



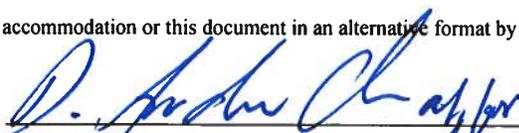
Roosevelt Lake Fisheries Management Plan 2019 – 2029

Curt Gill, Aquatic Wildlife Program Manager, Region VI

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Approved [X] by Chris Cantrell


Date: 6/29/19
Aquatic Wildlife Branch Chief

Location

Roosevelt Lake was formed by Roosevelt Dam impounding the Salt River approximately 55 miles northeast of Phoenix. Roosevelt Lake can be reached from AZ State Route 188 (Figure 1).



Figure 1. Map of Roosevelt Lake.

Management Prescription

The Arizona Game and Fish Department (Department) has developed concepts under a Warmwater Strategic Vision Document (AGFD 2019) to help guide warmwater fisheries management in Arizona. Using these concepts, fisheries management at Roosevelt Lake will focus primarily on a AZ Hawg Bass, Largemouth Bass *Micropterus salmoides* fishery, secondarily to manage for a Fat Cat water for Flathead Catfish *Pylodictis olivaris* and thirdly on a Featured Species opportunity fishery for Black Crappie *Pomoxis nigromaculatus*.

Objective 1: Maintain the Largemouth Bass population to meet or exceed Hawg Concept standards.

Objective 2: Maintain the Black Crappie population to meet or exceed the Featured Species Concept standards.

Objective 3: Maintain the Flathead Catfish population to meet or exceed Fat Cat Concept standards.

Monitoring activities, including community-wide or species-specific electrofishing surveys and angler creel surveys will be used to determine if aforementioned management objectives are being met. Objective guidelines to meet objectives are listed in Table 1 below.

Table 1. Roosevelt Lake Objectives and Adaptive Management Strategies.

<i>Objective 1: Maintain the Largemouth Bass population to meet or exceed Hawg Concept standards as listed in the Warmwater Sportfisheries Strategic Vision Document.</i>			
Parameters	Objective Guideline	Trigger point to address unmet objectives	Strategies if Objectives are not met
Electrofishing Catch Rates	Spring electrofishing CPUE ¹ ≥ 50 fish per hour.	<p>Mean CPUE drop below 50 fish/hour for three consecutive surveys.</p> <p>Mean CPUE drops below 10 fis/hour for a single sampling event.</p>	<ul style="list-style-type: none"> • Re-evaluate survey methods and equipment • Stocking • Regulation Changes

Size Structure	PSD ² between 50-80, PSD-P between 30-60, and PSD-M between 10-25.	Three consecutive sampling events showing population below management guideline.	<ul style="list-style-type: none"> • Re-evaluate survey methods and equipment • Stocking • Regulation Changes
Angler Catch Rates	Angler CPUE of no less than 0.25 fish per hour for anglers targeting Largemouth Bass.	Angler CPUE drops below 0.25 Largemouth Bass per hour for two consecutive creel surveys.	<ul style="list-style-type: none"> • Stocking • Regulation Changes • Outreach/Education

Objective 2: Maintain the Black Crappie population to meet Featured Species Concept standards as listed in the Warmwater Sportfisheries Strategic Vision Document.

Size Structure	Multiple Age Classes PSD between 30-60, PSD-P > 10.	Three consecutive sampling events showing population below management guideline.	<ul style="list-style-type: none"> • Re-evaluate survey methods and equipment • Regulation Changes • Stocking
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Objective 3: Maintain the Flathead Catfish population to meet or exceed Fat Cat Concept standards as listed in the Warmwater Sportfisheries Strategic Vision Document.

Electrofishing Catch Rates	Fall electrofishing catch rates \geq 10 fish/hour.	Three consecutive surveys with <10 fish/hour.	Consider bag or length limits changes for Flathead Catfish
Size Structure	Greater than 15% of the total catch of Flathead Catfish is greater than 34 inches.	Three consecutive sampling events showing population below management guideline.	<ul style="list-style-type: none"> • Re-evaluate survey method and equipment • Stocking • Regulation Changes

¹ CPUE=Catch Per Unit Effort (fish per hour) ² PSD=Proportional Size Distribution

Background

Roosevelt Lake is the upper most and largest lake in a series of four reservoirs on the Salt River (Figure 1). The Bureau of Reclamation constructed Theodore Roosevelt Dam in 1911 forming Roosevelt Lake. At full capacity it is approximately 22 miles long with 91 miles of shoreline; its maximum depth is over 300 feet. The mean depth is 100 feet, storing approximately 1,653,043 acre feet of water (Table 2).

The land around Roosevelt Lake is managed by the U.S. Forest Service, more specifically the Tonto National Forest. The aquatic species within the lake are managed under the authority of the Arizona Game and Fish Department (Department). The Department's sportfish management objectives are to provide a diversity of sportfish to anglers.

Roosevelt Lake electrofishing surveys in 2008, 2009, 2011, and 2013 indicated a dwindling population of Largemouth Bass, Black Crappie, and Bluegill. Electrofishing catch per unit effort (CPUE) for Largemouth Bass declined from 44.4 fish/hour in 2008 to 10.6 fish/hour in 2013, a roughly 75% decline. Similarly, electrofishing CPUE for Bluegill declined more than 80% from 30.0 fish/hour in 2008 to 5.6 fish/hour in 2013. Additionally, both species showed a decline in physical condition, although condition had not yet fallen below normal levels considered for a healthy population. Mean relative weight (W_r) of Largemouth Bass declined from 96 in 2008 to 86 in 2013, while Bluegill mean W_r declined from 93 in 2008 to 83 in 2013. Black Crappie have also shown a dramatic decline in CPUE based on recent surveys. Gill net catch rates for Black Crappie declined over 80% from 0.27 fish/hour in 2008 to 0.06 fish/hour in 2011. Black Crappie also experienced a decline in mean W_r from 109 in 2008 to 99 in 2011.

The angling public, through creel surveys and angler comments, further supported recent fishery declines. During that period, AGFD has received numerous complaints about the "quality" of fishing at Roosevelt Lake. Recent Angler Roundtables held in Tonto Basin were held to address the angling public's concerns for the declining fishery at Roosevelt Lake. The decline in the fishery may be explained by a number of complex factors such as the relatively recent appearance of gizzard shad, ongoing water level fluctuations, water quality (e.g. golden algae), diseases (e.g. Largemouth Bass Virus), and lack of habitat due to the aging reservoir syndrome. Roosevelt Lake has had minimal fisheries habitat enhancement projects implemented and current fish habitat conditions in the lake are believed to be marginal.

The cumulative impact of these stressors may be negatively affecting multiple species at the population level. The ability to pinpoint the relative impacts of each individual stressor is difficult due to the complex community dynamics. There is also limited ability to address each of the stressors due to limited availability of appropriate tools, methods, and feasibility; however, two areas were recently identified to address the observed decline of angler catch rates; augmentation of key species within the sport fish community and habitat enhancement.

Productivity/Water Quality

The Department's Aquatic Wildlife Branch water quality staff collects water quality data at Regional reservoirs. Data collected between 2000 and 2014 at various times of year, and at multiple sites around the lake, were used to summarize the productivity and water quality for Roosevelt Lake (Table 2).

Conductivity

Specific conductivity ranged from 543 $\mu\text{S}/\text{cm}$ to 2867 $\mu\text{S}/\text{cm}$ during the period and averaged 1445 $\mu\text{S}/\text{cm}$. Typically, conductivities are lower in year with high runoff from the Salt River and higher in years with low runoff. Over the last few years, conductivities in the reservoir have averaged around 1800 $\mu\text{S}/\text{cm}$ due to poor winter precipitation and reduced runoff. These values are similar to other lakes on the Salt River chain, but significantly higher than those of other lakes in the Region.

Sodium Concentration

Sodium concentration values averaged 285 mg/l.

pH

The pH values ranged from 7.3 to 9.1, with a mean of 8.1, representing an alkaline system.

Thermal Stratification

Roosevelt Lake exhibits thermal stratification during summer months. Depth of the thermocline varies between years, but typically occurs at a depth of around 25 – 30 feet. Dissolved oxygen levels below this depth are generally below 3.0 mg/L.

Productivity

A trophic state index (TSI), developed by Carlson (1977), was calculated to measure the lake's productivity. The TSI uses chlorophyll-a, total phosphorus, and secchi depth values to provide a single quantitative index for the purpose of classifying and ranking lakes. Trophic state index scores range from 0 for highly oligotrophic lakes to 100 for hypereutrophic lakes. Data collected from Roosevelt Lake between 2000 and 2014 produced a TSI value of 49. This classifies the lake as mesoeutrophic.

Phytoplankton

Phytoplankton resources in Roosevelt Lake have been poorly documented. Of concern though is the recent detection of Golden Algae *Prymnesium parvum*. Golden Algae was first documented in Arizona in 2005 in the lower three (Apache, Canyon, and Saguaro) reservoirs in the Salt River chain. Golden Algae was responsible for major fish kills in all three reservoirs greatly reducing many fish species and basically eliminating Smallmouth Bass *Micropterus dolomieu*. Additionally, Golden Algae has been found in more than 30 small municipal or private water and several urban fishing lakes in central Arizona but until 2012 it had not been documented in Roosevelt Lake. In August and September 2012 the first Golden Algae related fish kills were documented. These were relatively small kills that affected primarily Gizzard Shad *Dorosoma*

cepedianum. Additional kills were documented in August 2013 with some sportfish affected.

There is a fish consumption advisory for Largemouth Bass, and Channel Catfish caught at Roosevelt 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

Bluegill

Bluegill sunfish provide recreational angling opportunities and are an important forage fish for littoral predators at Roosevelt Lake. Catch rates and length ranges for Bluegill are included in the species discussion later in the document.

Shad

Roosevelt Lake contains both Gizzard and Threadfin Shad *Dorosoma petenense*. Adult Gizzard Shad are able to reach large sizes and can outgrow gape limits of many predators. Threadfin Shad adults are considerably smaller, rarely exceeding 6 inches in length. Threadfin are temperature sensitive and stress at temperatures below 45°F.

Zooplankton

The zooplankton resources at Roosevelt Lake have not been well documented. The most recent known study that looked at zooplankton resources in any fashion was conducted as part of a study to determine the limiting factors to crappie populations in the Salt River chain of lakes (Horton 1997). Horton (1997) noted that Roosevelt Lake contained larger zooplankton than the 3 lower reservoirs. However, this study is 20 years old and Gizzard Shad are now abundant in Roosevelt Lake. Zooplankton species composition, size and density may have changed considerably since then. The Department will work to develop a protocol for monitoring zooplankton resources to get a feel for how Gizzard Shad may be affecting them and any potential related impacts to sportfish populations.

Habitat

Natural fish habitat consists of rocky points, areas of limited standing timber (primarily near the Tonto Creek and Salt River confluences), rock, coarse gravel, and mud or sand flats. Rooted aquatic vegetation is limited in Roosevelt Lake due to the fluctuating nature of the reservoir, although aquatic macrophytes and cattails are present in some coves. Additional habitat includes man-made structures such as rip-rap (primarily near the dam) and old tires.

Roosevelt Lake is an aging reservoir that has been impounded for more than 100 years. Much of the large woody debris has broken down and siltation has covered much of the substrate near the inflow areas of the reservoir. Artificial habitat would be beneficial to the sportfish populations in Roosevelt Lake. The last habitat enhancement of any kind occurred in Roosevelt Lake in May 1996. This was a small-scale project that consisted of the placement of 22 weighted brush piles in the vicinity of the Roosevelt Lake Marina (Region VI files). The brush from this project has likely

completely degraded. Due to the aging of the reservoir and recent declines in sportfish populations, the Department has recently began a more large-scale, long-term habitat enhancement project for Roosevelt Lake that began in spring 2017. The Department has been utilizing a variety of man-made habitats: Fishiding Highrise fish structures, Mossback Safehaven fish structures, Concrete Fish Balls, and Georgia cubes. These structures have been placed at 20 locations over a 2-year period (Jones and Weedman 2014). To date, over 1,100 of these structures have been placed into Roosevelt Lake.

Species

The major sportfish in Roosevelt Lake include Largemouth Bass, Smallmouth Bass, Black Crappie, Bluegill, Flathead Catfish, and Channel Catfish. Yellow Bass are also present in Roosevelt Lake but do not contribute significantly to the fishery, although recent data suggest their density may be increasing. The primary forage species include Threadfin Shad, Gizzard Shad, and several species of sunfish *Lepomis* spp. Other species found in the lake include Bigmouth Buffalo *Ictiobus cyprinellus*, Smallmouth Buffalo *I. bubalus*, Black Buffalo *I. niger*, and Common Carp *Cyprinus carpio*.

Special fishing regulations which apply to Roosevelt Lake include:

Black Crappie: 15 per day,

All other species in Roosevelt Lake are managed under statewide general daily bag limits.

Black Bass and Temperate Bass

Roosevelt Lake contains two species of black bass: Largemouth Bass and Smallmouth Bass and is known as one of the best black bass lakes in the Southwest. In 2014, Roosevelt Lake ranked as the #1 fishing lake in Arizona according to results reported to the Department from an angler opinion survey (Duda et al. 2014).

Fishing regulations are applied as one tool to manage for healthy fish populations, including black bass. Department biologists found during the late '80s, bass catch rates at Roosevelt Lake were down to 0.12-bass-per-hour. This meant the average angler caught one bass for every eight hours of fishing. Additionally, Roosevelt Lake was experiencing a 51% harvest rate on all bass caught (AGFD 1989). Based on this information, a no possession slot limit of 12" to 16" was initiated for bass in 1990. Two years later the lower slot limit value was increased to 13" to allow harvest of 12" fish. The objectives of the slot limit were to increase angler catch rates for bass in general by protecting spawning adults while increasing the average size of bass caught by making more 13-16 inch fish available. This slot was in effect until 2009 when it was changed to allow one bass in the 13" to 16" slot to be kept. In August 2010, the slot regulation was no longer needed due to increased catch and release practices and a decline in angler harvest and therefore removed. Currently, the statewide daily bag limit of six bass, either Smallmouth or Largemouth, in any combination, is the only regulations applied for bass on Roosevelt Lake.

Largemouth Bass:

Largemouth Bass is the dominant black bass species in Roosevelt Lake. Roosevelt was first stocked with Largemouth Bass in 1941 and has been stocked periodically since then (Appendix A). Through the years, Roosevelt Lake has always produced numerous stock size and preferred size Largemouth Bass. However, recent declines in the Largemouth Bass population (Figure 2) and the recent introduction and proliferation of Gizzard Shad prompted the Department to begin stocking Florida strain Largemouth Bass to increase abundance of bass, especially those in the larger size classes. The Department collected DNA samples from Largemouth Bass in fall 2013 that indicated that 0% were pure Florida strain, 10 % were F₁, 90 % were F_x, and 0% were northern strain bass. Additionally, it was determined that 48% of the alleles were from Florida strain and 52% were from northern strain Largemouth Bass.

Catch rates for Largemouth Bass declined greatly following the introduction and proliferation of Gizzard Shad, although declines were observed later than in the Bluegill populations. Fall electrofishing catch rates have historically averaged over 30 fish/hour but in 2013 and 2014 fall survey catch rates fell to around 10 fish/hour (Figure 2). Stewart et al. (2013) noted that supplemental stocking of bass may be beneficial when electrofishing catch rates fall below 10 fish/hour. As a result we stocked roughly 370,000 Florida Largemouth Bass fry in spring 2014, 570,000 fry and 40,000 fingerling in spring 2015, and an additional 40,000 fingerlings in spring 2016. Our fall 2015 electrofishing survey resulted in a catch rate of 41.9 fish/hour. The increase in catch rates can be attributed to larger increases in age-0 and age-1 bass (Figure 3), likely boosted by the supplemental stocking of Florida strain Largemouth Bass. Relative weight (Wr) of Largemouth Bass declined from 96.0 in 2008 to 86.0 in 2013. The 2015 survey noted an increase in Wr to 90.6, indicating prey availability for Largemouth Bass may be improving.

The Department would like to manage the Largemouth Bass fishery in Roosevelt Lake under the Hawg bass concept. Targets under this concept include spring electrofishing catch rates of ≥ 50 fish/hour. Historically, the electrofishing surveys at Roosevelt Lake were conducted in the fall, however we did switch to spring electrofishing surveys in 2018 to more easily compare results with Regional, State, and National data. The 2018 survey produced a catch rate of 54.5 fish/hour which meets this target.

Additionally, the Hawg concept has a goal for angler catch rates of no less than 0.25 fish/hour. The most recent creel survey completed in 2015 documented Largemouth Bass catch rates of 0.58 fish/hour, well above the target. However, the spring 2018 electrofishing survey calculated Largemouth Bass PSD at 46.7, PSD-P at 15.8, and PSD-M at 0.4, all of which are currently below the size structure targets outlined under the Hawg concept.

Smallmouth Bass:

Smallmouth Bass were stocked in 1941 (Appendix A). The population is self-sustaining but has remains at relatively low numbers when compared to other Smallmouth Bass populations, like Apache Lake. Sampling data is limited for Smallmouth Bass given their preference for deeper,

rock and bolder type habitat. These habitats are not effectively sampled by fall nighttime electrofishing. Spring electrofishing samples conducted during 2018 did not capture Smallmouth Bass therefore we have no recent data on the species.

Yellow Bass:

Yellow Bass are present in Roosevelt Lake and may contribute to the recreational fishery. Catch rates for Yellow Bass have varied over the past five surveys (Figure 8) but are typically considerably lower than those on the lower 3 Salt River lakes. Total catch of Yellow Bass was 27 for a catch rate of 5.1 fish/hour during our most recent survey. However, the catch rate was substantially lower than the previous two surveys (Figure 4).

Sunfish

Black Crappie:

Black Crappie is the only crappie species in Roosevelt Lake. Angling for crappie is popular during the spring spawn and throughout the year around known crappie habitat. Creel surveys were conducted at Roosevelt Lake in 2009/2010 and again in 2014/2015. Results from these creel indicated that angler exploitation was about 65%. Restrictive harvest regulations (15 fish/day) were implemented following the creel survey that ended in 2010 to improve the size structure of the population and increase the percentage of older crappie.

Sampling for crappie has been primarily through the use of gill nets at Roosevelt Lake. Following documentation of Gizzard Shad, crappie catch rates in gill nets fell to almost undetectable levels (Figure 5). For this reason we began experimenting with standard American Fisheries Society (AFS) crappie fyke (trap) nets (Bonar et al. 2009) in spring of 2014. We caught more crappie in trap nets in spring 2014 than in prior gill net surveys but catch was still low at 1.7 crappie per net night (0.07 fish/hr) and we only collected crappie greater than 8 inches. This was not surprising as spring trap net sampling has been shown to be biased towards larger length individual (Bonar et al. 2009). Additionally, Bonar et al. (2009) noted that standard trap nets are limited in lakes with abundant steep shoreline habitats like Roosevelt Lake. In response we purchased, and began using, a floating trap net similar to those developed in Mississippi as an alternative to the AFS standard trap net for sampling crappie (Miranda et al. 1996). The main differences between the Mississippi trap net described by Miranda et al. (1996) and our trap net was ours had smaller frames (6' x 6' vs. 8' x 8') and a shorter lead (150' vs. 200') to make them easier to set and pull than the Mississippi nets.

We used both the floating trap nets and the standard AFS trap nets in early spring 2015. During the spring sampling effort we set floating trap nets for four net nights and standard AFS trap nets for 11 net nights which produced 13 total crappie at a catch rate of 1.75 crappie/net night in floating nets and 0.55 crappie/net night in standard nets. Based on the results and the recommendations in Bonar et al (2009) to sample crappie in late summer or early fall we sampled again in early fall 2015 using only floating crappie nets. Fall sampling proved much more fruitful and produced a

total of 148 crappie for a mean catch rate of 13.6 crappie/net night (0.62 crappie/hr). Approximately 14% of the population exceeded 8" during the fall 2015 survey but the majority of were less than 4" (Figure 6).

The Department would like to manage Roosevelt Lake as a Featured Species concept Black Crappie fishery. Under this concept the Department wants to maintain multiple age classes of Black Crappie. Most recent survey results indicate that this target is being met. Additionally, we would like to maintain a balanced Black Crappie population as defined by Gabelhouse (1984). He recommended a PSD of between 30-60 and an RSD-P of >10 for a balanced crappie population. Results from the fall 2015 crappie trap netting survey produced a PSD of 45.6 and a RSD-P of 14.0, both well within the range for a balanced population.

Bluegill:

Bluegill are an important prey species in Roosevelt Lake and also contributes to the recreational fishery. Catch rates for Bluegill have been highly variable over the past five surveys (Figure 7) but are typically comprised of smaller individuals. During the 2015 fall electrofishing survey we caught 345 Bluegill at a rate of 54.6 fish/hour. This was the highest catch rate for Bluegill over the past 5 surveys, however most of the Bluegill (97%) were less than 5" long, and would not be of harvestable size for the typical angler but would be forage for predatory sportfish.

Catfish

Flathead Catfish:

Flathead Catfish are a popular recreational sportfish in Roosevelt Lake. It is not uncommon to catch Flathead Catfish over 60 pounds. Recently the new state record Flathead Catfish, weighing over 76 pounds, was caught in Bartlett Lake. This has put Arizona in the National spotlight as a destination for Flathead Catfish angling. However, monitoring for Flathead Catfish has not been a priority in the past. Any data collected on Flathead Catfish has been ancillary during surveys conducted primarily to collect data on Largemouth Bass. For this reason, the Region began using survey methods to specifically target Flathead Catfish in 2015. The purpose of the survey is to collect baseline data on Flathead Catfish to assess the potential of Roosevelt Lake as a trophy fishery.

In conjunction with our standard nighttime bass sampling, we began preliminary sampling using low-frequency, pulsed-DC electrofishing during the daytime similar to those described by Cunningham (1995) in fall 2015. Catch and length frequency data were compared between the standard nighttime electrofishing and low-frequency daytime electrofishing. Flathead Catfish mean catch rates for standard nighttime electrofishing and low-frequency daytime electrofishing were 9.5 fish/hour (S.E. 3.1) and 15.2 fish/hour (S.E. 4.5) respectively. In general, nighttime electrofishing was biased towards smaller size classes (<20 inches) of Flathead Catfish while daytime electrofishing produced a more unbiased representation of Flathead Catfish lengths, but did fail to catch fish less than 7 inches long (Figure 8). Since daytime electrofishing produced

higher catch rates and less biased size class data, it will be used as the primary method to assess the Flathead Catfish population in Roosevelt Lake.

The Department would like to manage for an exceptional Flathead Catfish fishery at Roosevelt Lake under the Fat Cat concept. One target would be to have 15% of the fall daytime electrofishing catch be greater than 34 inches. During recent fall surveys the percentage of fish > 34 inches was 15.8% in 2015, 1.8% in 2016 and 17.5% 2018, with two of the three years over our target. The second target is for an electrofishing catch rate of ≥ 10 fish/hour. The last three surveys produced catch rates of 14.9, 39.3, and 44.4 fish/hour in 2015, 2016, and 2018 respectively, all well over our target.

We believe that managing for an exceptional Flathead Catfish fishery under this concept would highlight a unique opportunity at Arizona's most used lake as well a potentially help control the large Gizzard Shad population. Slaughter and Jacobsen (2008) noted that Gizzard Shad could not achieve a body size large enough to avoid predation by Flathead Catfish 47 inches or larger. We have documented Flathead Catfish of this size in Roosevelt Lake and managing to protect these fish should help to control Gizzard Shad in the lake.

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. Electrofishing catch rates for channel catfish have remained inconsistent over the last five surveys. In 2015, we only captured one Channel Catfish in 5.3 hours of electrofishing effort. Therefore, no statistics were calculated for Channel Catfish in 2015.

Undesirable or Invasive Species:

Quagga Mussels *Dreissena bugensis* were first detected in central Arizona in Lake Pleasant in 2008. Since that time, adult Quagga Mussels have become widespread throughout small ponds and lakes in the Phoenix metro area and have been recently documented in the lower 3 Salt River chain lakes. Due to the popularity of Roosevelt Lake and the other infected lakes and their close proximity to each other, numerous vectors exist for the transfer of water and Quagga Mussel larvae (called veligers) to Roosevelt Lake and surrounding reservoirs. The Department has already taken on an aggressive campaign to prevent the spread of Quagga Mussels. The Region should work closely with AIS program to monitor Roosevelt Lake for the detection of Quagga Mussels.

Largemouth Bass Virus (LMBV) is the only virus known to cause a newly recognized lethal disease of wild Largemouth Bass. The disease usually occurs during the summer and typically affects adult fish (Grizzle and Brunner 2003). In Largemouth Bass signs of the disease may include increased blood flow and darkened skin, distended abdomen, bloated swim bladder, lesions in the membrane lining the body cavity, necrosis (burst cells resulting in inflammation) of gastrointestinal mucosa, pale liver, red spleen, red intestinal caeca, infected gills, lethargic swimming, decreased responsiveness, swimming at the surface and/or in circles, and difficulty

remaining upright. Sores or lesions on the outside of the body are secondary and not caused by the actual viral infection (Kipp 2012). Roosevelt Lake tested positive for LMBV in 2011. Although no declines have been directly attributed to LMBV the virus has been shown to cause mortalities in other states.

Gizzard Shad *Dorosoma cepedianum* were first documented in the lake by the Department in 2007. By 2011 Gizzard Shad had the highest catch rates in both gill netting and electrofishing surveys (Cantrell and Rogers 2012). The most source of the introduction is unknown but since their documentation in the reservoir they have had negative effects on the Largemouth Bass, Black Crappie and Bluegill populations.

Golden alga *Prymnesium parvum* was first discovered in Arizona in 2005 and has since been identified in all four reservoirs along the Salt River on the Tonto National Forest. Golden alga has been documented to be the cause of several kills that have occurred in these reservoirs starting in 2001 with Asian Clam *Corbicula fluminea* die offs in Saguaro Lake. Under certain environmental stresses, golden algae produce a toxin that negatively affects gill-breathing species such as fish, mollusks, arthropods, and the gill-breathing stage of amphibians (Stewart 2012). To date Roosevelt Lake has not experienced any fish kills in the main reservoir but there have been isolated fish kills in the arms of the reservoir in 2012 and 2013. The most likely reason fish kills have not occurred at the lake is due to the constant inflow that maintains a lower conductivity and influx of nutrients compared to the rest of the chain Apache, Canyon, and Saguaro Lakes.

Access

Roosevelt Lake provides a number of access points for boaters. Boat ramps are available at Indian Point, Cholla, Marina (private), Windy Hill (Badger, Ringtail, Bobcat, and Coyote ramps), Grapevine and Schoolhouse. At the current reservoir elevation of 2,130 feet, the Badger boat ramp is under water and unusable. Shoreline access is excellent on most of the southwest side of the lake, with multiple access points in addition to those mentioned above. Bermuda Flat, Cholla Bay, Bachelor Cove, Vineyard, and Frazier provide developed access points and there are additional undeveloped access points around the lake. Roosevelt Lake has the greatest access for shoreline anglers of any of the Regional lakes.

Catch

Roosevelt Lake was estimated to experience 451,242 angler use days per year and was ranked the most popular fishing lake in Arizona according to a recent statewide angler opinion survey (Duda et al. 2014). Additionally, Roosevelt Lake is a very popular tournament lake, holding multiple bass tournaments every week for most of the year.

Satisfaction

An angler satisfaction of 80% is the established goal for this fishery. The 2014/2015 creel study showed that only 60% of anglers rated their experience fair or better and only 32% rated their fishing experience good or excellent. This is down from 2010 when 69% of anglers rated their

experience fair or better and 47% rated their experience good or excellent. That is not surprising as we had not yet noted declines in the Largemouth Bass population until 2013. Also, satisfaction varies seasonally at Roosevelt Lake. Anglers report higher satisfaction in spring and fall and lower satisfaction in winter and summer. These correlate closely with angler catch rates during those seasons. We have noted recent increases in both Largemouth Bass and Black Crappie populations. It will be interesting to see if we detect a corresponding increase in angler satisfaction and catch rates during our next creel survey that will likely begin in 2019.

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Tables and Figures

Table 2. Physical and chemical characteristics of Roosevelt Lake

Management Agencies:	
Water Storage/Power production	Salt River Project (SRP)
Land Management	U.S. Forest Svc. – Tonto Natl. Forest
Aquatic Species Management	Arizona Game and Fish Department
Impoundment Date	1911
Watershed (main drainages)	
Salt River	4,306 square miles
Tonto Creek	675 square miles
Surface Area	21,493 acres
Capacity	1,653,043 acre-feet
Length	22 miles
Shoreline	91 miles
Mean Depth	100 feet
Maximum Depth	300 feet
Secchi Depth Average	7.2 feet
pH Range	7.5 – 9.0
Conductivity Average	543 – 2867 umhos
Sodium Concentration Average	285 mg/l
Chl-a Average*	4.8 ug/l

* = 95% trimmed mean used to eliminate extreme outliers.

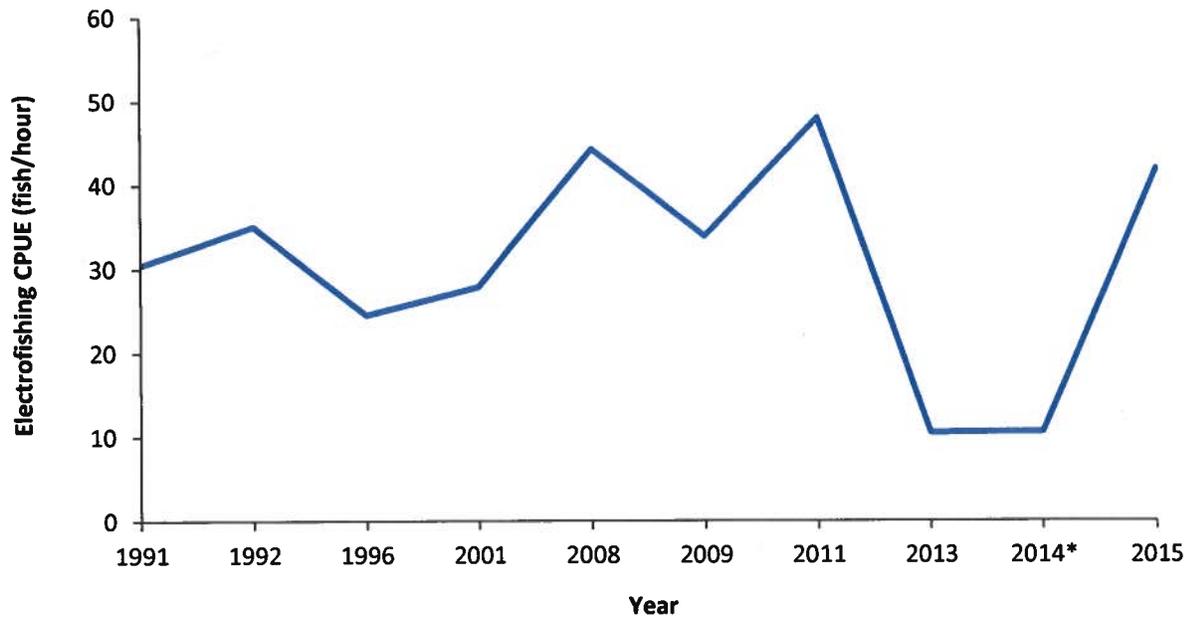


Figure 2. Fall electrofishing catch rates at Roosevelt Lake for Largemouth Bass between 1991 and 2015 (* 2014 data from University of Arizona eDNA study).

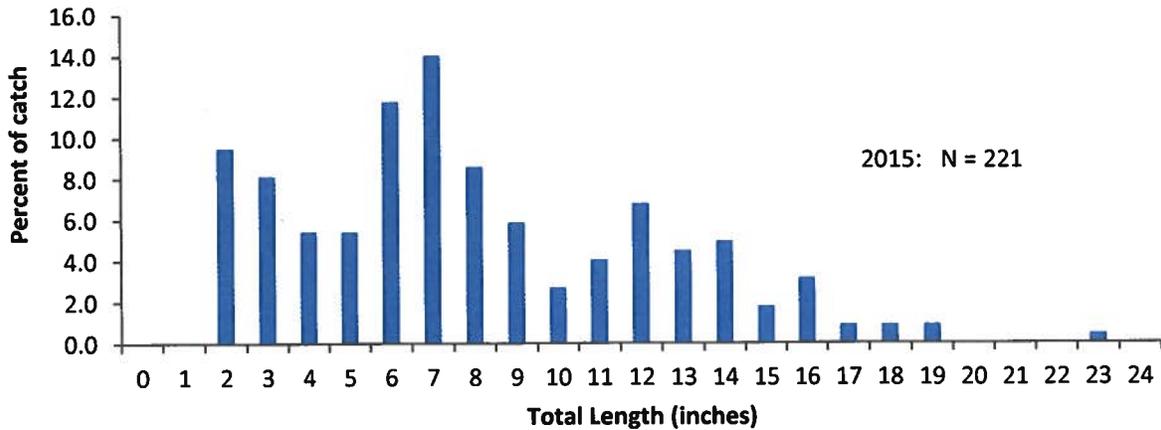
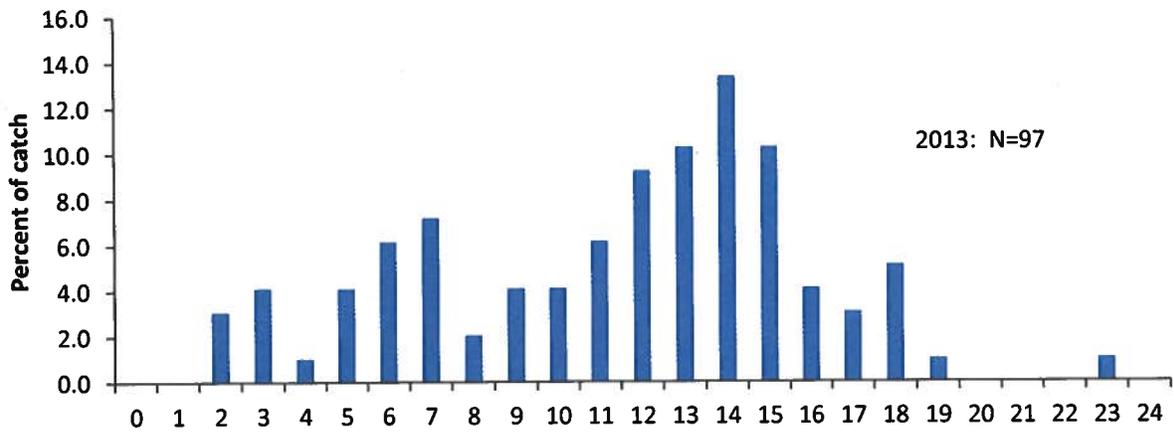
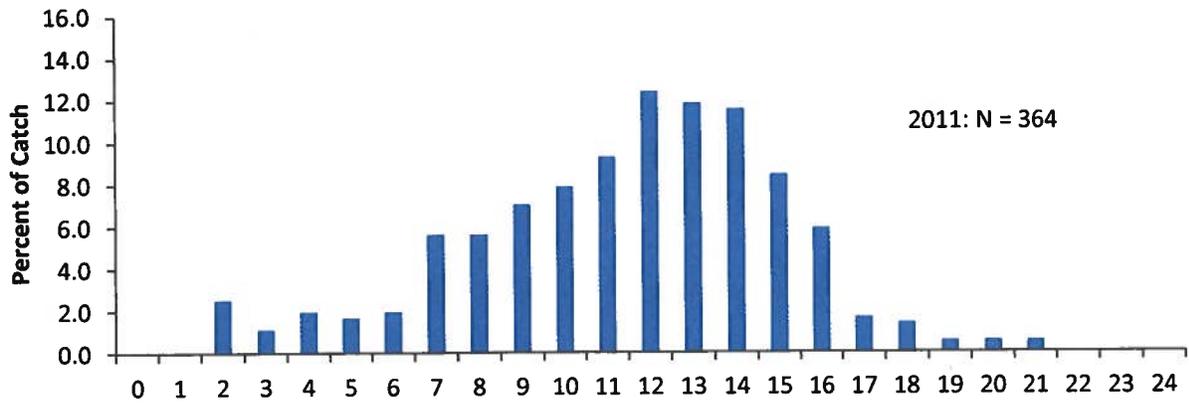


Figure 3. Length frequency of Largemouth Bass caught in during electrofishing at Roosevelt Lake in fall 2011, 2013, and 2015.

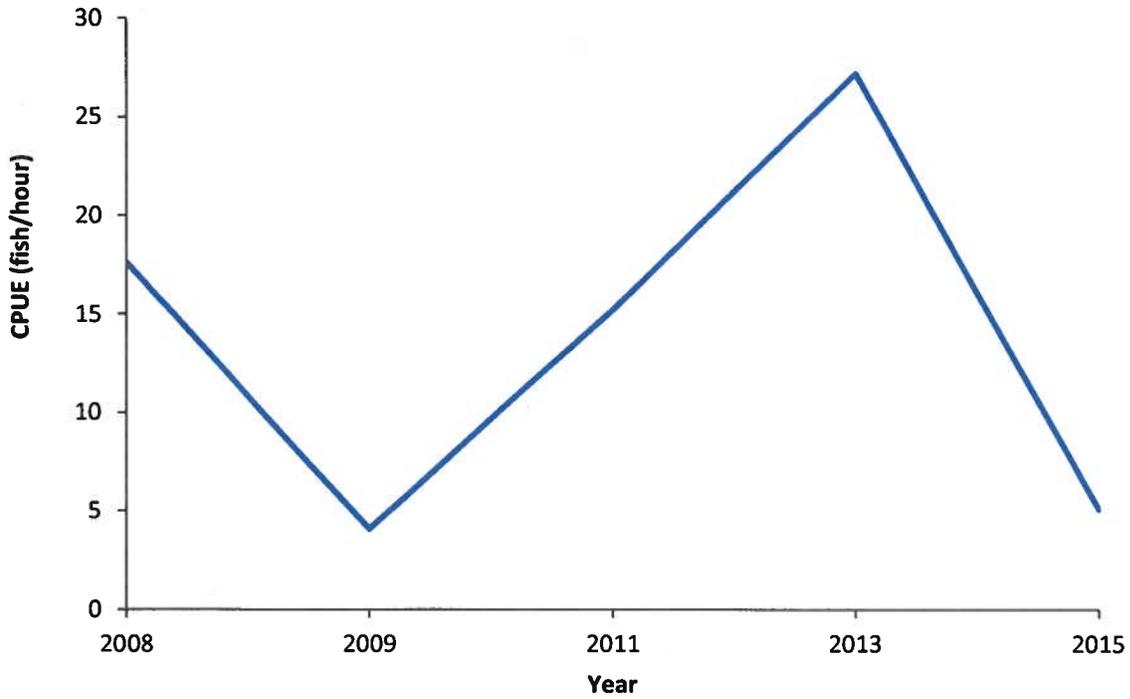


Figure 4. Fall electrofishing catch rates at Roosevelt Lake for Yellow Bass between 2008 and 2015.

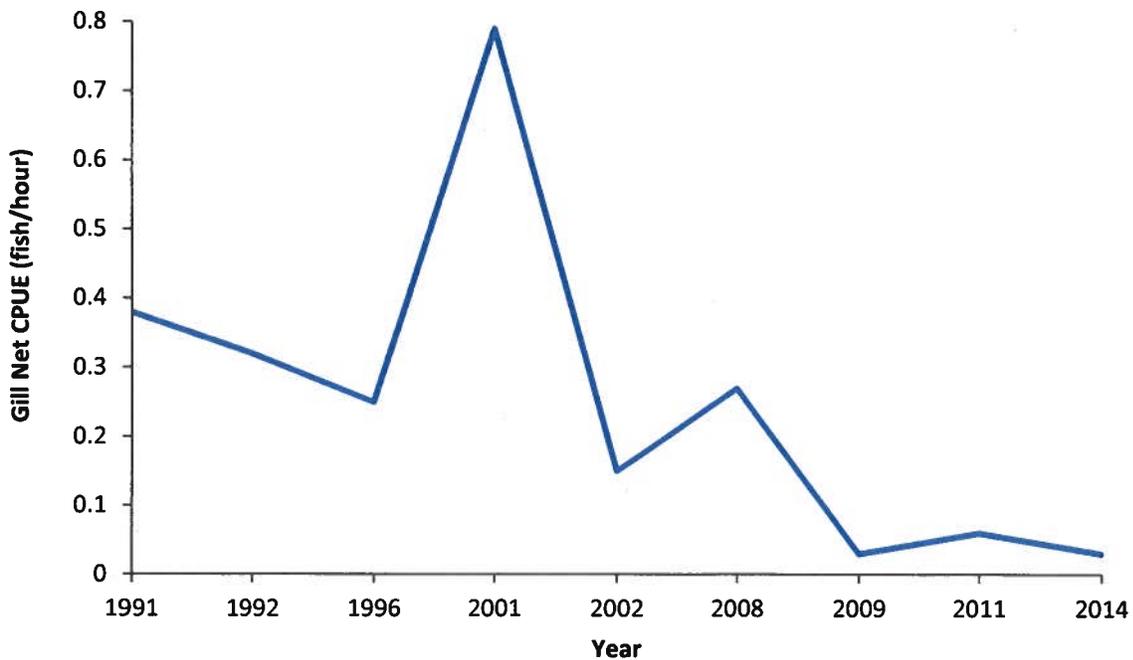


Figure 5. Gill net catch rates at Roosevelt Lake for Black Crappie between 1991 and 2014.

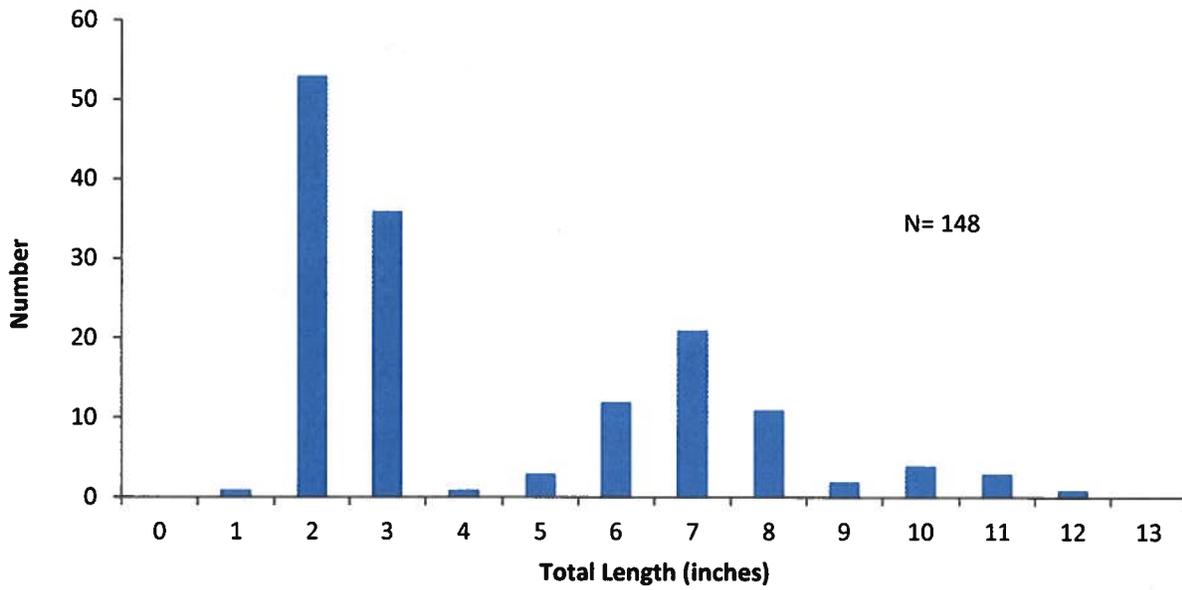


Figure 6. Length frequency of Black Crappie caught in floating trap nets at Roosevelt Lake in fall 2015.

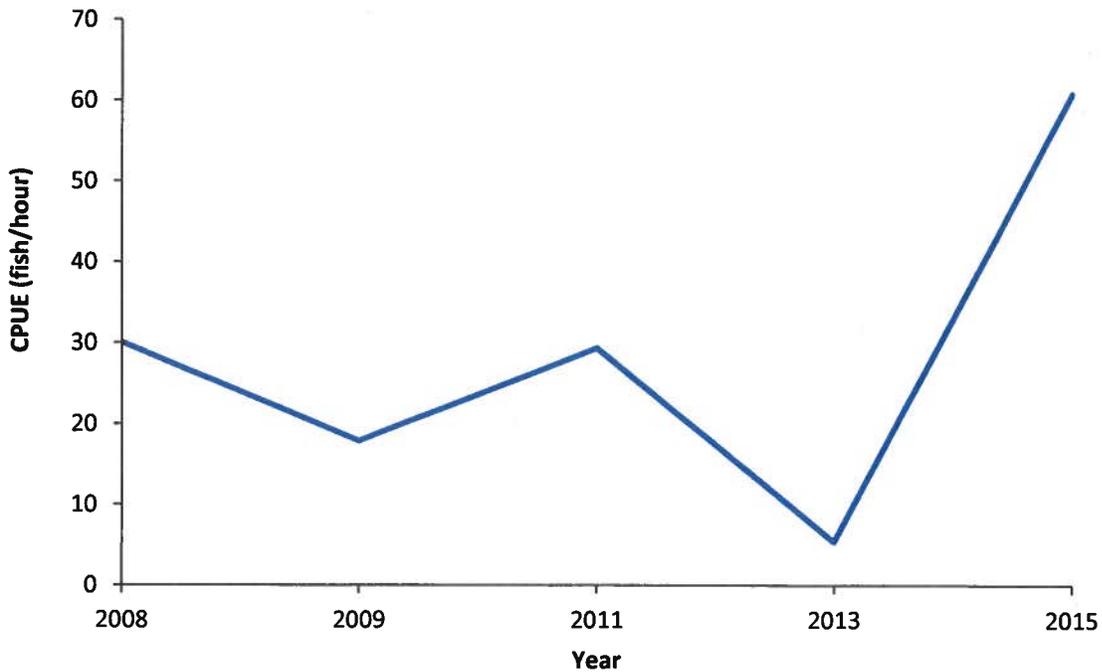


Figure 7. Fall electrofishing catch rates at Roosevelt Lake for Bluegill between 2008 and 2015.

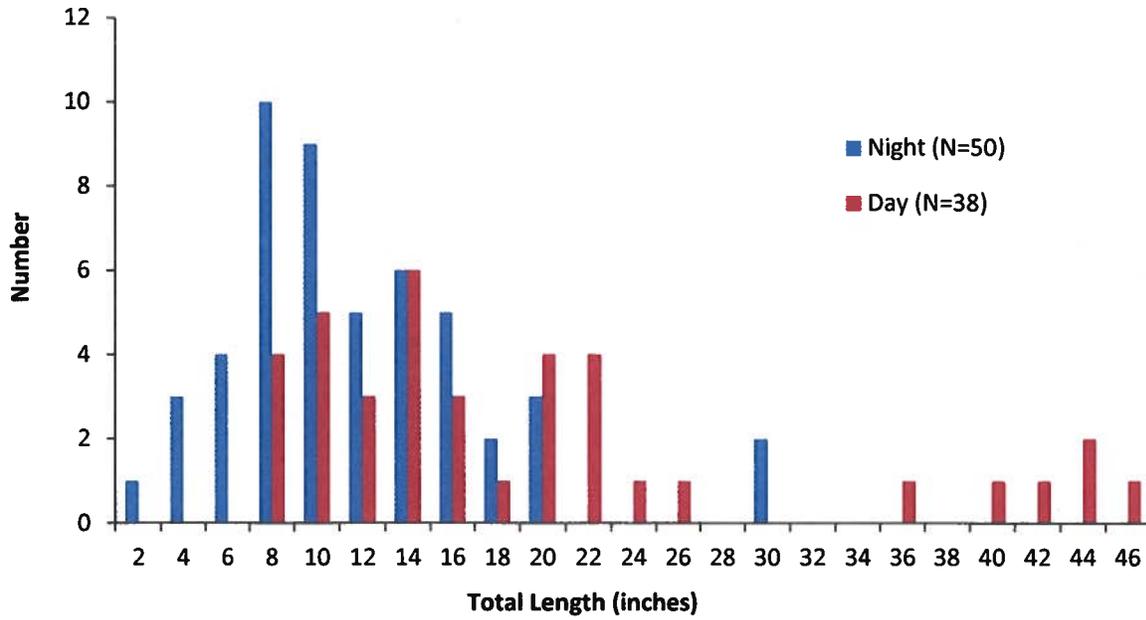


Figure 8. Length frequency of Flathead Catfish caught during standard nighttime bass electrofishing (Night) and low-frequency daytime electrofishing (Day) at Roosevelt Lake in fall 2015.

Appendices

Appendix A. Species, year stocked, size (if known), number of stockings, and total number of fish stocked per year in Roosevelt Lake from 1941 to 2016.

Species	Year	Size	# of Stockings	Total # Stocked
Black Crappie	1949		1	136
Bluegill	1941		5	32,832
Bluegill	1949		2	11,500
Bluegill	1968		1	900
Black Crappie	2017		1	10,000
Black Crappie	2019		2	22,800
Largemouth Bass	1941		18	173,820
Largemouth Bass	1948		1	2,000
Largemouth Bass	1949		5	134,000
Largemouth Bass	1951		3	54,823
Largemouth Bass	1980		1	1,100
Largemouth Bass (FS)	2014	Fry	2	376,800
Largemouth Bass (FS)	2015	Fry	3	577,000
Largemouth Bass (FS)	2015	Fingerling	1	40,000
Largemouth Bass (FS)	2016	Fingerling	1	40,000
Largemouth Bass (FS)	2017	Fingerling	1	8,000
Largemouth Bass (FS)	2017	Sub-catchable	1	20,667
Largemouth Bass (FS)	2019	Fingerling	1	10,000
Rainbow Trout	1991	Catchable	1	1,000
Smallmouth Bass	1941		2	2,100
Threadfin Shad	1941		1	2,500