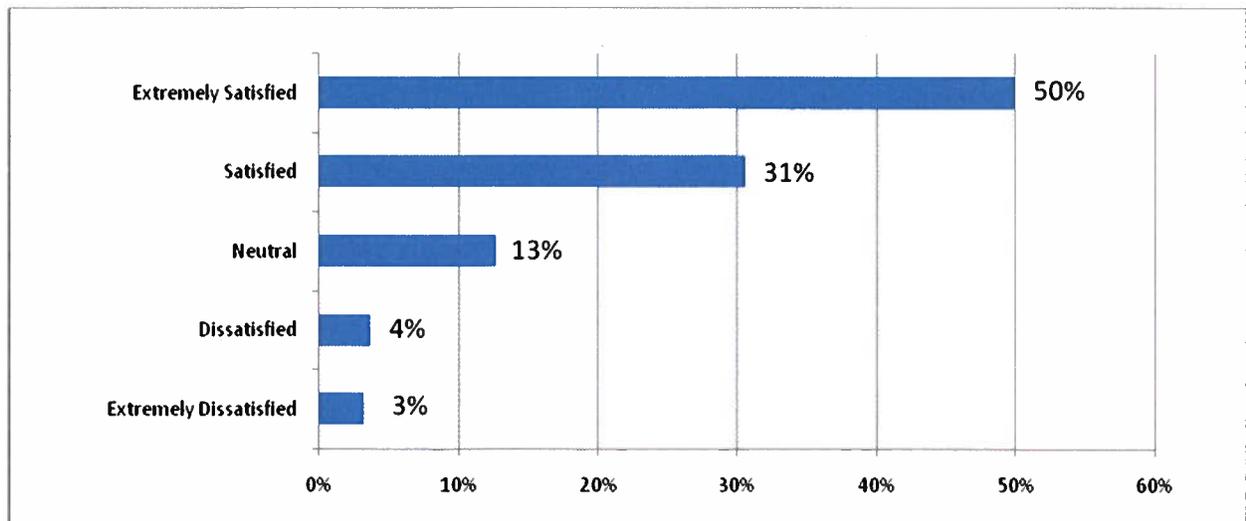


Figure 7. Satisfaction ratings for 2008-2009 Lynx Lake Creek survey.