Goldwater Lake
Fisheries Management Plan
2019-2029

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Approved [X] by Chris Cantrell _____ Date: 8/7/19
Chief of Fisheries

Location

Goldwater Lake is located in Game Management Unit 20A surrounded by the Prescott National Forest (PNF) in the Bradshaw Mountains, Yavapai County at an elevation of 6,000 feet above mean sea level. The lake is approximately 75 miles North of Phoenix, and approximately 4 miles south of the City of Prescott (Figure 1).

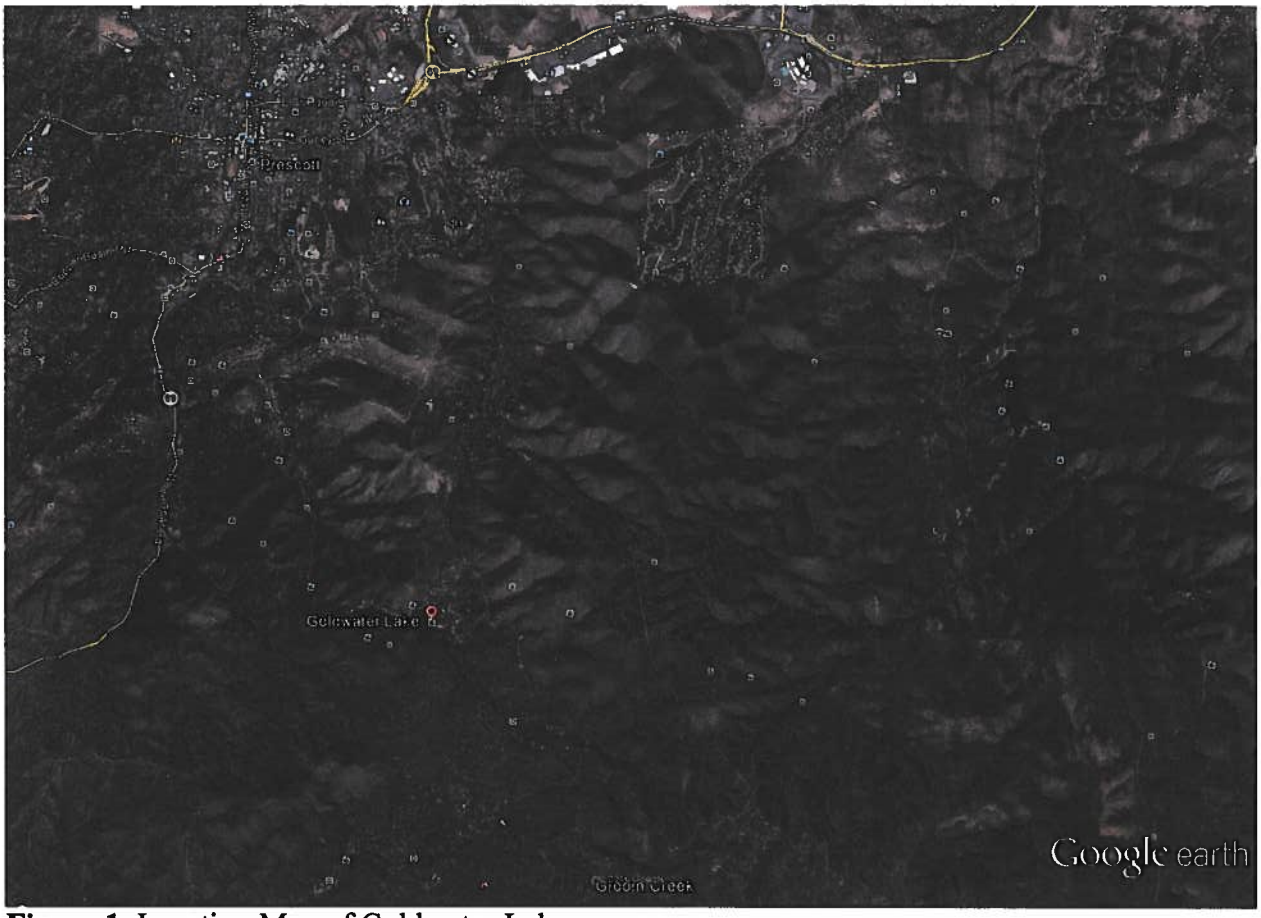

Figure 1. Location Map of Goldwater Lake.

Management Prescription

Fisheries management at Goldwater Lake involves a 22 surface-acre (Upper Goldwater) and an 8.5 surface-acre (Lower Goldwater) impoundment of Bannon Creek (Fig. 1). Currently only Upper Goldwater is open to the public and actively managed. Management does not focus on a single species but instead focuses on a well-rounded fish population that provides anglers opportunities to catch multiple species. This includes an Intensive Use concept per the Coldwater Vision document (AGFD 2019a) for Rainbow Trout *Oncorhynchus mykiss* and an Intensive Use concept fishery per the Warmwater Vision document (AGDF 2019b) for Channel Catfish *Ictalurus punctatus* fishery and a General Opportunity concept for 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 Goldwater Lake during creel census rate the fishing as fair, good, or excellent.

Table 1. Goldwater Lake Objectives and Adaptive Management Strategies:

Parameters	Objective Guideline	Trigger point to address unmet Objectives	Strategies if Objectives are Unmet
Objective 1: Maintain an Intensive Use Rainbow Trout fishery during months where water quality allows.			
Angler Catch Rates	Maintain an angler catch rate of 0.5 fish/hour for 7 days following stocking.	Catch rates drop below 0.5 fish/hour during assessment of catch rates on a 5 year rotational basis through creel surveys.	• Implement changes in daily bag limit. • Increase number of trout stocked to meet demand. • Increase frequency of stocking. • Consider renovation to remove warmwater species.
Objective 2: Maintain an Intensive Use concept warmwater fishery for Channel Catfish using stockings of catchable sized fish.			
Angler Catch Rates	Maintain an angler catch rate of 0.5 fish/hour.	Catch rates drop below 0.5 fish/hour during assessment of catch rates on a 5 year rotational basis through creel surveys.	• Increase number of catfish stocked to meet demand. • Increase frequency of stocking. • Increase the amount of artificial habitat.

Parameters	Objective Guideline	Trigger point to address unmet Objectives	Strategies if Objectives are Unmet
Objective 3: Maintain a General Opportunity concept warmwater fishery for Largemouth Bass with periodic stockings, supplementing limited reproduction and growth.			
Population Structure	Maintain a ≥50 fish/hour electrofishing of Largemouth Bass.	Two consecutive sampling events showing the population below management guidelines.	• Schedule a stocking of catchable sized bass. • Increase the amount of artificial habitat. • Pursue ways in increase diversity of forage.
Angler Catch Rates	Maintain an angler catch rate of 0.5 fish/hour.	Catch rates drop below 0.5 fish/hour during assessment of catch rates on a 5 year rotational basis through creel surveys.	• Increase number of bass stocked to meet demand. • Increase the size of bass stocked to replace lost recruitment. • Modify regulations to further protect larger bass. • Increase frequency of stocking. • Increase the amount of artificial habitat.
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.	• Increase stocking rates. • Increase size of trout stocked. • Increase or modify efforts for angler education, preferably at the lake.

Background

Created in the 1930's as a water supply reservoir for the City of Prescott (City), Goldwater Lake sits at approximately 6,000 feet in elevation nearly 4-miles south of downtown Prescott. Two dams situated in the headwaters of Granite Creek on a drainage known as Bannon Creek create an upper 22-acre reservoir and a lower 8.5-acre reservoir. In 1976, the City created a day-use recreation area at the upper lake. As a result of this development, the Arizona Game and Fish Department (Department) began managing the upper lake as an intensive use, warm-water recreational fishery with an emphasis on sunfish and catfish. By the late 1990's, Goldwater offered a launch ramp and two fishing piers located on the southeast side of the lake. Goldwater Park also offers a trail that enables anglers to access almost the entire lake. The current State Records for Bluegill and Redear sunfish were caught at Goldwater Lake. In 2004, the Department changed the emphasis of the fishery to a "two-story" concept and began stocking catchable sized Rainbow Trout. This change was done in response to the increasing population of the area and low catch rates for warm water species. Gila Trout are the only fish that have been stocked in the lower lake by the Department because it is currently not open to the public. However, populations of Largemouth Bass, Bluegill, and Black Crappie have been known to persist in the lower lake and the Department uses the lower lake as a source of Largemouth Bass to bolster the bass population in the upper lake. Recently the City of Prescott has shown interest in opening lower Goldwater to the public.

Productivity/Water Quality

Water quality and chemistry are both conducive to Rainbow Trout survival and growth. In the summer, when water quality is at its worst for Rainbow Trout, the pH is under 8.5 and water temperatures remain cool below the thermocline. The temperature above the thermocline is around 24.5°C which is warm for Rainbow Trout; however temperatures fall rapidly below the thermocline as does the oxygen levels. Oxygen drops to less than 1 ppm by three meters below the thermocline. This creates a narrow, about 3m, window for Rainbow Trout to live in where the water temperatures are cool enough and the oxygen is high enough for them. Even in this narrow window, they not only survive the summer, they are actively feeding and can be caught.

Forage/Prey

A large prey base of Green Sunfish *Lepomis cyanellus* supports a self-sustaining Largemouth Bass population. Monitoring of the sunfish populations as a constituent of the prey base occurs as part of the biannual electrofishing surveys conducted at Goldwater Lake. (Table 2-5.) This population is evaluated on their body condition through all size classes and overall length frequencies. For body condition, established management guidelines require that relative weights for a balanced population should be within the range of 90 to 100.

In the spring of 2018, thousands of Fathead Minnow *Pimephales promelas* were observed spawning from shore by AGFD regional personnel; however none were sampled during the fall electrofishing survey (Table 2). Red Shiner *Cyprinella lutrensis* are also present in low levels. In 2016, twelve were sampled during fall electrofishing surveys, but they were not sampled in 2018

(Table 2). This seems to suggest that small bodied fishes are available to predators such as bass and catfish.

While Crayfish are not sampled, they have been observed to be very abundant in the past, to the point that they have stripped the lake of all its vegetation. Over the past 20 years the City has trapped crayfish to reduce densities. The trapping does appear to have a short term effect in reducing the densities of crayfish as well as making their average size smaller. Largemouth Bass stockings are also believed to help control the crayfish. The crayfish population has currently been observed to be lower that it has been in the past.

Habitat

As man-made impoundments age, they tend to loose 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. The large crayfish population has stripped the lake of nearly all submerged vegetation.

In January 2009, 80 Christmas trees donated by the local Home Depot were placed into Goldwater. Local Wildlife Manager Virginia Gouldsbury inquired about the trees and accepted the donation. Department and City staff used sand bags to sink the trees in 5 locations. (Figure 2) Some were individually anchored while others were bundled and sank as a group. Six 10-inch diameter, 3-foot long pieces of PVC were incorporated into the bundles. The trees were placed using a 19-foot Boston Whaler boat with a sheet of ply wood.

In August 2009, the City offered surplus concrete culverts and metal pipes for additional habitat in Goldwater Lake. In addition, Department staff had acquired several long PVC pipes to be used as habitat. In all 23 pipes were sunk in Goldwater. Most of the pipes were 10-inch diameter and around 36-inches long. One culvert was 4-foot by 2.5-feet in diameter. Seven pipes were 1.5-inches in wall thickness and varied in length from 2.5 to 4-feet. All pipes were filled with 2-4 inches of concrete on one end, plugging the end. The habitat was put in 10-15 feet of water. Pipes were sunk in pairs. They were tied together using lead line, so that the open ends faced opposite directions. Two bundles of two were sunk in each of five locations. Three metal pipes were sunk individually near 3 of the five sites. All pipes and culverts were placed in proximity to the Christmas trees that were installed in January of that year.

Species

The species composition at Goldwater Lake consists of Green Sunfish, Channel Catfish, Rainbow Trout, Gila Trout, and Largemouth Bass. Channel Catfish are present in low numbers, while Largemouth Bass and Rainbow Trout numbers are tied to recent stocking events and are the most sought after species by anglers (Fig 3). Green Sunfish are numerous, but are small and are not targeted by anglers.

to 8 years has made finding and moving bass very difficult. In June 2017, funding was available to purchase catchable sized Largemouth Bass. As a result, 350 bass were stocked averaging about 1 pound.

Going back 15 years, the Largemouth Bass population at Goldwater Lake has struggled to maintain fish over 3 years old. In 2019, some anglers have reported catching 2-pound Largemouth Bass, likely holdovers from the June 2017 stocking. However these fish were not sampled during the 2018 electrofishing survey, suggesting the number of fish this size is low. The results of that survey showed a Catch Per Unit Effort (CPUE) for Largemouth Bass at 105.2 (Table 2) which is more than double the goal of Objective three (Table 1). While 79 Largemouth Bass were sampled, they all were between 80-140 mm total length (Table 2-3). Anderson (1980) reported that Largemouth Bass populations that are in balance with their prey base will express PSD values in the range of 40 -70%, PSD-Preferred values in the range of 10% - 40% and PSD-Memorable values in the range of 0% - 10%.

The 2014-2018 data shows that bass in the PSD, PSD-Preferred sized class were only sampled in 2014 (Table 4). All other years there were no fish sampled in these ranges. This seems to be a recurring pattern. After Largemouth Bass are stocked, they successfully spawn the first year or two and we see young bass in fall surveys. But we can't document recruitment of these young fish past their first fall. It was originally thought that the Green Sunfish and Crayfish were prohibiting the bass from successfully spawning, but by doing fall surveys' instead of spring survey's we know that the bass are successfully spawning. The special regulation in 2014 was an attempt to address this lack of recruitment into larger size classes. Effective on January 1, 2014, only one bass over 13" may be taken. This was intended to reduce take of bass and maintain a self-sustaining population.

If fall electrofishing surveys continue to show the bass population not responding to the regulation with more bass in the larger size classes and Green Sunfish and Crayfish numbers increase, then we need to consider options in order to remove both the Green Sunfish and the Crayfish. These options may include renovating Goldwater Lake using a piscicide. If all other options are not feasible and both the City of Prescott and the public support the use of a piscicide, the Department may pursue this option.

Access

Goldwater Lake can be accessed by parking areas on both the North and East side of the lake for day use. Amenities include restrooms, ramadas, a fishing pier, picnic tables, and hiking trails that allow anglers to access the entire lake. A boat launch is located on the North side of the lake, but boat use is restricted to electric only. There is a $3 entrance fee.

Catch

Catch rate goals established for this fishery are 0.5 fish an hour. The most recent complete creel data is from 2009-2010. Catch Per Unit Effort (CPUE) was calculated by quarter. During the autumn (September - November), catch rates were at their highest (0.53) (Table 6). All other

quarters fell short of the 0.5 fish per hour targeted goal with the summer (June – August) as the lowest (0.20). Of note is that the winter (December – February) when we only stock trout two of the three months, we have our second highest catch rates (0.25). Fifty-three percent of the trout stocked during that creel period were caught. While this is low, it is higher than other lakes in the area.

Goldwater Lake should be stocked with larger trout and greater numbers of trout. The small size of trout stocked, often under 9" average, likely contributes to low return to creel. Small fish can be easily preyed upon and are not easily caught. The City of Prescott estimates around 100,000 vehicles enter the park per year. While the number of people per car varies, a conservative number is 200,000 people visit Goldwater Lake annually (personal comm. Tim Legler). The 2013 angler use survey estimates 22,656 Angler Use Days per year. On a typical year, only about 24,000 Rainbow Trout are stocked. That is about one fish for every person who tries to fish there and about one fish for every 9 people that visit the park. When we consider the return rate, it is really only one fish for every eighteen people that visit the park. Only about 1 in 9 people visiting Goldwater Lake is fishing. Angler success breeds angler use. There is a tremendous opportunity for angler use to go up, but we need to provide more fish. We need to consider purchasing additional fish. Department funding is limited and hatchery space is limited. This results in a fixed number and size of fish being stocked throughout the state. Our hatcheries are unable to meet the demand of our constituents, so we must come up with alternative ways to meet that demand. Purchasing fish requires additional funding that the Department does not currently have.

A creel survey is just being completed in the spring of 2019. In the future this survey will be conducted on a 5 year rotational basis.

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 2009-2010 creel survey 87% of anglers were either satisfied or extremely satisfied with their fishing experience. Only 2% were dissatisfied or extremely dissatisfied. (Figure 4)

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Tugend, K. I., M. S. Allen, and M. Webb. 2002. Use of Artificial Habitat Structures in U.S. Lakes and Reservoirs: A Survey from the Southern Division AFS Reservoir Committee. Fisheries, 27:5, 22- 27.

Tables and Figures

Table 2. Species composition, total number, percent of total, catch per unit effort (fish/hr), and standard error of fished sampled electrofishing during fall surveys of Goldwater Lake.

Species	Year	Number Sampled	Percent of Total %	CPUE	Standard Error
Channel Catfish	2014	3	1	4	0.81
	2016	1	0	1.8	0.35
	2018	*	*	*	*
Green Sunfish	2014	210	96	280	23.65
	2016	370	97	740	31.1
	2018	143	64	190.8	9.1
Red Shiner	2014	*	*	*	*
	2016	12	3	5.76	0.71
	2018	*	*	*	*
Largemouth Bass	2014	3	1	4	0.47
	2016	*	*	*	*
	2018	79	36	105.2	4.2

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 Goldwater Lake.

Species	Year	Total Length (mm)				Weight (g)			
		Min	Max	Mean	SE	Min	Max	Mean	SE
Channel Catfish	2014	615	720	670	30	3980	4321	4195	108
	2016	651	651	651	*	3577	3577	3577	*
	2018	*	*	*	*	*	*	*	*
Green Sunfish	2014	48	150	65	1.4	2	67	7	0.6
	2016	30	145	59	0.8	1	63	6	0.43
	2018	66	135	86	1.1	5	27	12	0.4
Largemouth Bass	2014	121	445	232	107	25	1811	621	595
	2016	*	*	*	*	*	*	*	*
	2018	80	140	112	1.3	5	27	15	0.6

Table 4. Proportional Size Distribution (P=preferred, M=memorable, T=trophy) of Largemouth Bass collected during fall electrofishing surveys at Goldwater Lake.

Species	Year	PSD	PSD-P	PSD-M	PSD-T
Channel Catfish	2014	100	67	33	*
	2016	100	100	*	*
	2018	100	*	*	*
Green Sunfish	2014	4	*	*	*
	2016	*	*	*	*
	2018	*	*	*	*
Largemouth Bass	2014	100	100	*	*
	2016	*	*	*	*
	2018	*	*	*	*

Table 5. Overall average and structural indices categories (S=stock, Q=quality, P=preferred, M=memorable, T=trophy) of relative weight (W_r), for Largemouth Bass electrofished during fall survey at Dead Horse Ranch State Park's Middle Lagoon in 2017.

Species	Year	W_r Overall	W_r S	W_r Q	W_r P	W_r M
Channel Catfish	2014	133	*	*	147	105
	2016	122	*	*	122	*
	2018	*	*	*	*	*
Green Sunfish	2014	96	95	96	*	*
	2016	98	98	*	*	*
	2018	93	94	*	*	*
Largemouth Bass	2014	131	*	131	*	*
	2016	*	*	*	*	*
	2018	87	*	*	*	*

Table 6. Catch Per Unit Effort (CPUE) and Harvest Per Unit Effort (HPUE) by season from Goldwater Lake 2009-2010 Roving Creel/Use Survey. Effort is measured in hours.

Season	CPUE weekday	CPUE Weekend	Total CPUE	HPUE weekday	HPUE weekend	Total HPUE
Summer (June-Aug.)	0.21	0.18	0.20	0.15	0.06	0.10
Autumn (Sept.-Nov.)	0.58	0.51	0.53	0.51	0.36	0.41
Winter (Dec.-Feb.)	0.32	0.19	0.25	0.20	0.07	0.13
Spring (Mar.-May.)	0.37	0.15	0.23	0.23	0.15	0.17
Total	0.29	0.25	0.27	0.21	0.14	0.17

Table 7. The number of fish caught, fish harvested, and trout harvested by season from Goldwater Lake 2009-2010 Roving Creel/Use Survey. Effort is measured in hours.

Season	PSU	# Days in period	Fish caught	Fish harvested
Summer (June-Aug.)	weekday	59.5	1,297.1	868.7
	weekend	32.5	867.8	289.3
		Summer Subtotal:	*2,164.90*	*1,158.0*
Autumn (Sept.-Nov.)	weekday	56.5	2,406.9	2,079.2
	weekend	33.5	2,512.5	1,755.4
		Autumn Subtotal:	*4,919.4*	*3,834.6*
Winter (Dec.-Feb.)	weekday	54.5	381.5	239.8
	weekend	35.5	252.1	88.8
		Winter Subtotal:	*633.6*	*328.6*
Spring (Mar. - May.)	weekday	59.5	2,677.5	1,160.3
	weekend	32.5	497.3	484.3
		Spring Subtotal:	*3,174.8*	*1,644.6*
		Weekday Total:	**6,763.00**	**4,348.00**
		Weekend Total:	**4,129.70**	**2,617.80**
		TOTAL:	**10,892.70**	**6,965.80**

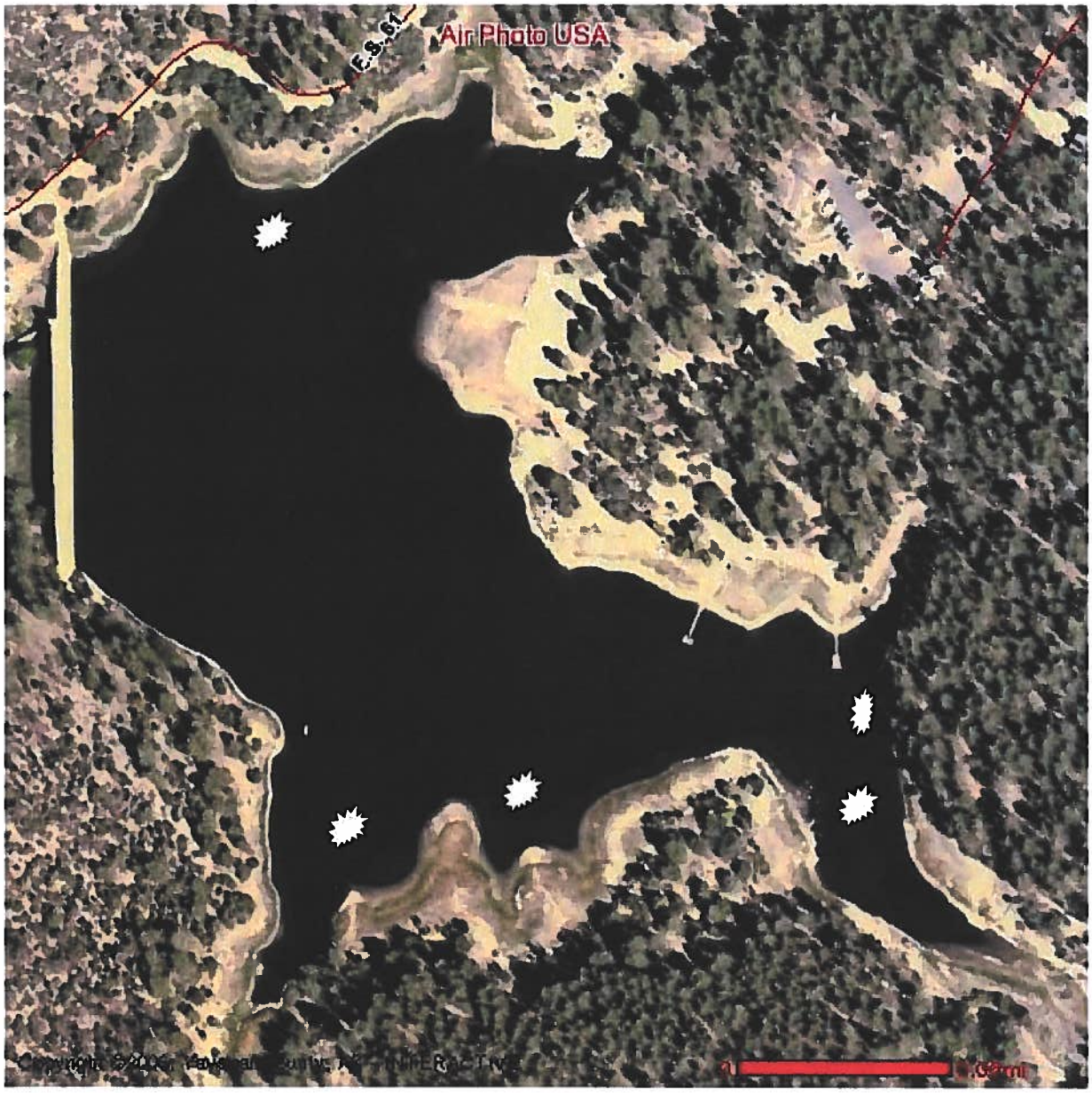

Figure 2. Goldwater Lake habitat locations.

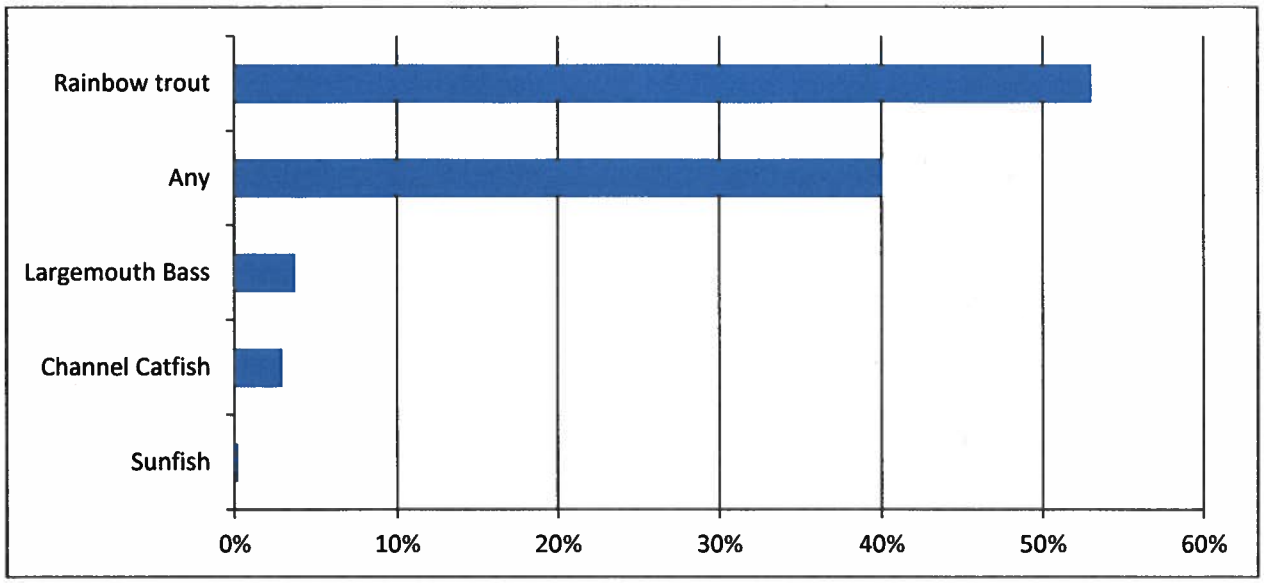

Figure 3. Species preference by anglers from Goldwater Lake 2009-2010 Roving Creel/Use Survey

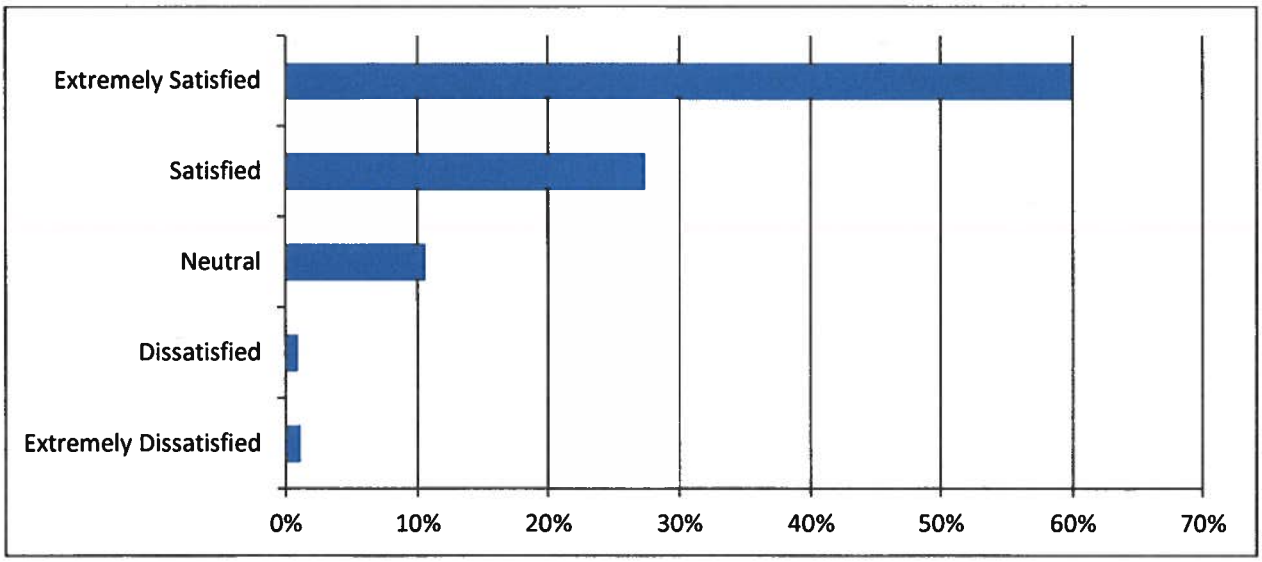

Figure 4. Satisfaction ratings from Goldwater Lake 2009-2010 Roving Creel/Use Survey.