



Horsethief Basin Lake Fisheries Management Plan 2020 – 2030

**Amberle Jones, Aquatic Wildlife Program Specialist, Region VI
Curt Gill, Aquatic Wildlife Program Manager, Region VI**

The Arizona Game and Fish Department (AGFD) prohibits discrimination on the basis of race, color, sex, national origin, age, or disability in its programs and activities. If anyone believes that they have been discriminated against in any of the AGFD's programs or activities, including its employment practices, the individual may file a complaint alleging discrimination directly to the Directors Office, 5000 W. Carefree Hwy, Phoenix, AZ 85086, (602) 942-3000 or U.S. Fish and Wildlife Service, Attn: Civil Rights for Public Access, 5275 Leesburg Pike, MS:WSFS, Falls Church, VA 22041-3803.

Persons with a disability may request a reasonable accommodation or this document in an alternative format by contacting the Director's Office as listed above.

Approved [] by Chris Cantrell *D. Andrew Clark* acting for Date: 10/1/2020
Aquatic Wildlife Branch Chief

Location

Horsethief Basin Lake is located in the Bradshaw Mountains approximately 105 kilometers (65 miles) northwest of the Phoenix Metropolitan area and 5.6 kilometers (3.5 miles) southeast of the community of Crown King. Horsethief Basin Lake can be reached from Forest 259 Road to Forest 52G Road (Figure 1).

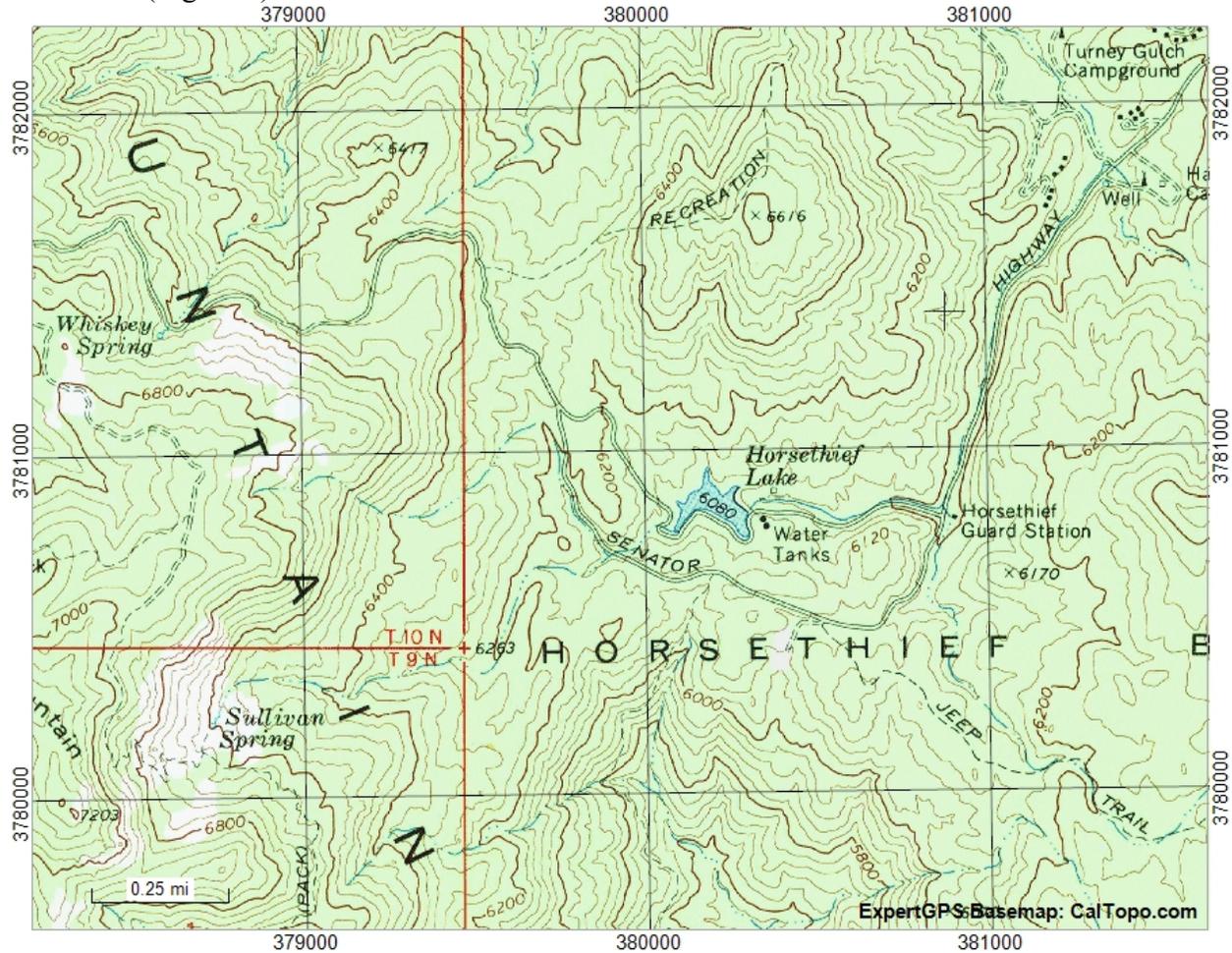


Figure 1. Map of Horsethief Basin Lake, Yavapai County, Arizona.

Management Prescription

The Arizona Game and Fish Department (Department) has developed approaches under a Warmwater Strategic Vision Document (AGFD 2019) to help guide warmwater fisheries management in Arizona. Using these approaches, fisheries management at Horsethief Basin Lake will focus primarily on a General Opportunity, Largemouth Bass *Micropterus salmoides* and Redear Sunfish *Lepomis microlophus* fishery and secondarily to manage for a potential Featured Species opportunity fishery for Tiger Muskellunge (Tiger Muskie) *Esox masquinongy x lucius*.

Management objectives and adaptive management strategies have been set under the General Opportunity and Featured Species approaches. Monitoring activities, including community-wide or species-specific fish surveys and angler creel surveys will be used to determine if management objectives are being met. Guidelines to meet objectives are listed in Table 1 below.

Objective 1: Maintain the Largemouth Bass population to meet or exceed General Opportunity standards.

Objective 2: Maintain the Redear Sunfish population to meet or exceed General Opportunity standards.

Objective 3: Maintain the Tiger Muskie population to meet or exceed the Featured Species Concept standards.

Objective 4: Maintain angler satisfaction at 80%.

Table 1. Horsethief Basin Lake Objectives and Adaptive Management Strategies.

<i>Objective 1: Maintain the Largemouth Bass population to meet or exceed General Opportunity standards.</i>			
Parameters	Objective Guideline	Trigger point to address unmet objectives	Strategies if Objectives are not met
Electrofishing Catch Rates	Summer electrofishing CPUE ¹ ≥ 50 fish per hour	Mean CPUE drops blw 50 fish/hour for three consecutive surveys Mean CPUE drops blw 10 fish/hour for a single sampling event	<ul style="list-style-type: none"> • Re-evaluate survey methods and equipment • Stocking • Regulation Changes
Angler Catch Rates	Angler CPUE of no less than 1.0 fish per hour for anglers targeting Largemouth Bass	Angler CPUE drops blw 1.0 Largemouth Bass per hour for two consecutive creel surveys	<ul style="list-style-type: none"> • Stocking • Regulation Changes • Outreach/Education

Objective 2: Maintain the Redear Sunfish population to meet or exceed General Opportunity standards.

Parameters	Objective Guideline	Trigger point to address unmet objectives	Strategies if Objectives are not met
Electrofishing Catch Rates	Summer electrofishing CPUE ¹ ≥ 50 fish per hour	Mean CPUE drop below 50 fish/hour for three consecutive surveys Mean CPUE drops below 10 fish/hour for a single sampling event	<ul style="list-style-type: none"> • Re-evaluate survey methods and equipment • Stocking • Regulation Changes
Angler Catch Rates	Angler CPUE of no less than 1.0 fish per hour for anglers targeting Redear Sunfish	Angler CPUE drops below 1.0 fish per hour for two consecutive creel surveys	<ul style="list-style-type: none"> • Stocking • Regulation Changes • Outreach/Education

Objective 3: Maintain the Tiger Muskie population to meet Featured Species standards.

Electrofishing Catch Rates	Summer electrofishing CPUE ¹ ≥ 20 fish per hour	Mean CPUE drop below 20 fish/hour for three consecutive surveys Mean CPUE drops below 5 fish/hour for a single sampling event	<ul style="list-style-type: none"> • Re-evaluate survey methods and equipment • Stocking • Regulation Changes
Angler Catch Rates	Percentage of anglers targeting Tiger Muskie > 50%	Three consecutive sampling events showing population below management guideline	<ul style="list-style-type: none"> • Determine if the species should continue to be managed

Objective 4: Maintain angler satisfaction at 80%.			
Parameters	Objective Guideline	Trigger point to address unmet objectives	Strategies if Objectives are not met
Angler Satisfaction	Angler satisfaction in creel surveys >80%	Angler satisfaction drops below 80% for two consecutive creel surveys	<ul style="list-style-type: none"> • Stock warmwater species • Outreach/education

¹ CPUE=Catch Per Unit Effort (fish per hour)

Background

Horsethief Basin Lake was constructed in 1936 by the City of Phoenix to provide water resources to Horsethief Basin Recreation Area. The U.S. Forest Service (USFS) has since assumed management responsibility for the lake and surrounding area. The lake is currently maintained for recreational opportunities, including sportfishing, as well as a Special Water Use supply by the Bradshaw Ranger District of the Prescott National Forest (PNF). In addition to providing water to Horsethief Basin Recreation Area, the lake serves as an important fire suppression resource.

The lake elevation is approximately 1,850 meters (6,069 feet) and is located within the Horsethief Basin Recreation Area. Horsethief Basin Lake is approximately 2 hectares (5 surface acres) with a storage capacity of 79 megaliters (64 acre-feet) and a maximum depth of 6 meters (20 feet). Horsethief Basin Lake is the only sport fishing lake in the southern three-quarters of the Bradshaw Mountains. Due to its location, the lake has the potential to provide important recreational opportunities for the town of Crown King and growing communities in north Phoenix.

Historically, the Department has stocked catchable sized Channel Catfish during the summer to establish a put-and-take Channel Catfish fishery. However in 2003, due to low angler numbers and poor access for the hatchery truck, Channel Catfish stockings were discontinued. In 2019, the Department stocked fingerling Tiger Muskie to provide an additional opportunity to catch a unique species. A total of 450 fingerlings were stocked in May of that year.

Productivity/Water Quality

The Department’s Region VI Aquatic Wildlife staff collects water quality data at Horsethief Basin Lake. Data collected between 2006 and 2019 during fish surveys at multiple sites around the lake, were used to summarize the productivity and water quality for Horsethief Basin Lake (Table 2, Jones 2019).

Oxygen

The lake has a history of low oxygen level during the monsoon season due to prevalent vegetation. The lake appears to be most affected during cloudy days when there is not enough sunlight to allow for oxygen production. An aeration system was purchased by the USFS in 1994 and was being utilized at the lake. Several years after the aeration system was installed, vandals striped all the

copper from it. After getting the unit repaired and installed back into the lake, the entire unit was then stolen a short time later. The USFS has not replaced the system. Due to the remote location and history of vandalism and theft, the Department is exploring solar options that would be more cost effective and less likely to be stolen.

Conductivity

Specific conductivity was only taken at the 2019 survey and ranged from 62 $\mu\text{S}/\text{cm}$ to 136 $\mu\text{S}/\text{cm}$ and averaged 89 $\mu\text{S}/\text{cm}$.

pH

The pH values during the 2019 survey were taken at multiple locations and depths and ranged from 6.12 to 7.47, with a mean of 6.68.

Thermal Stratification

Horsethief Basin Lake exhibits thermal stratification during summer months. Depth of the thermocline varies between years, but typically occurs at a depth of around 2 meters (7 feet). Dissolved oxygen levels below this depth (2 m) are generally below 1.0 mg/L and not suitable for fish survival.

Phytoplankton

Phytoplankton resources in Horsethief Basin Lake have been poorly documented. Department staff collected an algae sample at the dam site in July 2008 and documented *Microcystis*, *Oscillatoria*, *Cosmarium*, *Euglena*, *Tracelmonas*, *Synurophye synura*, *Eudorina*, and *Oocystis* (Unpublished data 2008).

The Arizona Department of Environmental Quality has issued a fish consumption advisory for Largemouth Bass caught at Horsethief Basin Lake. This advisory is the result of elevated levels of mercury found in the flesh of these species. Details of the advisory can be found in the Arizona Fishing Regulations booklet or at <https://azdeq.gov/fca>.

Forage/Prey

Zooplankton

The zooplankton resources at Horsethief Basin Lake have not been well documented. Department staff collected a zooplankton sample at the dam site in July 2008 and documented 140 zooplankton per liter (Unpublished data 2008).

Redear Sunfish

Redear Sunfish provide recreational angling opportunities and are an important forage fish for Largemouth Bass at Horsethief Basin Lake. Catch rates and length ranges for Redear Sunfish are included in the species discussion later in the document.

Habitat

Natural fish habitat consists of aquatic vegetation (both emergent and submergent), woody debris, sand, and limited rocky areas. Rooted and floating aquatic vegetation is abundant in the lake with higher densities occurring in the summer and early fall.

Species

The major sportfish in Horsethief Basin Lake are Largemouth Bass and Redear Sunfish. Tiger Muskie are also present in Horsethief Basin Lake as of 2019; however minimal information has been gathered since initial stocking. Redear Sunfish are also the primary forage species for Largemouth Bass. All species in Horsethief Basin Lake are managed under statewide general daily bag limits.

Largemouth Bass:

The Department will manage the Largemouth Bass fishery in Horsethief Basin Lake under the General Opportunity approach. Targets under this approach include spring electrofishing catch rates of ≥ 50 fish/hour. Historically, canoe electrofishing surveys at Horsethief Basin Lake were conducted in the summer, however a switch was made to early fall electrofishing surveys in 2019. Due to heavy vegetation and protocols, future surveys will be conducted in spring or early summer to avoid the heavy vegetation around the lake. The 2016 and 2019 survey produced a catch rate of 105.41 and 55.79 fish per hour respectively, which meets this target (Figures 2 and 3, Dickens 2016, Jones 2019).

Redear Sunfish:

Redear Sunfish will be managed under the General Opportunity fishing standards and are also an important prey species in Horsethief Basin Lake. Catch rates for Redear Sunfish have been highly variable over the past three surveys (Figure 7) but are typically comprised of multiple individuals in the quality to preferred range (Jones 2019). During the 2019 fall canoe electrofishing survey we caught 48 Redear Sunfish at a rate of 92.26 fish per hour (Figures 4 and 5, Jones 2019). This was the highest catch rate for Redear Sunfish since 2009 and meets the General Opportunity standards (Figures 4 and 5).

Channel Catfish:

Channel Catfish are omnivorous, feeding on a wide variety of organic matter, dead and alive. Some of the more common foods are fish, mussels, snails, insects and crayfish. Historically, the Department has stocked catchable sized Channel Catfish during the summer to establish a put-and-take Channel Catfish fishery. However in 2003, due to low angler numbers and poor access for the hatchery truck, Channel Catfish stockings were discontinued. There are no plans to resume stockings of Channel Catfish.

Tiger Muskie:

The Department will manage the Tiger Muskie fishery in Horsethief Basin Lake under the Featured Species fishing standards. Targets under this approach include spring electrofishing catch rates of ≥ 20 fish/hour. In 2019, the Department stocked a total of 450 fingerling Tiger Musky in May. These fish were acquired from the State of Utah. During the fall 2019 survey there was an increase of vegetation which made deploying trap nets and conducting electrofishing surveys difficult. Additionally, the trap nets used in the survey were sinking nets that rested on the bottom. With anoxic conditions below two meters fish were unlikely to move into the trap section of the net and likely resulted in no fish being captured in trap nets (Jones 2019). Future surveys will be conducted in early summer to avoid vegetation issues.

Additionally, an objective guideline for the Featured Species approach at this lake is to maintain angler preference at 50% of anglers targeting Tiger Muskie. There has not been a creel conducted at Horsethief Basin Lake. A future creel should be conducted in the next ten years to evaluate angler catch rates.

Maintaining a Featured Species fishery for Tiger Muskie at Horsethief Basin Lake may be difficult. Studies have shown that stocking Tiger Muskie into lakes with Largemouth Bass result in heavy predation on the Tiger Muskie. Stein et al. (1981) estimated that mortality of Tiger Muskie exceeded 95% within 40 days of stocking in two Ohio lakes. They attributed the majority of this mortality to thermal stress and predation by Largemouth Bass. Unlike Stein et al. (1981) Horsethief Basin Lake temperature at stocking was very similar to the tank temperature and fish were tempered for 15 minutes prior to stocking to avoid this issue. Nonetheless, Wahl et al. (2012) also noted high post stocking mortality (~50%) due to Largemouth Bass predation in laboratory, pond, and lake stocking experiments. To hopefully negate this predation Tiger Muskie were stocked into Horsethief Basin Lake at a high density (225/ha). Once the stocked Tiger Muskie recruit to a size that makes them available to electrofishing gear sampling, we should get an idea on survival of this initial stocking. Future stocking densities will be based on the estimated survival of the initial stocking.

Access

Horsethief Basin Lake provides one small earthen boat ramp and shoreline access. However, in recent years the shoreline access has become impeded by the encroachment of cattail. The Region VI Aquatic Wildlife Program has been working with the PNF to complete the necessary compliance work to complete a cattail removal project at Horsethief Basin Lake to increase shoreline access.

Catch

Horsethief Basin Lake does not have an estimate of angler days because there has not ever been a complete creel survey at the lake. Horsethief Basin Lake also was not reported on in the 2013 statewide creel results. A future creel should be conducted in the next ten years to evaluate angler catch and use.

There was a voluntary creel conducted in 1992, 1997, and 1998 which each survey evaluated angler responses for one to four months in each of those summers. The 1992 results included 51 angler responses with 71% of the angler indicating their fishing experience at the lake was poor (McMahon and Warnecke 1998). The survey also indicated an angler catch rate of 0.22 fish per hour (McMahon and Warnecke 1998). The 1997 survey only captured 10 angler forms for one month (McMahon and Warnecke 1998). The 1998 voluntary angler creel form captured 57 anglers (McMahon and Warnecke 1998). The survey also indicated an overall angler catch rate of 0.77 fish per hour (McMahon and Warnecke 1998). A future creel should be conducted in the next ten years to evaluate angler catch rates.

Satisfaction

An angler satisfaction of 80% is the established goal for this fishery. A future creel should be conducted in the next ten years to evaluate angler satisfaction.

Literature Cited

- Arizona Game and Fish Department 2019. Warmwater Sportfisheries Strategic Vision Document. Arizona Game and Fish Department, Statewide Sportfish Program, Phoenix, Arizona.
- Dickens, B. 2016. Horsethief Basin Lake Fish Survey Report August 9 2016. Arizona Game and Fish Department, Mesa, Arizona. 6 pp.
- Jones, A.K. 2019. Horsethief Basin Lake Survey Report September 9-10, 2019. Arizona Game and Fish Department, Region VI. 9 pp.
- Stein, R.A., R.F. Carline, and R.S. Hayward. 1981. Largemouth Bass Predation on Stocked Tiger Muskellunge. Transactions of the American Fisheries Society. 110:604-612.
- McMahon, T.R. and J.J. Warnecke. 1998. Horsethief Basin Lake Fish Management Report, 1988-1998. Region VI Fisheries Program. Arizona Game and Fish Department, 7200 East University, Mesa, Arizona, 85207.
- Unpublished data. 2008. Arizona Game and Fish Department Aquatic Wildlife Water Quality Program.
- Wahl, D.H, L.M. Einfalt, and D.B. Wojcieszak. 2012. Effect of Experience with Predators on the Behavior and Survival of Muskellunge and Tiger Muskellunge. Transactions of the American Fisheries Society. 141:139-146.

Tables and Figures

Table 2. Physical and chemical characteristics of Horsethief Basin Lake

Management Agencies:	
Water Storage	U.S. Forest Svc. – Prescott Natl. Forest
Land Management	U.S. Forest Svc. – Prescott Natl. Forest
Aquatic Species Management	Arizona Game and Fish Department
Impoundment Date	1936
Watershed (main drainages)	
Poland Creek	0.76 square miles
Surface Area	5 acres
Capacity	64 acre-feet
Length	0.13 miles
Shoreline	0.5 miles
Mean Depth	10 feet
Maximum Depth	20 feet
Secchi Depth Average	2.3 feet
pH Range	6.2 – 9.0
Conductivity Average	89 μ S
Sodium Concentration Average	4.47 mg/l
Chl-a Average	3.89 ug/l

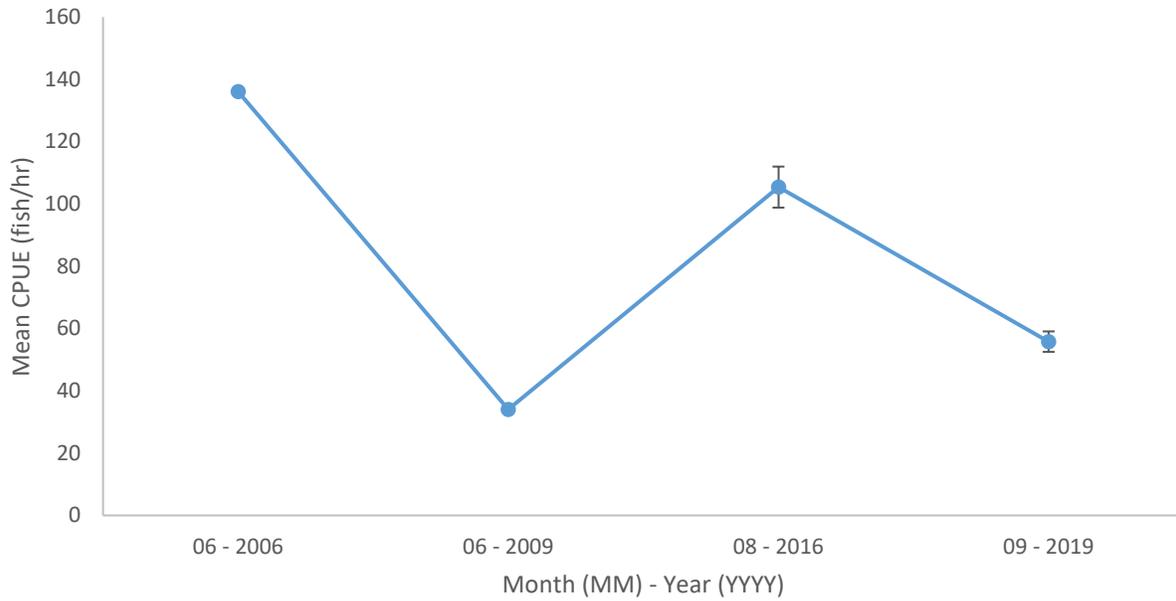


Figure 2. Electrofishing catch rates at Horsethief Basin Lake for Largemouth Bass between 2006 and 2019 with standard error when available.

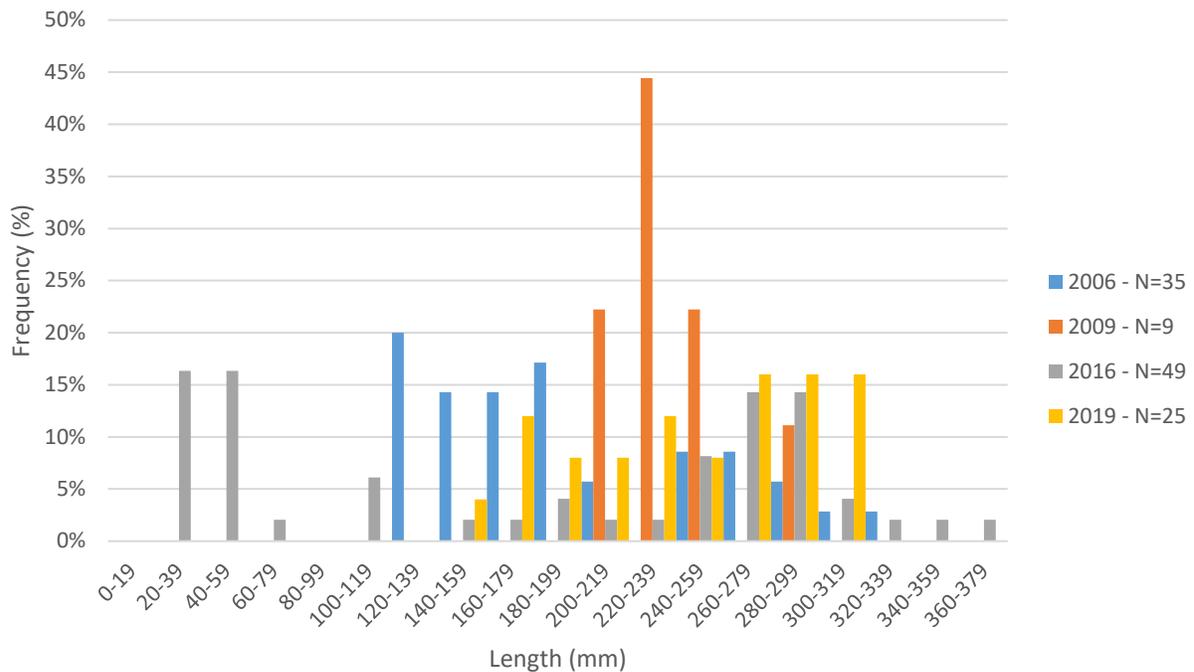


Figure 3. Largemouth Bass length frequency for canoe electrofishing at Horsethief Basin Lake for 2006, 2009, 2016, and 2019 with total number captured, N.

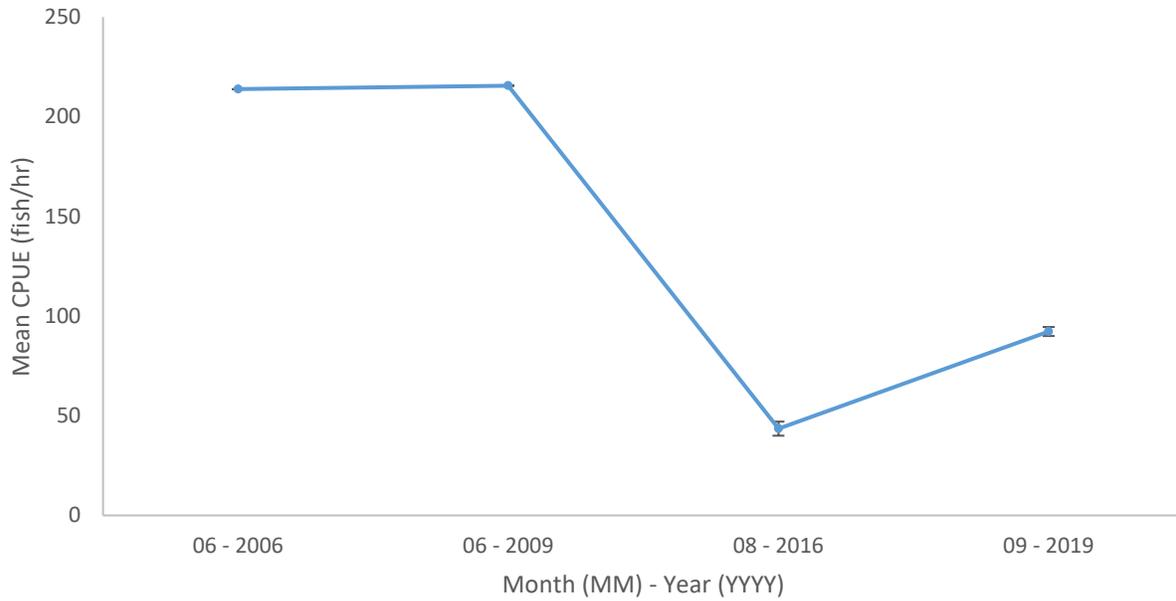


Figure 4. Electrofishing catch rates at Horsethief Basin Lake for Redear Sunfish between 2006 and 2019 with standard error when available.

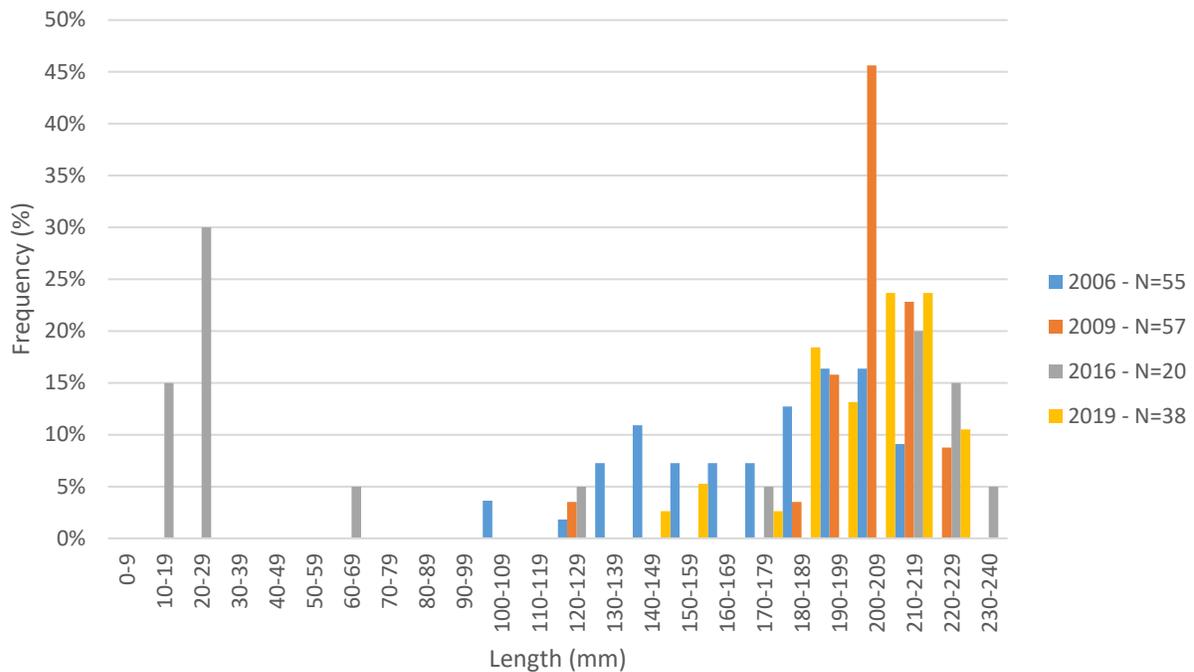


Figure 5. Redear Sunfish length frequency for canoe electrofishing at Horsethief Basin Lake for 2006, 2009, 2016, and 2019 with total number captured, N.

Appendices

Appendix A. Species, year stocked, size (if known), number of stockings, and total number of fish stocked per year in Horsethief Basin Lake from 1954 to 2019.

Species	Year	Size	# of Stockings	Total # Stocked
Bluegill	1954		1	17,000
Channel Catfish	1965-2003		3	1,160
Channel Catfish	1965	Fingerling	1	1,000
Channel Catfish	1966	Fingerling	1	1,000
Channel Catfish	1976	Fingerling	1	5,000
Channel Catfish	1981	Fingerling	1	400
Channel Catfish	1984	Fingerling	1	400
Channel Catfish	1988	Subcatchable	1	200
Channel Catfish	1992	Fingerling	1	250
Channel Catfish	1995	Catchable	1	300
Channel Catfish	1996	Catchable	1	62
Channel Catfish	1997	Catchable	1	100
Channel Catfish	1998	Catchable	1	150
Channel Catfish	2000	Catchable	1	156
Channel Catfish	2000	Catchable	1	150
Channel Catfish	2002	Catchable	1	151
Channel Catfish	2003	Catchable	1	149
Fathead Minnow	1998	Adult	1	1,500
Largemouth Bass	1954-1960		1	5,000
Largemouth Bass	1960	Fingerling	1	2,000
Redear Sunfish	1988	Subcatchable	1	300
Tiger Muskie	2019	Fingerling	1	449