NEVADA DEPARTMENT OF WILDLIFE
STATEWIDE FISHERIES MANAGEMENT

FEDERAL AID JOB PROGRESS REPORT
F-20-54
2018

LAKE MOHAVE
SOUTHERN REGION

NEVADA DEPARTMENT OF WILDLIFE, FISHERIES DIVISION
JOB PROGRESS REPORT

Table of Contents

Contents Page

SUMMARY 1

BACKGROUND 2

OBJECTIVES and APPROACHES 3

PROCEDURES 4

FINDINGS 5

MANAGEMENT REVIEW 18

RECOMMENDATIONS 18

NEVADA DEPARTMENT OF WILDLIFE, FISHERIES DIVISION
ANNUAL PROGRESS REPORT

State: *Nevada*
Project Title: *Statewide Fisheries Program*
Job Title: *Lake Mohave*
Period Covered: *January 1, 2018 through December 31, 2018*

SUMMARY

Thirty-seven access point, contact creel days were spent on Lake Mohave in 2018. These included 30 days at Willow Beach, 6 at Cottonwood Cove, and 1 day at Katherine Landing and 186 creel surveys were conducted. Additionally, anglers completed only two volunteer creel forms at the Willow Beach drop-box and none at Cottonwood Cove.

A cooperative effort between NDOW, Arizona Game and Fish Department (AZGFD), and United States Bureau of Reclamation (USBR) completed 51 net-nights of gill netting throughout April 2018. Species included Channel Catfish *Ictalurus punctatus* (37.5%, *n*=120), Common Carp *Cyprinus carpio* (24.7%, *n*=79), Striped Bass *Morone saxatilis* (9.4%, *n*=30), Smallmouth Bass *Micropterus dolomieu* (8.4%, *n*=27), Green Sunfish *Lepomis cyanellus* (6.8%, *n*=22), Largemouth Bass *Micropterus salmoides* (5.3%, *n*=17), Razorback Sucker *Xyrauchen texanus* (3.1%, *n*=10), Yellow Bullhead *Ameiurus natalis* (2.2%, *n*=7), Bluegill *Lepomis macrochirus* (1.3%, *n*=4), and Gizzard Shad *Dorosoma cepedianum* (1.3%, *n*=4).

An electroshocking survey was conducted during April and consisted of eight randomly selected coves and five fixed reference coves along the Lake Mohave shoreline. The survey caught 330 fish, resulting in an average CPUE of 25.4 fish per station. Species composition consisted of Green Sunfish (37.7%, *n*=108), Common Carp (16.4%, *n*=54), Bluegill (15.5%, *n*=51), Smallmouth Bass (13.0%, *n*=43), Channel Catfish (11.5%, *n*=38), Largemouth Bass (7.6%, *n*=25), Striped Bass (1.5%, *n*=5), Gizzard Shad (1.2%, *n*=4), Yellow Bullhead (0.3%, *n*=1), and Razorback Sucker (0.3%, *n*=1).

Thirteen artificial habitat structures and five brush bundles were constructed and deployed into Shoshone, Princess, Solicitor, and Box coves. Electroshocking surveys were completed at six coves having artificial habitat and seven without as part of the regular spring survey. Trammel nets were set for 20 hrs in Tequila Cove over four mornings in November to capture Largemouth Bass for a habitat use and movement study using sonic telemetry. No Largemouth Bass large enough to be tagged were captured. Four of six Largemouth Bass previously sonic tagged have been consistently found near the site of release. One fish released in Carp Cove that has not left the area is suspected to be dead. Efforts to retrieve the tags from mortalities are ongoing. The remaining two fish have not been detected since their release.

BACKGROUND

Sixty-seven miles downstream from Hoover Dam, the USBR constructed Davis Dam on the Colorado River in 1951. By May of that year, the new reservoir had backed up to the tailrace of Hoover Dam, which was considered full. The purpose of the impoundment is to meet irrigation requirements, regulate erratic water releases from Hoover Dam, and produce hydroelectric power, making the reservoir subject to fluctuating water levels and exchange flows. The upper 20 mi of reservoir are confined within the narrow walls of the Black Canyon and alternates between lotic or lentic environments depending on water elevations and Hoover Dam releases. The constant cold-water releases from Hoover Dam permit the upper regions of Lake Mohave to be managed as a year round coldwater fishery.

The Colorado River sport fishery is supported by Striped Bass, stocked Rainbow Trout, Largemouth Bass, Smallmouth Bass, Bluegill, Green Sunfish, Channel Catfish, and Yellow Bullhead. Nongame species present include Threadfin Shad *D. petenense,* Gizzard Shad, Common Carp*,* Bonytail Chub *Gila elegans*, and Razorback Sucker*.*

The upper region of the lake has historically been stocked year round with catchable Rainbow Trout, except during October 2013 to February 2017 when hatchery issues halted in rearing Rainbow Trout. Striped Bass were first documented in Lake Mohave in the early 1980s and they since have become a major component of the sport fishery. Striped Bass reproduce in the seasonally warm reaches of the reservoir and as they become larger, move into cold-water areas and eventually prey on stocked Rainbow Trout. The impact Striped Bass had on the stocked Rainbow Trout fishery was significant in later years and resulted in some modifications to the trout-stocking program. Major forage species present in Lake Mohave other than Rainbow Trout are Threadfin Shad, Gizzard Shad, Bluegill, Green Sunfish, and crayfish. Large Striped Bass are also known to prey on Common Carp and Razorback Suckers. Populations of all forage species have remained relatively abundant with the exception of shad. Predation by Striped Bass, among other factors, reduced the shad population to a point where they were difficult to detect.

In January 2007, the invasive quagga mussel *Dreissena bugensis* was discovered in the lower Colorado River system including Lake Mohave. Subsequently, the Lake Mead Fish Hatchery was closed due to quagga mussel contamination and lower Lake Mead elevations supplying warmer water to the hatchery. The Lake Mead Fish Hatchery provided a significant portion of the Rainbow Trout stocked into Lake Mohave. The changes this invasive species brings to the Lake Mohave fishery continue to evolve.

Native fishes, Razorback Sucker and Bonytail Chub, inhabiting in Lake Mohave are listed as endangered under the Endangered Species Act of 1973, as amended. The Razorback Sucker population has most recently been estimated at less than 5,000 fish, which is a significant decline from previous estimates of 60,000 in the late 1980s. Once abundant throughout the Colorado River Basin, the species is now extirpated from

much of its former range. Nonetheless, Lake Mohave contains one of the largest and most genetically diverse populations of Razorback Suckers throughout its current range. Bonytail Chub presently exists in low numbers in Lake Mohave. Efforts to insure these species do not disappear precipitated the formation of the Native Fish Work Group. This group is an association of private, state, and federal biologists with responsibilities for managing Lake Mohave and other main-stem Colorado River reservoirs. The Colorado Pikeminnow *Ptychocheilus lucius* is another endangered species native to the historic Colorado River, including the stretch now inundated by Lake Mohave. It is considered extirpated from Lake Mohave.

OBJECTIVES and APPROACHES

General Management

Objectives: To monitor angler use and catch rates, fish population dynamics, and maximize the availability and return of stocked Rainbow Trout to anglers in Lake Mohave.

Approaches:

- Measure angler use and harvest by conducting three creel survey days per month at Willow Beach and one day per month at Cottonwood Cove.
- Utilize creel survey and monitoring data to assess sport fishery performance and changes to estimate sport fish availability and condition.
- Maintain two volunteer, angler survey drop-boxes at Willow Beach and Cottonwood Cove.
- Monitor fish population dynamics through a minimum of 50 net-nights of gill netting surveys and up to 20 electroshocking survey sites in the spring, implemented cooperatively with AZGFD and USBR.
- Coordinate with National Park Service (NPS), AZGFD, and other cooperators on sport fish management needs and cooperative monitoring activities.
- Cooperate with other agencies on implementing long-term monitoring of quagga mussel distribution.

Habitat Enhancement Study

Objectives: To enhance angler success through the placement of constructed underwater habitat and to provide areas of persistent underwater habitat that concentrate game fish species in locations accessible to anglers.

Approaches:

- Construct and install up to 100 underwater habitat structures at selected locations on Lake Mohave using PVC and cut vegetation structures.
- Coordinate with the NPS for harvest and use of shoreline invasive tamarisk used for the brush element of the habitat structures.
- Work with the NPS, AZGFD, and volunteers to assist with construction and placement of habitat structures.

- Utilize the NDOW fish habitat barge for habitat deployment.
- Survey habitat sites monthly using underwater SCUBA dive transects.
- Evaluate angler success and use at habitat improvements sites through data and questionnaires collected during the general fisheries creel survey.

PROCEDURES

Angler Use and Harvest

Angler survey activities were conducted at Willow Beach using a stratified access-point survey. The primary sampling unit was a 12 hr day from 0600 to 1800 hrs, with a secondary 4.0 hr survey block. Days were stratified into high use days (Friday-Sunday), low use days (Monday-Thursday) and were conducted throughout the year.

Surveys were conducted opportunistically at Cottonwood Cove boat ramp. Information collected included hours fished, total anglers per party, angler target species, angler state of origin, species caught, number of fish harvested and released, length and weight of catch (when harvested), area and coves fished, and awareness of the habitat enhancement program.

Voluntary angler creel drop-boxes were stationed at shaded fish cleaning stations at Willow Beach and Cottonwood Cove. A copy of the creel form is located in Appendix 1.

Gill Netting

This was the 15th year utilizing AZGFD gill netting and electroshocking protocols. Sampling was completed with 150 ft x 8 ft six panel experimental gill nets from Davis Dam north to Mile 41. Nets were set in April at 43 randomized sites and 8 fixed reference sites selected by AZGFD.

Electroshocking

Nevada Department of Wildlife staff completed the annual spring electroshocking survey along the northern half of Lake Mohave on the nights of April 19, 20, and 26. The electroshocking boat was equipped with a Coffelt VVP-15B Electrofisher control box with an electrode array. Five randomly and five fixed reference stations were surveyed (fifteen minutes of electroshocking conducted per station) and all fish captured were identified to species, counted, measured, weighed, and then released back to the lake. AZGFD completed the southern portion of the lake on April 4 and 5, but due to equipment problems, only three of ten planned sites were completed.

Habitat Improvement

Artificial aquatic habitat structures were constructed of tamarisk (cut on site) and PVC pipe with snow fencing and plastic lattice. Units were constructed on the deck of

the NDOW habitat barge or on shore, weighted with sand bags, and then deployed above the 620 ft contour. Agencies involved included the NPS, AZGFD, NDOW, Arizona Department of Corrections, and volunteers.

Fish use of habitat structures was monitored via SCUBA transects, gill or trammel nets, and electroshocking. SCUBA surveys were conducted by circling structures and recording habitat type, survey time, depth, and all fish seen. Two 150 ft trammel nets were set in Solicitor and Carp coves for two hours in early morning to collect Largemouth Bass for sonic tagging. A short sampling period minimized the contact time and stress of fish caught in a net. Due to sonic tag weight, Largemouth Bass had to be a minimum of 2.5 lbs for implanting. A surgical and anesthesia station was setup on shore of each cove fished. Each fish was anesthetized in a cooler of lake water and dissolved carbon dioxide until each achieved a level of light sedation (i.e., lying on one side, only slight reaction to external stimuli, high opercular rate). At the time of surgery, each fish was placed in a cradle with the head underwater. The surgical field was dry and sterilized. Each tag was inserted into approximately a 1.5 in incision made slightly to the left of the midline on the abdomen. The incision was closed with absorbable silk sutures. Each fish was moved to a cooler of aerated lake water, and released upon recovery.

FINDINGS

Angler Use and Harvest

The access point, contact creel survey was conducted 37 days on Lake Mohave, 30 days at Willow Beach, 6 at Cottonwood Cove, and 1 at Katherine Landing. At Willow Beach, 170 surveys were collected, along with 16 at Cottonwood Cove, and none at Katherine Landing.

The 170 surveys at Willow Beach included 311 anglers mostly residing from Nevada (Table 1). Shoreline anglers (*n*=251) made up 92.6% of those contacted and boat anglers (*n*=20) comprised only 7.4%. In 38 surveys, 77 anglers fished for 393.8 hrs. Boat anglers (*n*=62) were 80.5% of those surveyed and 19.5% (*n*=15) from shore (Table 2). The increase in shoreline anglers is exclusively due to Rainbow Trout stockings that resumed at Willow Beach in early 2017. Shoreline anglers fished for Striped Bass 13% less and for Rainbow Trout 23% more in 2018 than in 2017. Survey days increased slightly from 24 in 2017 to 29 days in 2018, but number of total interviews decreased from 208 to 170 respectively.

TABLE 1. State of origin for individuals interviewed at Willow Beach, January-December 2018.

Home state	% of Anglers	Number of anglers
Nevada	87.1	271
Arizona	6.4	20
California	2.6	8
Other	3.9	12

TABLE 2. Species preference (percent of anglers targeting a species) by anglers at Willow Beach, 2018.

Target species	Boat anglers (*n* = 60)	Shore anglers (*n* = 251)	Total anglers (*n* = 311)
Rainbow Trout	6.9 %	80.8 %	74.5 %
Striped Bass	75.9 %	19.7 %	36.1 %
Black Bass	19.0 %	0 %	5.2 %
Channel Catfish	0 %	1.0 %	1.8 %
No particular species	5.2 %	8.7 %	12.9 %

*Percentages do not equal 100 because anglers could target more than one species

Anglers at Willow Beach fished for 1,223.25 total hrs and targeted Rainbow Trout 74.5% of the time for 785.75 hrs. In addition, 36.4% of anglers targeted Striped Bass for 475 hrs, 5% targeted black bass for 68.25 hrs, 1.8% targeted Channel Catfish for 14 hrs, and 12.9% spent 105.75 hrs fishing for no particular species (Table 2). Note that target percentages did not equal 100% because anglers fished for more than one species. Of anglers contacted in person, 34% showed success and caught fish at a rate of 0.33 fish/hour (f/hr) (Table 3). At Willow Beach, 189 (60.4%) of Rainbow Trout and 9 (47.4%) Striped Bass caught were reported harvested.

TABLE 3. Angler catch rates (fish/hour) at Willow Beach for Rainbow Trout and Striped Bass from 2018 contact creel survey.

Species	Catch rates from boat	Catch rates from shore	Total catch rate
Rainbow Trout	0.16	0.41	0.17
Striped Bass	0.11	0.004	0.06
Black bass	0.76	0	0.76
All species	0.27	0.3	0.33

Interestingly, even though the time anglers spent fishing for Striped Bass decreased by 127.75 hrs in 2018 from 2017, catch rates remained the same. Boat anglers spent less effort (59 hrs) targeting black bass at Willow Beach than at Cottonwood Cove, but showed a higher catch rate of 0.76 f/hr compared to Cottonwood Cover of 0.17 f/hr. Anglers targeting black bass at Willow Beach fished between AOP and Tequila coves (south of Cottonwood Cove). Boat anglers also caught 12 sunfish, but did not report them as a targeted species.

Shoreline anglers caught almost exclusively Rainbow Trout. One Striped Bass was reportedly caught from shore, down from seven caught last year and with approximately 100 fewer angling hours targeting them. Catch rates for shore caught Rainbow Trout increased to 0.41 f/hr, from 0.33 f/hr in 2017.

The 16 completed angler contact surveys at Cottonwood Cove showed 32 anglers (24 from Nevada, 1 from Arizona, 4 from California, and 3 from other states) fished for 200 hr for a catch rate of 0.77 f/hr (Figure 1). The catch rate was more than double that in 2017, as well as greater than the long-tern average of 0.4 f/hr. Boat anglers were the only contacts in 2018 at Cottonwood Cove. Seventy-two percent (Figure 2) of the anglers successfully caught 33 Largemouth Bass, 94 Smallmouth Bass, and 26 Striped Bass. Results showed 91% (*n*=21) of anglers targeted black bass for 193.5 hr and 9% or two anglers targeted Striped Bass for 6.5 hr. Out of 105 black

bass caught, 9 (8.5%) were harvested, and from 26 Striped Bass caught, 6 (23.0%) were harvested

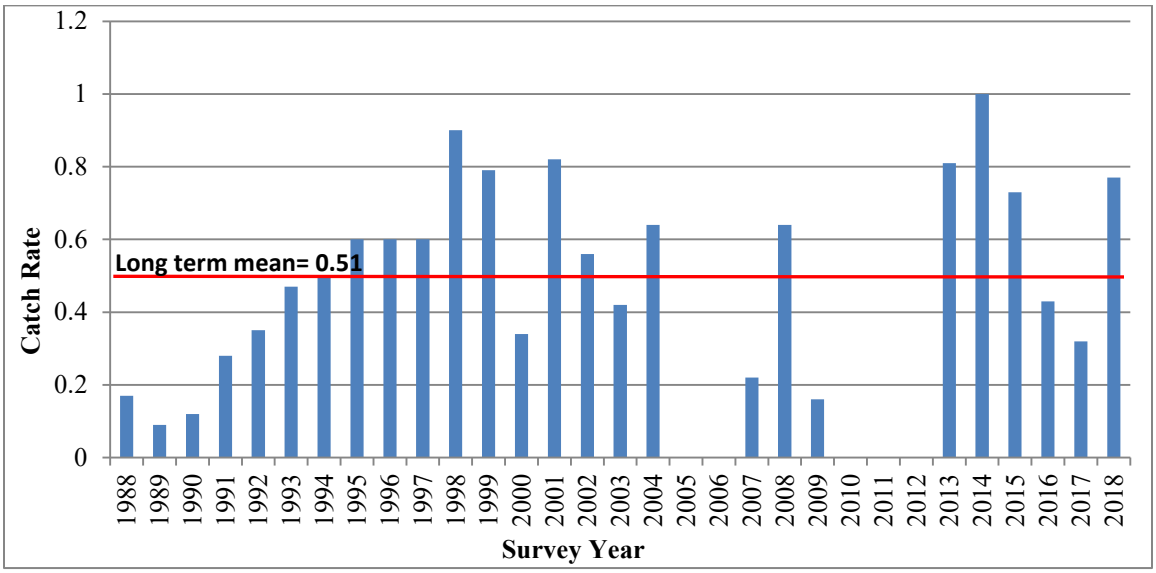

FIGURE 1. Angler catch rates (fish/hour) from contact creel surveys at Cottonwood Cove, Lake Mohave, 1988-2018.

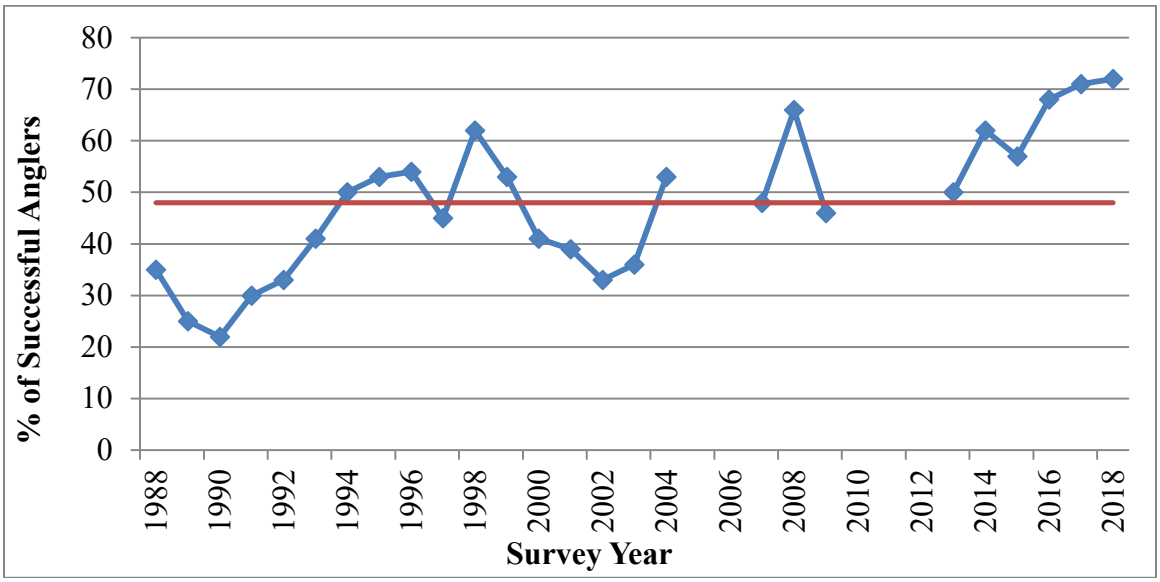

FIGURE 2. Successful anglers (% of all anglers surveyed) from contact creel surveys at Cottonwood Cove, Lake Mohave, 1988-2018.

Two volunteer creel forms were collected from Willow Beach and each caught six Rainbow Trout, but did not report effort. The drop-box was in need of repair for part of 2018 and survey instructions may not have been clear to anglers. The fish cleaning station at Cottonwood Cove was shut down with construction fencing from spring to winter for septic tank repair. The drop-box was not accessible, explaining the lack of completed surveys. These issues have since been resolved.

Gill Netting

Results from 50 net-nights of spring 2018 gill netting efforts yielded 307 fish representing 10 species (Table 4). Nonnative fish accounted for 96.1% of the catch, with 70.9% considered sport fish. The most numerous sport fish was Channel Catfish, which ranged from 256 to 720 mm TL and had a mean of 509 mm TL. Weight ranged from 185 to 3,910 g, with a mean of 1,576 g (Table 5). The only native fish species captured was Razorback Sucker.

TABLE 4. Species composition (percent of total catch) and catch rates (CPUE) from 2018 gill netting surveys on Lake Mohave.

Species	*n*	Percent of total catch	CPUE (fish/net-night)
Channel Catfish	120	37.5	2.35
Common Carp	79	24.7	1.55
Striped Bass	30	9.4	0.59
Smallmouth Bass	27	8.4	0.53
Green Sunfish	22	6.9	0.43
Largemouth Bass	17	5.3	0.33
Razorback Sucker	10	3.1	0.20
Yellow Bullhead	7	2.2	0.14
Bluegill	4	1.3	0.08
Gizzard Shad	4	1.3	0.08
Total	320	100	6.27

Total CPUE increased from 4.62 fish/net-night (f/n-n) in 2017 to 6.27 f/n-n in 2018. Catch rates increased substantially for Channel Catfish and Common Carp. Smallmouth Bass, Green Sunfish, Bluegill, and Yellow Bullhead abundance increased, but they were still caught in relatively low numbers. Largemouth Bass catch rate and number caught remained the same. Striped Bass and Razorback Sucker showed the only decreases in catch rates.

TABLE 5. Minimum, maximum, and mean total length and weight of sport fish captured during spring gill net surveys in Lake Mohave, 2018.

Species	*n*	Total length (mm)			Weight (g)		
		Min.	Max.	Mean	Min.	Max.	Mean
Channel Catfish	120	256	720	509	185	3,910	1,576
Striped Bass	30	234	680	474	117	3,506	1,490
Smallmouth Bass	27	288	515	409	305	2,035	1,068
Green Sunfish	22	75	180	121	5	105	36
Largemouth Bass	17	260	535	407	204	2,472	1,166
Yellow Bullhead	7	179	380	268	25	1,014	405
Bluegill	4	70	162	126	13	80	28

The Striped Bass catch rate was 0.59 f/n-n, down from 0.7 f/n-n in 2017 and lower than the 10-year mean of 0.73 f/n-n, which may have been skewed from an unusually high catch rate in 2015 (Figure 3). This was still well below some historical high peaks of 10.88 f/n-n, 7.67 f/n-n, and 7.94 f/n-n in 1994, 1998, and 2002, respectively. Several factors have contributed to the decline in population size of

Striped Bass. The species was prominent in upstream Lake Mead and showed up in Lake Mohave in the 1980s at barely detectable abundances during surveys. When a species is new to an ecosystem, it typically takes several years for its population to expand, and then it exhibits seemingly exponential growth while it exploits typically unutilized forage, in this case Threadfin Shad. The population typically declines following depletion or drastic decreases to this forage base, but levels out based on what the ecosystem can support. Striped Bass catch rates increased by 2,620% from 1989 (0.4 f/n-n) to its historic peak of 10.88 f/n-n in 1994. Since 1994, however, the catch rate has shown a downward trend until it leveled out and remained mostly consistent since the mid- to late 2000s.

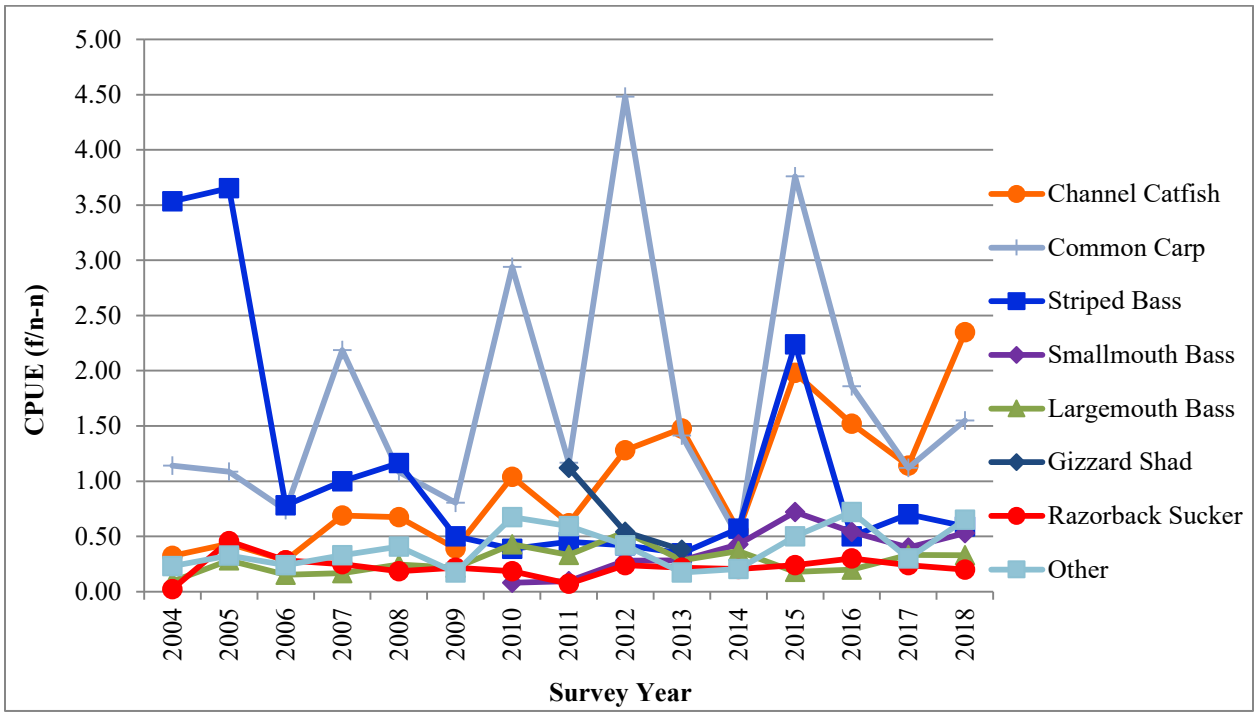

FIGURE 3. Total catch rates from spring gill netting surveys on Lake Mohave, 2004-2018. "Other" fish include sunfish, Yellow Bullhead, Bonytail Chub, Rainbow Trout, and Threadfin Shad.

While Threadfin Shad were not caught in large numbers during historical gill net surveys, they were commonly observed during boating activities and were readily captured by seine hauls. They became less and less common and were rarely seen or captured in the 2000s. After 2010, shad boils started becoming more common and large numbers were seen during SCUBA and boating activities in 2013 and 2014. Striped Bass readily utilize stocked Rainbow Trout as forage and interruption of trout stocking (2013 to 2017) likely affected Striped Bass abundance. It is probable that the forage base (Threadfin Shad) had been severely depleted and high abundances found in 1994, 1998, and 2002 are no longer sustainable. However, it is possible the relatively recent introduction of Gizzard Shad will provide additional forage for Striped Bass.

TABLE 6. Minimum, maximum, and mean total length and weight of native and non-sport fish captured during spring gill net surveys in Lake Mohave, April 2018.

Species	*n*	Total length (mm)			Weight (g)		
		Min.	Max.	Mean	Min.	Max.	Mean
Common Carp	75*	330	720	575	558	6,315	3,130
Razorback Sucker	10	506	742	627	1,455	4,730	3,025

* A representative sample were weighed and measured.

Catch rates for Smallmouth Bass (Figure 4) increased every year since their detection in 2010, with a peak catch rate of 0.72 f/n-n in 2015. Catch rates declined in 2016 and 2017 (0.54 and 0.40 f/n-n, respectively), but increased in 2018 to 0.53 f/n-n. The Smallmouth Bass catch rate remains higher than for Largemouth Bass the sixth consecutive year. The 2018 Largemouth Bass catch rate was 0.33 f/n-n, identical in individuals caught and the catch rate in 2017 (Figure 4). The Razorback Sucker catch rate was 0.20 f/n-n, which was consistent with the long-term mean of 0.28 f/n-n. Sunfish numbers have increased from a low in 2013 (<0.1) to 0.51 f/n-n, but were caught in such low enough numbers (under 30 individuals) that it is difficult to reach conclusive results regarding their status in the lake.

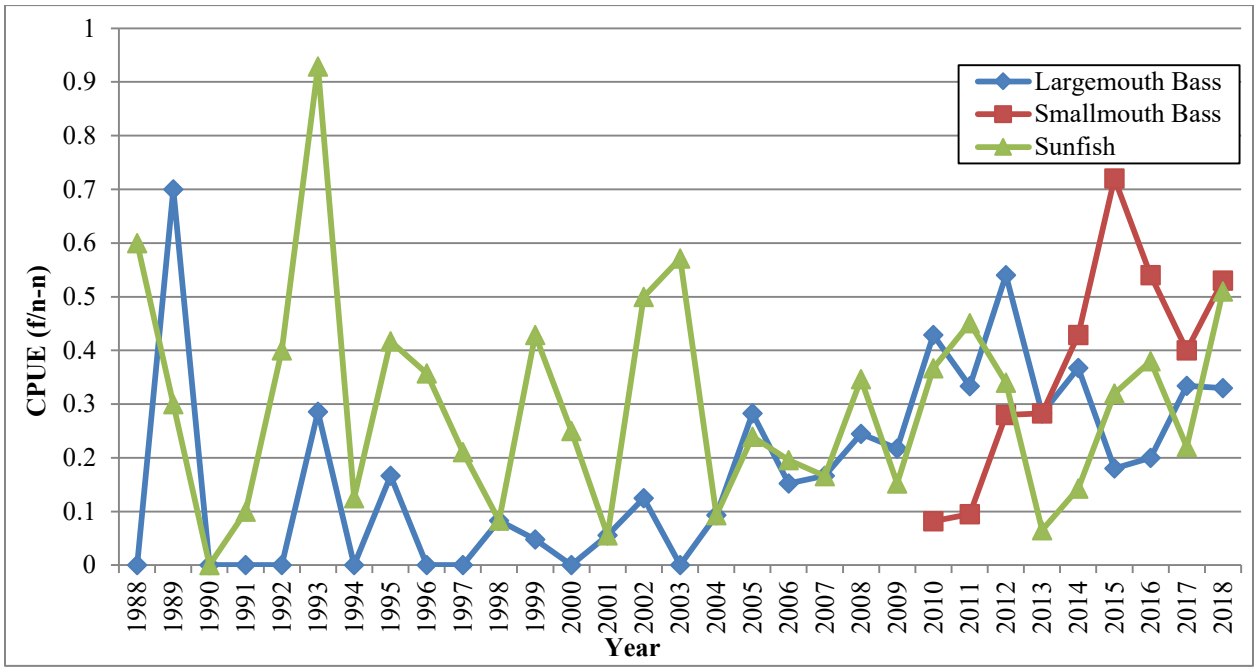

FIGURE 4. Long-term catch rates for Largemouth Bass, Smallmouth Bass, and sunfish from gill netting surveys on Lake Mohave, 1988-2018.

The Channel Catfish catch rate in 2018 (2.35 f/n-n) was more than double the 2017 catch rate of 1.14 f/n-n and the 15-year mean catch rate of 0.98 f/n-n (Figure 5). The majority of fish caught were between 500 and 550 mm (Figure 6). Common carp abundance also increased this year (Figure 5). There was no substantial change in sunfish or other forage fish catch rates. Threadfin Shad has historically been the main source of forage for Striped Bass, but it has been captured in gill netting surveys at very low rates and only three times in the past 32 years.

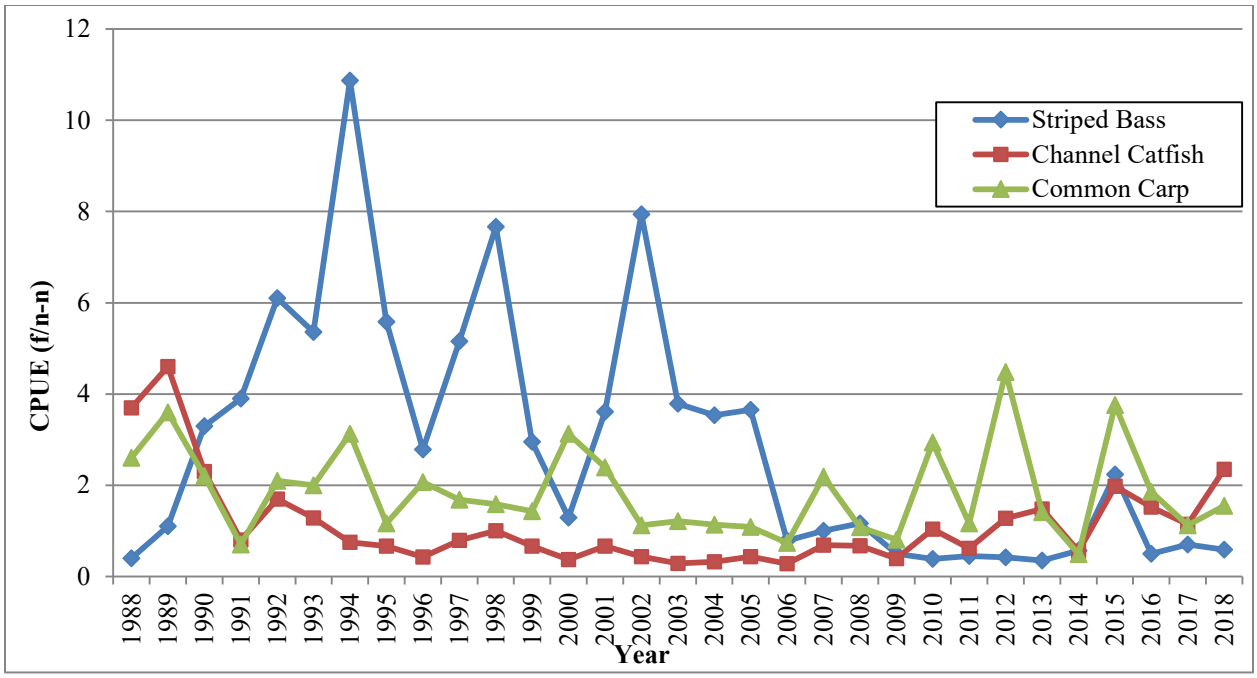

FIGURE 5. Long-term total catch rates for the three most commonly caught species from gill netting surveys on Lake Mohave, 1988-2018.

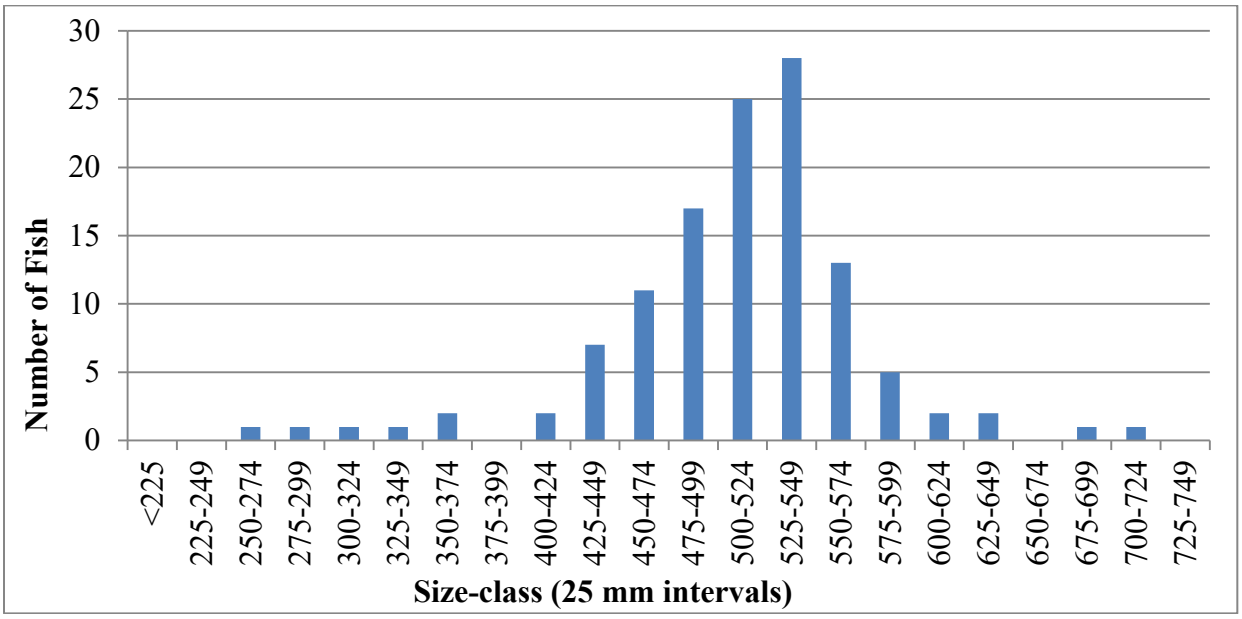

FIGURE 6. Length frequency distribution of Channel Catfish captured during gill net surveys at Lake Mohave, April 2018.

Ninety percent of Channel Catfish encountered were considered to be in the quality catch category, while Largemouth and Smallmouth Bass numbers did not reach a minimum sample size to present a length frequency data, it is worth noting that of the fish that were caught, all appeared healthy (Table 7) and above a PSD stock size (Table 8).

TABLE 7. Physical condition (relative weight, W_r)[1] of Channel Catfish, Smallmouth Bass, and Largemouth Bass captured by gill net in Lake Mohave, April 2018.

Species	Size-class (mm)	No. of Fish	Mean Relative Weight (W_r)
Channel Catfish	Pre-stock (150-279)	2	135.1
	Stock (280-409)	4	108.1
	Quality (410-609)	108	116.1
	Preferred (610-709)	5	111.4
	Memorable (710-909)	1	95.5
	Trophy (>910)	0	-
Total		120	115.8

Species	Size-class (mm)	No. of Fish	Mean Relative Weight (W_r)
Smallmouth Bass	Pre-stock (150-179)	0	-
	Stock (180-279)	0	-
	Quality (280-349)	6	87.7
	Preferred (350-429)	5	101.0
	Memorable (430-509)	15	92.2
	Trophy (>510)	1	90.0
Total		27	92.8

Species	Size-class (mm)	No. of Fish	Mean Relative Weight (W_r)
Largemouth Bass	Pre-stock (150-199)	0	-
	Stock (200-299)	2	91.4
	Quality (300-379)	4	111.8
	Preferred (380-509)	10	95.6
	Memorable (510-629)	1	98.0
	Trophy (>630)	0	-
Total		17	98.3

[1] A fish's relative weight is the relationship between the actual weight of a fish at a given length to the national average weight (standard weight W_s) of a fish of the same species and length (Anderson and Neumann 1996). A W_r value of 100 generally indicates that a fish is in good condition when compared to the national standard (75th percentile) for that species. The index is defined as $W_r = W/W_s \times 100$, where W is the weight (g) of an individual fish and W_s is the standard weight of a fish of the same total length (mm). Standard weight (W_s) was derived from a standard weight-length ($\log_{10}$) relationship, defined in Anderson and Neumann (1996). Largemouth Bass less stock size were excluded from calculations of W_r as variability can be significant for small fish.

TABLE 8. Proportional Size Distribution (PSD) of Channel Catfish, Striped Bass, Smallmouth Bass, and Largemouth Bass captured during Lake Mohave gill net surveys in April 2018.

Species	# Fish caught	#Stock-size fish[a]	PSD[b]	PSD S-Q[c]	PSD Q-P	PSD P-M	PSD M-T	PSD T
Channel Catfish	120	118	97	3	92	4	1	0
Striped Bass	30	23	78	22	78	0	0	0
Smallmouth Bass	27	27	100	0	22	19	56	4
Largemouth Bass	17	17	88	12	24	59	6	0

[a] Stock-size fish = Channel Catfish >279 mm, Striped Bass >299 mm, Smallmouth Bass >179 mm, and Largemouth Bass >199mm.

[b] PSD = Proportional Size Distribution: Channel Catfish >409 mm, Striped Bass >509 mm, Smallmouth Bass >279 mm, and Largemouth Bass >299mm.

[c] Fish quality index: S-Q=Stock to Quality, Q-P=Quality to Preferred, P-M=Preferred to Memorable, M-T=Memorable to Trophy.

PSD values can provide insight into population dynamics and for Striped Bass, showed a large increase in 2007 and again in 2008 (Figure 7). In 2010, PSD reached the maximum of 100, but dropped to 37 in 2011. This steep drop possibly indicates low recruitment, as younger age classes are more susceptible to detection when gill netting. Wide annual variations in PSD may indicate the population suffers from issues with recruitment and growth of juveniles. In recent years, large Striped Bass made up the majority of population caught. Proportional size distribution in 2018 was 78.

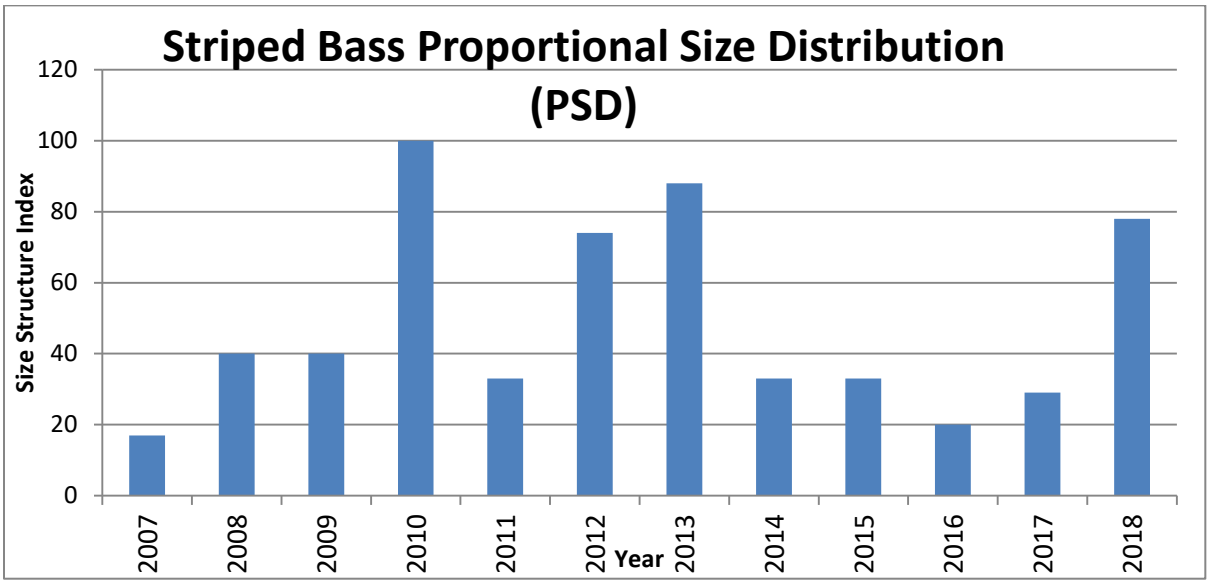

FIGURE 7. Proportional Size Distribution of striped bass from gill netting surveys on Lake Mohave, 2007-2018.

Electroshocking Surveys

Results from thirteen sites of sampling efforts yielded 330 fish from ten species (Table 9). The abundance of the dominant species included 108 Green Sunfish, 51 Bluegill, 43 Smallmouth Bass, 25 Largemouth Bass, and 4 Channel Catfish. Nonnative fish accounted for 99.7% of the catch, with 82.0% of the catch as game fish. Nonnative fish species captured included Common Carp, Green Sunfish, Bluegill, Striped Bass, Largemouth Bass, Smallmouth Bass, Gizzard Shad, Yellow Bullhead, and Channel Catfish. The only native fish species captured was Razorback Sucker (*n*=1).

Fall electroshocking surveys occurred from 1997 to 2002 and 2009 to 2011, while spring surveys occurred from 2004 to 2007 and 2012 to 2018. No electroshocking surveys were conducted in 2001, 2003, and 2008. The 2018 catch rates were similar to other spring sampling years for all species encountered, except for Channel Catfish (Figure 8). The annual average number of Channel Catfish caught during spring from 2012 to 2017 was 6.6 fish. In 2018, 38 Channel Catfish were caught and even though the catch rate increased by more than five times, it is difficult to interpret the results.

Table 9. Relative species composition (percent of total catch) and catch rates (CPUE) from 2018 electroshocking surveys on Lake Mohave.

Species	*N*	Percent of total catch	CPUE (fish/net night)
Green Sunfish	108	33.1	8.3
Common Carp	54	16.5	4.2
Bluegill	51	15.6	3.9
Smallmouth Bass	43	13.2	3.3
Channel Catfish	38	11.6	2.9
Largemouth Bass	25	7.6	1.9
Striped Bass	5	1.5	0.4
Gizzard Shad	4	1.2	0.3
Razorback Sucker	1	0.3	0.1
Yellow Bullhead	1	0.3	0.1
Total	330	100	25.4

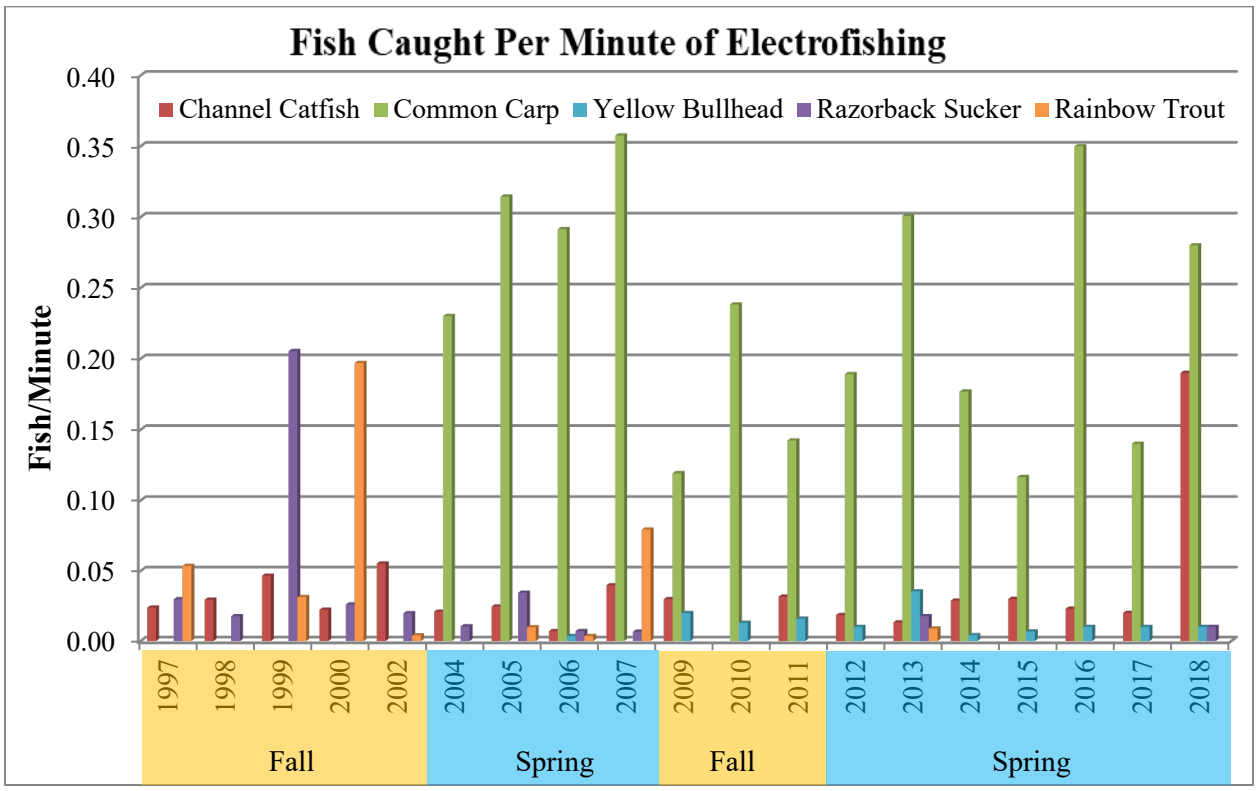

FIGURE 8. Catch rates for Channel Catfish, Common Carp, Razorback Sucker, Yellow Bullhead, and Rainbow Trout captured during electroshocking surveys on Lake Mohave, 1997-2018.

Smallmouth Bass were first captured in electroshocking surveys during the fall 2009 and have been caught every year since (Figure 9). Five Striped Bass were captured in 2018 and sunfish catch rates increased slightly this year (Figure 9). A total of 195 min of electroshocking was expended, averaging 15 min/site.

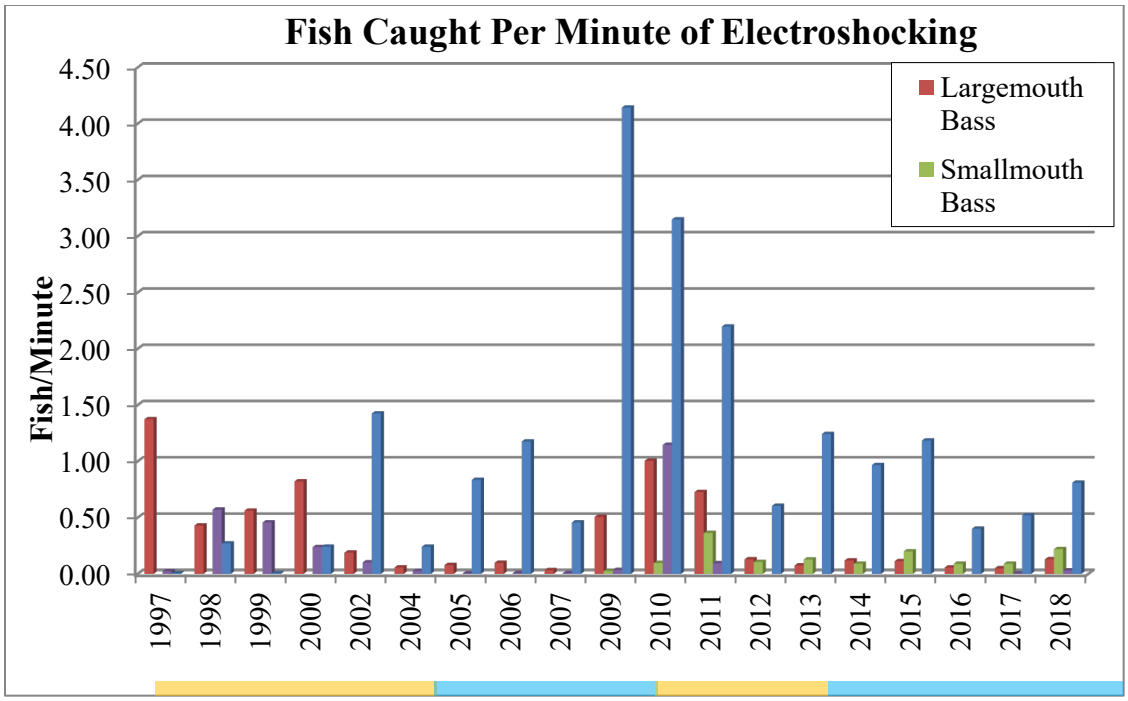

FIGURE 9. Catch rates (fish/min of electroshocking) for Largemouth Bass, Smallmouth Bass, Striped Bass, and sunfish from electroshocking surveys on Lake Mohave, 1997-2018.

The most numerous game fish encountered this year was Green Sunfish Table 9) that showed a length range from 45 to 185 mm (Table 10). The average length was 87 mm. Their weight ranged from 1.0 to 192.0 g, with an average of 116 g. Average lengths and weights of all fish encountered are presented in Table 10 and 11. Gizzard Shad (*n*=4), however, were not measured.

Table 10. Minimum, maximum, and average length and weight of game fish collected in Lake Mohave electroshocking surveys, April of 2018.

Species	Total length (mm)			Weight (g)		
	Min.	Max.	Mean	Min.	Max.	Mean
Green Sunfish (*n*=108)	45	185	87	1	192	116
Bluegill (*n*=51)	35	185	97	1	128	31
Smallmouth Bass (*n*=43)	109	441	245	12	1120	268
Channel Catfish (*n*=38)	126	614	511	10	2885	1711
Largemouth Bass (*n*=25)	66	485	279	2	1634	529
Striped Bass (*n*=5)	177	304	224	57	445	161
Yellow Bullhead (*n*=1)	252	252	252	255	255	255

Table 11. Minimum, maximum, and average length and weight of native and non-game fish collected in Lake Mohave electroshocking surveys, April of 2018.

Species	Total length (mm)			Weight (g)		
(n=number caught)	Min.	Max.	Mean	Min.	Max.	Mean
Common Carp (*n*=54)*	339	720	502	530	6044	2817
Razorback Sucker (*n*=1)	605	605	605	4410	4410	4410

* A representative sample was weighed and measured.

Habitat Improvement

Thirteen artificial habitat structures constructed of PVC cubes were deployed into Shoshone, Princess, and Box coves. The equivalent of five brush bundles were cut and placed as "nearshore" habitat in Shoshone Cove for times of low water. PVC structures were constructed from 1.5 inch PVC and the basic unit was a 5.0 ft x 5.0 ft cube. Cubes were then attached together with heavy-duty (175-lb test) zip ties, covered with snow fencing and/or plastic lattice, and stuffed with brush. Structures were placed between the 620 and 630 ft elevation. Since this project started and by the end of 2018, the amount of habitat placed included:

- 161 PVC, snow fence, and brush structures;
- 216 assorted brush bundles;
- 24 poly shrubs;
- 88 pallet and brush A-frames;
- 24 pallet structures; and
- 25 barge loads of Christmas trees, approximately 625 trees

Habitat Effectiveness Evaluation – SCUBA Monitoring

Due to scheduling and availability of personnel, SCUBA fish counts were limited in 2018. Divers spent time tracking black bass and performing maintenance on existing PVC structures.

Habitat Effectiveness Evaluation – Largemouth Bass Movement Study

Trammel nets were set in each of the experimental coves for two hours during early morning. In 20 hrs of netting effort, 13 Largemouth Bass, 15 Smallmouth Bass, and 2 Common Carp were caught. The short netting time was done to minimize contact time and stress to fish. Due to tag weight, Largemouth Bass must be a minimum weight of 1,130 g to be implanted with a tag. None of the Largemouth Bass contacted met this weight requirement. Data of captured black bass is presented in Table 13.

Table 13. Largemouth and Smallmouth Bass caught during targeted trammel netting in Tequila Cove, December 2018.

Species	*n*	Total length (mm)			Weight (g)		
		Min.	Max.	Mean	Min.	Max.	Mean
Largemouth Bass	13	255	370	301	250	730	394
Smallmouth Bass	15	323	496	383	460	2040	965

Largemouth Bass were tracked opportunistically during other survey efforts. Tagged bass (see Table 14) were actively located 16 times in 2018 (Table 15). The directional hydrophone only pinpoints tags within about a 50 ft x50 ft (2,500 ft^2) area. Fish likely remain and move within the small area of each cove where they were released. Largemouth Bass #6 was located 16 times while Largemouth Bass #5 was located 10 times.

Table 14. Largemouth bass tagged with a Sonotronics radio telemetry tag Solicitor and Carp coves.

	Length (mm)	Weight (g)	Location	Telemetry code	Sonic Tag #	Frequency	Interval
Largemouth Bass	467	1,510	Solicitor Cove	333	#1	69 KHz	870
Largemouth Bass	438	1,390	Solicitor Cove	334	#2	70 KHz	860
Largemouth Bass	511	1,875	Solicitor Cove	447	#5	73 KHz	910
Largemouth Bass	555	2,980	Carp Cove	365	#3	71 KHz	890
Largemouth Bass	488	1,805	Carp Cove	366	#4	72 KHz	880
Largemouth Bass	506	2,225	Carp Cove	448	#6	74 KHz	900

Table 15. Tagged Largemouth Bass tracking in Lake Mohave, 2018.

Tracking Date	Tracking Time	Location (Cove)	Tag number
1/23/2018	1200	Carp	6
1/23/2018	1200	Carp	4
1/23/2018	1325	Solicitor	2
1/23/2018	1330	Solicitor	5
2/9/2018	0908	Carp	6
2/9/2018	0945	Solicitor	2
2/9/2018	0945	Solicitor	5
2/12/2018	1800	Carp	6
2/12/2018	1850	Solicitor	5
3/13/2018	1728	Carp	6
3/13/2018	1733	Carp	4
3/13/2018	1820	Solicitor	5
4/4/2018	0912	Solicitor	5
4/4/2018	0915	Solicitor	2
4/19/2018	0705	Bass	2
4/19/2018	0745	Carp	6
4/23/2018	0910	Carp	6
4/23/2018	1000	Solicitor	5
5/2/2018	1918	Carp	6
5/2/2018	1925	Carp	4
5/2/2018	1945	Solicitor	2
5/8/2018	1900	Solicitor	5
5/8/2018	1922	Solicitor	2
5/8/2018	2015	Carp	6
9/4/2018	1500	Carp	6
11/26/2018	1622	Carp	6
11/26/2018	1650	Carp	4
11/26/2018	1930	Solicitor	5
11/27/2018	1029	Carp	6
11/27/2018	1029	Carp	4
11/28/2018	1130	Carp	6
11/28/2018	1147	Carp	4
11/28/2018	1220	Solicitor	2
12/4/2018	0935	Carp	6
12/11/2018	1007	Carp	6
12/20/2018	1415	Carp	6

MANAGEMENT REVIEW

The Lake Mohave Striped Bass fishery remains largely stunted and there is low recruitment of juvenile age classes into the population. As other agencies continue to collect water quality data, a better understanding of the Lake Mohave ecosystem may help explain the decline in the Striped Bass fishery. In recent years, the water temperature has changed, which is likely a result of water elevation changes in Lake Mead and increasing ambient air temperatures during winter months.

Lake Mohave remains a reservoir known for trophy Striped Bass. The trophy fishery was built on limited abundance at younger life stages, permitting recruitment into the larger size classes. Abundant recruitment leading to a sudden and large increase in the Striped Bass population quickly eliminated the limited forage base, and over time resulting in even fewer trophy fish. There remains a few trophy-sized Striped Bass in Lake Mohave; however, the traditional “hot spots” for catching fish have changed, as Rainbow Trout have not been stocked for several years. Striped Bass now disperse throughout the lake in search of other prey.

Fish habitat enhancements will continue in 2019. Largemouth Bass, Smallmouth Bass, Bluegill, Channel Catfish, and Common Carp, in all life stages utilize these structures. This project appears successful since fish abundance is generally higher in areas of constructed habitat compared to coves without.

RECOMMENDATIONS

- Maintain present regulations.
- Continue monitoring fish populations through gill netting and SCUBA surveys.
- Continue to mark black bass with Floy tags to examine movement and if fish are caught again or observed during SCUBA surveys.
- Continue participating with the Lake Mead National Recreation Area Fisheries Management Team.
- Continue developing and implementing the Lake Mohave Habitat Enhancement project by installing artificial habitat structures.
- Maintain existing artificial habitat structures during SCUBA surveys.
- Assess additional coves to expand Lake Mohave Habitat Enhancement project
- Continue to participate in the Lake Mohave Native Fish Work Group and associated native fish restoration projects.
- Maintain volunteer angler drop-boxes and continue contact creel surveys.

Prepared by: Lisa Ozborn
Biologist III, Southern Region

Date: June 27, 2019

Appendix 1

Lake Mohave & Colorado River

Angler Drop-Box

The Nevada Division of Wildlife asks for your help in evaluating this fishery.
Please fill out a form only for ***ONE PERSON*** for ***EACH DAY*** you fished.

Date you fished;_____ Zip Code:_____
Time Started_____ Time Ended_____

What type of gear you used: **Artificial _____** **Live/powerbait _____**

TOTAL *Number of* ***Trout*** *Caught*_____ *Number Released*_____
TOTAL *Number of* ***Striped Bass*** *Caught*_____ *Number Released*_____
TOTAL *Number of* ***Largemouth Bass*** *Caught*_____ *Number Released*_____
TOTAL *Number of* ***Smallmouth Bass*** *Caught*_____ *Number Released*_____
TOTAL *Number of* _____ *Caught*_____ *Number Released*_____
Fill in Species

SIZE OF FISH

Enter ***Number of Fish*** you caught in each size category below (**Include Released Fish**)

Species	**Under 10”**	**10”-15”**	**15”-20”**	**over 20”**
Striped Bass……..	_____	_____	_____	_____
Largemouth Bass..	_____	_____	_____	_____
Smallmouth Bass..	_____	_____	_____	_____
Rainbow Trout…...	_____	_____	_____	_____
Channel Catfish....	_____	_____	_____	_____
Sunfish……	_____	_____	_____	_____
Other …….....	_____	_____	_____	_____

ANGLER SATISFACTION

Please indicate satisfaction with your fishing trip by ***CIRCLING*** a number below that closely reflects your feelings.

	Not Satisfied				***Satisfied***
Today’s fishing experience	1	2	3	4	5
Number of fish	1	2	3	4	5
Size of fish	1	2	3	4	5

*** Thank you for supporting us in managing this fishery ***