NEVADA DEPARTMENT OF WILDLIFE
STATEWIDE SPORT FISHERIES MANAGEMENT

FEDERAL AID JOB PROGRESS REPORT

F-20-52
2016

LAKE MEAD
SOUTHERN REGION

NEVADA DEPARTMENT OF WILDLIFE, FISHERIES DIVISION
JOB PROGRESS REPORT

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NEVADA DEPARTMENT OF WILDLIFE, FISHERIES DIVISION
ANNUAL PROGRESS REPORT

State: *Nevada*
Project title: *Statewide Fisheries Program*
Job title: *Lake Mead*
Period Covered: *January 1, 2016 to December 31, 2016*

SUMMARY

General Sport Fishing Evaluation

In 2016, a total of 110 days were expended conducting creel surveys on Lake Mead. A total of 882 anglers were contacted whose catch totaled 3,698 fish of multiple species for a catch rate of 4.6 fish/angler-day and averaged 0.93 fish/angler-hour. The observed 1,752 fish harvested provided a harvest rate of 1.98 fish/angler-day and an average 0.4 fish/angler-hour.

During the fall, NDOW, Arizona Game and Fish Department (AZGFD), and U.S. Bureau of Reclamation cooperatively completed electroshocking and gill netting surveys. Electroshocking surveys were dominated by green sunfish *Lepomis cyanellus*, bluegill *L. macrochirus*, largemouth bass *Micropterus salmoides*, and smallmouth bass *M. dolomieu*, while gill netting surveys caught primarily gizzard shad *Dorosoma cepedianum*, striped bass *Morone saxatilis*, and common carp *Cyprinus carpio*.

Striped Bass Assessment

Striped bass catch per unit effort (CPUE) in the gill netting survey showed a slight increase from that of 2015, and angler interest in striped bass as a percentage of total angler preference decreased nearly eight percentage points from that observed in 2015 to 68.8%. Harvested striped bass sampled during creel surveys were slightly larger than last year and in similar condition. They averaged 16.9 inches (in, 429 millimeters [mm]) total length (TL), with an average weight of 1.6 pounds (lbs, 739 grams [g]), and an average condition factor ($K_{FL(fork\ length)}$) of 1.13. Striped bass length was slightly smaller in the gill netting sample compared to last year and their body condition decreased. Striped bass averaged 15.2 in (385 mm) TL, weighed an average of 1.13 lbs (512 g), and had a condition factor of 1.02 K_{FL}. This is a 0.13 K_{FL} decrease in condition factor.

Black Bass Fisheries Assessment

Gill netting surveys revealed decreases in abundance for both largemouth bass and smallmouth bass. Black bass angler harvest, as a percentage of the total harvest, increased in 2016 to 2.2% compared to 0.8% last year. The fishery remains mostly catch and release with only 5.6% of the observed catch harvested. The percentage of angler preference for black bass jumped to 25.6% of the total angling effort. Samples

taken from tournament mortalities revealed largemouth bass were similar in size to last year at 16.4 in (416 mm) with an average weight of 2.2 lbs (1,007 g) but had a reduced condition with a relative weight (W_r) of 88. Smallmouth bass were also similar in size and condition compared to last year at 15.1 in (384 mm) with an average weight of 1.6 lbs (728 g) and a W_r of 82. Largemouth bass had improved spawning success this year; with a small increase in young-of-the-year (YOY) snorkel observations, though their numbers were not as high as smallmouth bass. Smallmouth bass YOY snorkel observations were unchanged from last year. In the electrofishing efforts, both largemouth and smallmouth bass had slight increases in CPUE with the catch dominated by the YOY age class.

Prey Base Studies

Threadfin shad production was monitored during the spring/summer seasons in two basins of Lake Mead. A total of 26 standard transects were sampled in the Overton Arm and the Boulder Basin. The shad population exhibits a cyclical pattern with two to three years of poor production followed by a peak year in production. This was the second year that Boulder Basin declined with shad production dropping to 28 shad/3,531 ft^3 (100 m^3). Overton Arm also showed a decline in production at 43 shad/3,531 ft^3 (100 m^3). The overall lake average production dropped to 36 shad/3,531 ft^3 (100 m^3) compared to 84 shad/3,531 ft^3 (100 m^3) last year.

Salmonid Fisheries Assessment

No rainbow trout *Oncorhynchus mykiss* were stocked in 2016 and no trout were captured in any surveys.

BACKGROUND

Lake Mead was created by the completion of the Hoover Dam in 1935. The newly formed impoundment was stocked with largemouth bass and sunfish *L.* spp., and soon became known for its excellent bass fishery. In the 1940s, the bass fishery began to decline with reports of fish in poor condition. In 1954, threadfin shad were introduced to Lake Mead to provide additional forage. Initially there was some improvement in largemouth bass condition, but this was short-lived. In 1963, the construction of upstream impoundments reduced flow conditions with the filling of Lake Powell. This also changed historic water storage patterns to one of lower spring flows and higher winter flows, which cause drawdown during the black bass spawning season. Changes in temperature fluctuations and nutrient loading to Lake Mead were also noted after the construction of Lake Powell.

Because of the declining largemouth bass fishery, introductions of coldwater fish were made in 1969 to enhance the fishery and to fill a vacant niche. These fish included rainbow trout, cutthroat trout *O. clarkii*, hybrid bowcutt trout *O. mykiss* x *O. clarkii*, and silver salmon *O. kisutch*. Striped bass were also stocked at this time and up until 1972, at which time they were found to be naturally reproducing and stocking was discontinued. At the time of these introductions, the threadfin shad population had

grown to become an over-abundant pelagic biomass mostly unavailable to littoral species. After ten years, however, striped bass had become well established in Lake Mead and subsequently decreased the threadfin shad population. Moreover, increasing evidence indicated that striped bass were negatively impacting the concurrently established salmonid fishery and contributing to the severe decline of the long established black crappie fishery. Trout stocking was discontinued in 1983 for a variety of reasons, including poor long-term returns and other demands on production capability. Poor condition factors persisted in both striped and black bass.

Since 2007, the management strategy for striped bass has been an attempt to manipulate the structure of the lake-wide population by encouraging anglers to harvest the large number of available fish in the smaller size ranges through increased possession limits. Increased harvest of the 12 to 15 in (305-381 mm) size cohort, primarily one and two year old fish, would decrease the impact on YOY shad, thus making more of the current shad production available to larger striped bass when they can feed upon them in late summer and early fall. Ideally, this should result in improved condition factors in larger fish. Similar regulations are now continuous throughout Lakes Powell, Mead, and Mohave, with an unlimited take of striped bass under 20 in (508 mm) and a 20 fish limit on striped bass over 20 in. Under these regulations, there are a large number of one and two year old striped bass available for harvest each year, though striped bass over 20 inches are in shorter supply.

Second to the popular striped bass fishery is the black bass fishery. The largemouth bass population has remained stable over the past 10 years, despite long-term drought conditions. Smallmouth bass, first detected in the creel survey in 1999, are now a large part of the tournament catch and are found lake-wide, and since 2010 have rivaled largemouth bass in abundance. The salmonid stocking program, reestablished in 1991, has been suspended as of March 2011 due to the Lake Mead Fish Hatchery closure.

The newest challenges to the Lake Mead fishery are invasive species. In 2007, two aquatic nuisance species (quagga mussel and gizzard shad) made their way to Lake Mead. The impact these species will have on the Lake Mead fishery is unknown at this time. So far, gizzard shad have been found to provide additional forage for striped bass; however, they grow rapidly to a size most fish cannot utilize as prey and could become competitors for food resources. Another recent invader, the New Zealand mud snail *Potamopyrgus antipodarum*, now inhabits the benthos with unknown effects to the fishery. Despite these invasions, Lake Mead continues to provide anglers with a variety of fishing opportunities.

OBJECTIVES and APPROACHES

Objective: To monitor angler use, catch, and fish population dynamics of the Lake Mead fishery.

Approaches:

- Evaluate angler success through at least 100 days of contact creel surveys at four angler access points on Boulder Basin and Overton Arm.
- Collect angler catch data from black bass tournaments.
- Conduct gillnetting and trammel-net surveys lake-wide once in the fall in cooperation with Arizona Game and Fish Department (AZGFD).
- Conduct fall electroshocking surveys in cooperation with AZGFD to evaluate changes in littoral zone fish species.
- Conduct summer black bass dive transects to assess impacts of reduced and variable lake elevations on black bass spawning and recruitment.
- Complete weekly meter net trawls during peak threadfin shad production.
- Conduct quarterly stomach content analysis of a minimum of 200 tournament caught striped bass to detect changes in their diet.
- Utilize creel, tournament, and monitoring data to assess sport fishery performance and changes, and develop estimates of sport fish availability and condition to inform anglers.

PROCEDURES

Creel Survey

Contact creel surveys were conducted on 110 separate creel days from January through December. A total of four boat landings were surveyed. Boulder Harbor was surveyed on a weekly basis, Callville Bay and Echo Bay were surveyed less frequently from zero to six times a month, and Hemenway was surveyed infrequently.

The creel survey program was re-designed in September 2015 to stratified random sampling where the four landings have different sampling probabilities based on angler use. The following are landings with their respective sampling probabilities: Boulder Harbor, 0.56; Callville Bay, 0.22; Echo Bay, 0.11; and Hemenway, 0.11. The days sampled are randomly selected from Tuesday through Saturday and stratified as either morning or afternoon hours.

Surveys were performed for a continuous period and information collected included total catch, unit of effort, location fished, bait type, species caught, angler origin, species preference, and presence of tags or marks on fish. Subsamples of harvested fish were weighed and measured to obtain length and weight data.

Black Bass Tournament Monitoring

Major largemouth bass fishing tournaments were monitored to evaluate weigh-in procedures, obtain any tag return data, and insure a proper release procedure was adhered to consistent with National Park Service (NPS) permitting. Data on bass species composition and bag weights were collected. Additionally, species, length, and weight data were collected from tournament mortalities. Scale samples were also collected from the mortalities for aging and stomach contents were identified to determine diet.

Gill netting Surveys

The gill netting survey was carried out in the fall. Gill nets were set according to NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs for gillnetting warmwater species. An exception to the guidelines is that experimental gill nets used by NDOW on Lake Mead are multifilament experimental gill nets, 150 ft (46 m) in length, with five 30-ft (9 m) panels typically ranging in mesh size from 0.75 to 3 in (19 to 76 mm). Nets were set overnight and not deeper than 40 ft (12 m). Fish were identified to species, weighed, measured, and released back to the lake.

Electroshocking Surveys

Electroshocking was done in the fall, during the evening hours using a boat equipped with a Coffelt shocking apparatus and a VVP-15B electrical box. Boat electroshocking methods described in NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs were used. Fish were identified to species, measured, weighed, and released back to the lake.

Summer Dive Surveys

Dive counts were conducted using mask and snorkel. Observations were made at stratified random coves on the lake with cove selection dependent on visibility and clarity of water using methods described in NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs for snorkeling. Dive transects were timed counts where all species were counted or estimated (e.g., threadfin shad schools), and black bass were further categorized into fry, fingerling, juvenile, or adult size-classes. Substrate composition, percent vegetation, water temperature, and visibility were also recorded to characterize habitat conditions.

Shad Trawls

Weekly meter-net trawling for shad were conducted from May 16 to June 20. Samples were taken in the Boulder Basin and Overton Arm using established transects and procedures in accordance with a 1988 nutrient study protocols, but with reduced number of sample sites. Due to the loss of the inner Las Vegas Bay transect, a new transect located in outer Las Vegas Bay (near Sand Island) was added in 2015. The procedure for shad trawling, established in the 1988 protocol, consists of towing a cone-shaped net with an open end of 3.3 ft (1 m) in diameter and 0.06 in (1.6 mm) mesh screening. The net is 19.7 ft (6 m) in length, with a 10 in (25.4 cm) collecting cup on the end. The net is towed approximately 65.6 ft (20 m) behind the boat. A trawl lasts for 10 min at a boat speed of 2 knots (approximately at 1,000 rpm engine speed) and it is replicated three times to provide an average number. A flow meter is attached at the mouth of the net to record water movement through the net such that the volume of water sampled can be determined. Fish are counted and abundance is then converted to a value of fish/3,531.5 ft^3 (100 m^3) of water. This technique is efficient for small fish up to 0.8 in (20 mm), as larger fish tend to avoid the net and, therefore, is an estimate of

reproductive success and does not represent a true recruitment value. In 1997 after eight years of trend data, sampling was streamlined to concentrate on weekly surveys during peak shad production. Peak production values are calculated as an average of the highest four or five weeks of shad production.

FINDINGS

Creel Survey

A total of 110 days were expended conducting creel surveys on Lake Mead, contacting 882 anglers at four sites. Boulder Harbor received the most survey effort of the four sites at 54.5% followed by Callville Bay, Echo Bay, and Hemenway (Table 1). These anglers caught 3,698 fish of multiple species for a catch rate of 0.93 fish/angler-hour (Figure 1) and 4.6 fish/angler-day. Excellent catch rates were observed throughout most of the year with the winter months from January through March having the lowest catch rates of 0.45, 0.35, and 0.35 fish/hour, respectively. The highest catch rates were observed during the warmer months of May through October with 1.1 to 1.6 fish/angler-hour with May having the highest catch rate of 1.6 fish/angler hour (Figure 1). Of the 3,698 fish reported as captured, 1,752 were harvested. This resulted in a harvest rate of 0.4 fish/angler hour and 1.99 fish/angler-day. This year's overall catch rates have decreased from last year and are comparable to 2014 catch rates of 0.9 fish/angler-hour (Figure 1).

Since 2004, angler catch rates have exceeded the upper target catch rate of 0.75 fish/hour for a water managed as a warmwater, general fishery according to the Department's Fishery Management Concepts (NDOW). Even during the slow winter months, angler success rates were above the minimum target catch rate of 0.25 fish/hour (figure 1). Fish/angler rates have also exceeded the target rates of 1.0 to 2.0 fish/ angler day (NDOW) since 1991, with some of the highest angler catch rates occurring 2004 and after (Figure 2).

Species abundance of harvested fish was led by striped bass at 94.8%, followed by channel catfish at 2.6%, and black bass at 2.2% (Table 2). Angling effort (angler preference) in 2016 for striped bass as a percentage of the total decreased to 68.8% of the total, with large and smallmouth bass the second most sought after at 25.6%, channel catfish at 1.7%, and indiscriminate anglers dropped to 3.9% (Table 3). From a sample size of 286 harvested fish, striped bass averaged 16.9 in (429 mm) TL, 1.6 lbs (739 g), and had an average condition factor of 1.13 K_{FL}, with 13% in poor condition. Striped bass were in poorest condition during the months April through July, with condition improving later in the summer after the shad had spawned and were available as forage (Table 4).

Black bass percent of observed harvest increased this year to 2.2% compared to 0.8% of the total harvest in 2015 (Table 2). This harvest figure represents only a portion of the angler use on Lake Mead for black bass because of the catch-and-release nature of this fishery, with 94.4% of black bass captured released back to the lake. Preference

black bass anglers as a percentage of all anglers increased to 25.6%. Preference for black bass has not been near 20% since 2005.

TABLE 1. Fishing docks (marinas) and number of days surveyed by month during the 2016 Lake Mead creel survey.

	Dock (Marina)				
	Hemenway	Boulder Harbor	Callville Bay	Echo Bay	Total days
January	0	7	0	2	9
February	1	5	2	1	9
March	0	7	2	2	11
April	0	4	3	2	9
May	1	4	4	1	10
June	0	4	4	2	10
July	1	5	6	0	12
August	3	6	0	0	9
September	0	5	2	2	9
October	2	5	0	1	8
November	0	5	0	0	5
December	1	3	3	2	9
Total days	9	60	26	15	110
Percent	8.2	54.5	23.6	13.6	

Channel catfish was the second most harvested fish on Lake Mead in 2016 with a harvest rate of 2.6% of the total harvest (Table 2). This rate is similar to last year. Interest for catfish has remained low at 1.7% of the surveyed angling effort (Table 3). No bluegill were reported in the 2016 creel survey effort. Six black crappie were captured in the Overton Arm making up 0.3% of the harvest composition. These fish were captured during the months of February, March, and December. This period is when many out-of-state anglers travel south to get out of the snow and fish at Echo Bay. The creel clerk reports this is one of the busiest times for fishing at Echo Bay and the Overton Arm (Adam Stenson, pers. comm.).

TABLE 2. Composition of harvest by species (percentage of total harvest) from contact creel surveys on Lake Mead, 2006-2016.

Species	Year										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Black bass	0.5	0.2	0.3	0.7	0.4	1.0	0.6	3.5	1.7	0.8	2.2
Bluegill	0.1	0.1	0.1	0	0	0.8	0.5	0.3	0	0	0
Black crappie	0	0	0	0	0	0	0	0.2	0	0.5	0.3
Channel catfish	4.1	2.4	3.5	3.0	5.9	7.7	3.5	4.6	2.2	2.8	2.6
Rainbow trout	1.6	4.3	2.2	7.3	12.0	3.1	0	0	0	0	0
Striped bass	93.7	92.9	94.0	88.9	81.6	87.4	95.2	91.4	95.6	95.8	94.8

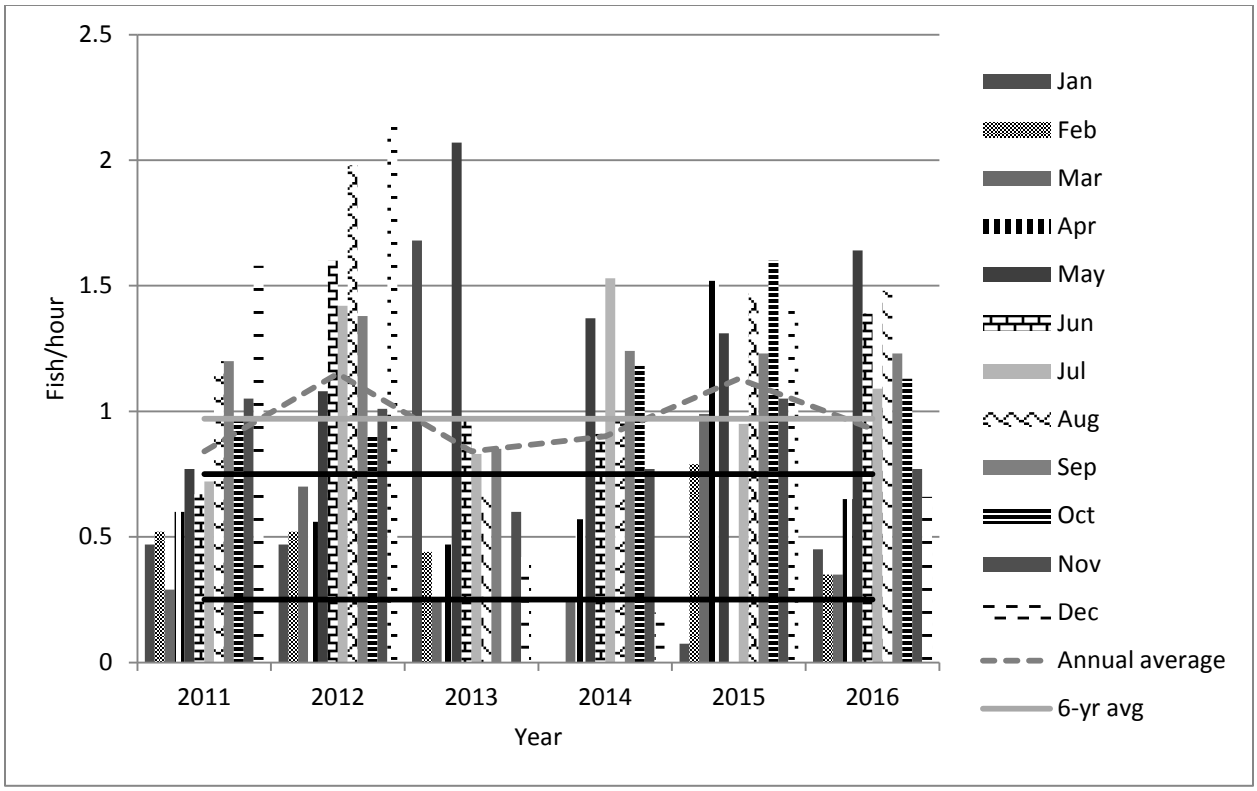

FIGURE 1. Lake Mead angler catch rates (fish/angler hour) by month from contact creel surveys, 2011-2016.

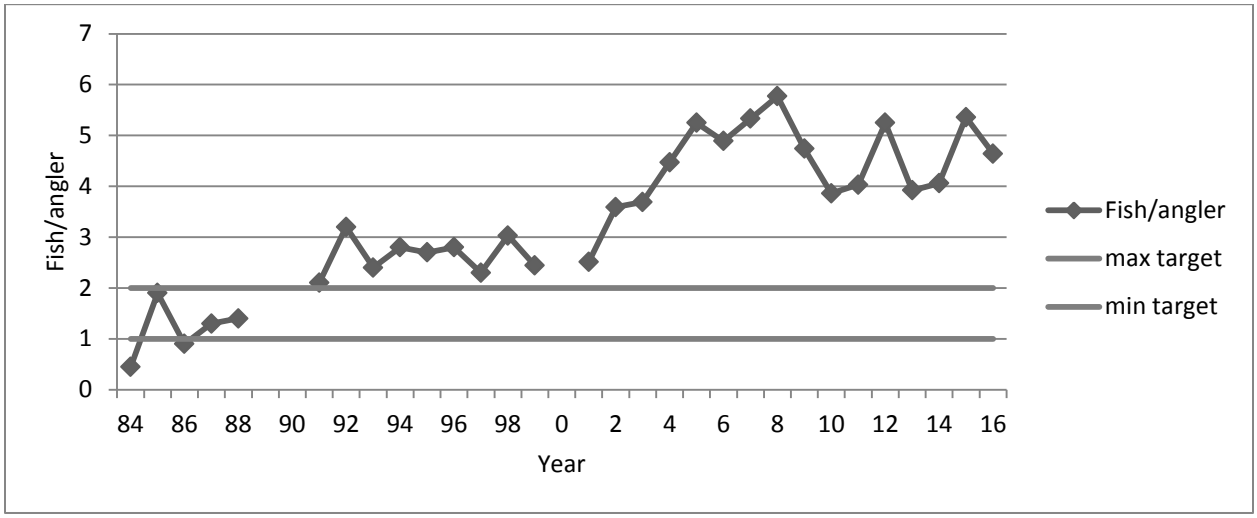

FIGURE 2. Lake Mead angler catch rates (fish/angler day) by month from contact creel surveys, 1984-2016.

TABLE 3. Lake Mead angler effort by species or preference (percent of total angler use) from contact creel surveys, 2006-2016.

Species	Year										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Black bass	16.9	6.1	5.4	8.0	5.1	8.7	11.2	14.8	21.0	15.0	25.6
Bluegill	0	0	0	0	0	0	0	0	0	0	0
Black crappie	0	0	0	0	0	0	0	0	0	0.5	0
Channel catfish	0.8	0.6	0.7	1.1	1.0	1.8	0.75	1.8	1.7	2.4	1.7
Rainbow trout	2.1	5.4	5.9	7.0	11.1	3.9	0	0	0	0	0
Striped bass	65.4	84.2	85.1	75.2	75.8	78.7	84.8	80.2	66.0	76.7	68.8
Multiple or any	14.8	3.6	2.8	8.7	7.0	6.6	3.0	2.9	9.6	4.8	3.9

TABLE 4. Striped bass average lengths, weights, and condition factor (K_{FL}) from 2016 monthly creel survey samples Lake Mead.

Month	*n*	Average total length		Average weight		K_{FL}	K_{FL} %<1.0
		in	mm	lb	g		
January	35	17.9	455	1.9	861	1.14	2.9
February	8	18.4	469	2.1	955	1.15	0
April	8	20.1	510	2.4	1081	1.02	50
May	9	20.1	510	2.4	1081	1.02	22.2
June	20	18.8	477	1.9	879	1.00	55
July	49	17.0	432	1.6	725	1.08	12.2
August	56	16.1	409	1.4	653	1.16	10.7
September	50	15.2	387	1.3	574	1.09	6
October	7	18.3	464	1.9	883	1.09	28.6
November	12	17.6	448	1.9	873	1.18	8.3
December	12	15.2	387	1.3	583	1.19	8.3
Average		16.9	429	1.6	739	1.13	12.6
Total	286						

In 2016, the percentage of out-of-state anglers decreased to 17.3% of anglers surveyed. Nevada anglers made up 82.7%, California 2.6%, Arizona 1.5%, and anglers from other states or countries made up 13.3% of angler use on Lake Mead. The percentage of California and Arizona anglers combined declined to 4.1% and anglers from other areas dropped to 13.3% (Table 5).

TABLE 5. Angler origin by state of residence (percentage of total angler use) from contact creel surveys on Lake Mead, 2006-2016.

State	Year										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Nevada	74.2	78.5	75.5	86.0	88.6	84.8	87.0	77.6	72.7	76.5	82.7
California	6.6	3.0	3.4	2.1	1.1	2.3	1.4	1.4	2.2	5.5	2.6
Arizona	2.1	0.6	1.4	0.6	0.1	0.2	0.6	1.8	3.9	2.3	1.5
Other	17.0	17.9	19.5	11.3	10.2	12.7	11.0	19.2	21.2	15.8	13.3

The Mail-in Angler Questionnaire Survey is another source of data that is used to track trends in angler use and fishing success. Each year, the previous year's angler questionnaire data becomes available, so the current angler questionnaire data is from 2015. Angler use at Lake Mead was highest in the late 1990s, with nearly 43,000 anglers/year. According to the questionnaire data, angler use at Lake Mead has continued to decline since 2002. Data shows that angler use in 2015 dropped a little from 2014 to 10,602 anglers/year, yet these anglers caught more fish than the previous year, catching 335,708 fish (Figure 3). The success rate increased to 4.0 fish/day, up from 2.7 fish/day in 2014. This rate is above the 19-year average of 3.1 fish/angler and double the maximum target rate of 2.0 fish/angler (Figure 4) as defined in the department's Fishery Management Concepts for a general warmwater fishery (NDOW).

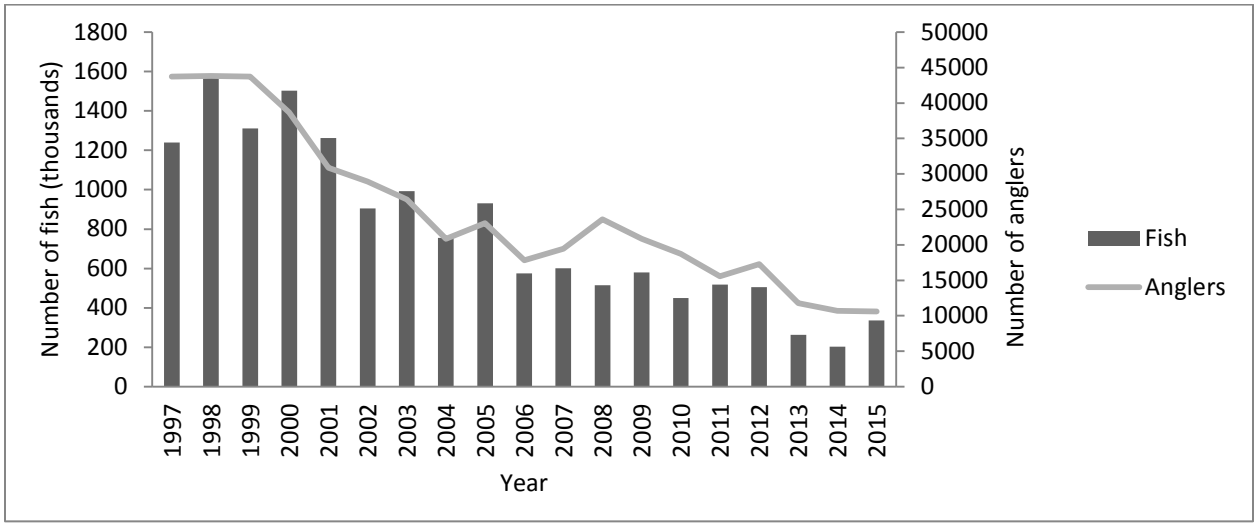

FIGURE 3. Expanded number of anglers and fish caught from the mail-in angler questionnaire data for Lake Mead, 1997-2015.

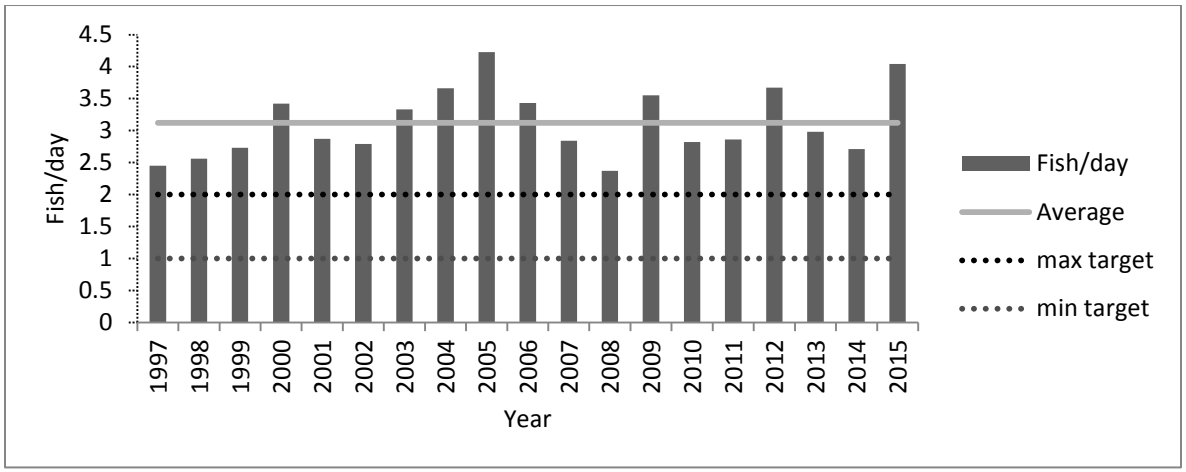

FIGURE 4. Expanded number of fish/day data from the mail-in angler questionnaire data for Lake Mead, 1997-2015.

Black Bass Tournament Monitoring

Nine black bass tournaments were attended to collect species composition, length, and weight data for investigating trends in the black bass fishery. Additionally, scale samples were taken and stomach contents were analyzed from the mortalities. As of January 2015, there has not been a live-release boat stationed at Callville Bay to take samples from, so a subsample of the catch was taken from the tournament mortalities. From these mortalities, 24 largemouth bass and 79 smallmouth bass were measured and weighed. Largemouth bass averaged 16.4 in (416 mm) TL and weighed an average of 2.2 lbs (1,007 g) with a W_r of 88. The average condition declined over last year's W_r of 93. Smallmouth bass averaged 15.1 in (384 mm) TL and weighed an average of 1.6 lbs (728 g) with a W_r of 82 (Table 6). Smallmouth bass condition was similar to the previous year. The presence of smallmouth bass in the tournament catch increased over that observed last year to 54%.

Stomach contents of the mortalities found the most frequent items were crayfish or fish mass. Other infrequent items found in the stomachs were lures and vegetation, and some stomachs were empty. Overall, crayfish was the most occurring food item with 60% of smallmouth and 42% of largemouth bass stomachs having crayfish. Fish mass frequency in stomachs was 13% for smallmouth bass and 4% for largemouth bass (Table 7). Fish in the stomachs were identified as green sunfish and one smallmouth bass; otherwise, the fish were digested beyond the point of identification. Seasonally, crayfish frequency was greatest for smallmouth bass in June and September while largemouth bass had a higher frequency of crayfish in April (Table 7). In addition to our samples, one tournament angler produced a 3.0 in (76 mm) striped bass that was in the stomach of one of his smallmouth bass catches.

TABLE 6. Summary of black bass tournament mortality samples with number (*n*), length in inches (in) and millimeters (mm), weight in pounds (lbs) and grams (g), and condition expressed as relative weight (W_r).

Date	Largemouth bass						Smallmouth bass					
	n	in	mm	lbs	g	W_r	*n*	in	mm	lbs	g	W_r
4/4/2016	11	16.7	424	2.5	1,135	92	9	15.5	393	1.8	813	89
6/25-26/2016	6	16.8	426	2.2	988	81	29	16	406	1.8	829	79
9/12-14/2016	7	15.5	394	1.8	820	86	41	14.4	367	1.4	641	83
Average		16.4	416	2.2	1007	88		15.1	384	1.6	728	82
Total n	24						79					

Summer Snorkel Surveys

Snorkel surveys were completed from June 28 to August 17, 2016. Initially, a list of 80 lake-wide random coves was developed from which a subsample of coves was chosen. The initial list was large because many randomly selected coves were without water, some were in turbid areas, and some were located in the Gregg Basin, which

was not sampled. The 13 survey coves that were chosen were limited to those located in the Boulder Basin (away from Las Vegas Bay). In addition, four non-random coves were snorkeled in the Boulder Basin for a total of 17 sites.

TABLE 7. Summary of stomach contents of smallmouth bass (SMB) and largemouth bass (LMB) tournament mortality samples with number (*n*), species, and percentage of sample containing crayfish and fish mass.

Date	Species	*n*	% crayfish	% fish mass
4/4/2016	SMB	9	22	0
	LMB	11	46	0
6/25-26/2016	SMB	29	59	28
	LMB	6	50	17
9/12-14/2016	SMB	41	68	5
	LMB	7	29	0
Overall	SMB	79	60	13
	LMB	24	42	4

Two divers snorkeled for a total of 847 minutes at 17 coves for an average of 25 minutes (min)/diver/transect. A total of 416 black bass of different ages were observed, of which 114 were largemouth bass and 302 were smallmouth bass (Table 8). Figure 5 summarizes the difference in observation rates between species and size classes for 2016, with smallmouth bass more abundant at all size classes. This year, smallmouth bass young of the year (YOY) were much more abundant than largemouth bass and numbered 211 for an observation rate of 7.0 fish/30 min, while there were only 81 largemouth bass YOY observed at a rate of 2.7 fish/30 min. The YOY observation rate for smallmouth bass was consistent with what was seen last year while largemouth bass observations nearly doubled from last year (Figure 6). This year visibility was not an issue in most of the coves with average visibility around 10 ft. Blue-green algae was not seen in the coves as it was last year. Cover for bass was somewhat improved with aquatic vegetation averaging 18% (last year was 12%).

TABLE 8. Largemouth (LMB) and smallmouth (SMB) bass observation numbers (*n*) and rates (fish/30 min) from 2016 Lake Mead snorkel surveys.

	LMB YOY	LMB juvenile	LMB adult	LMB all	SMB YOY	SMB juvenile	SMB adult	SMB all
n	81	16	18	115	211	52	39	302
Fish/30 min	2.7	0.5	0.6	3.75	7.0	1.7	1.3	9.9

Black bass in the juvenile size class showed a similar trend to the YOY class, with smallmouth bass being much more abundant than largemouth bass (Figures 5 and 7). Smallmouth bass juvenile observations were over three times higher than that of juvenile largemouth bass (Table 7). Figure 7 shows smallmouth bass juvenile abundance to be similar to the last two years while largemouth bass juvenile abundance has increased five times over that observed last year, though still well below numbers seen from 2011-2013.

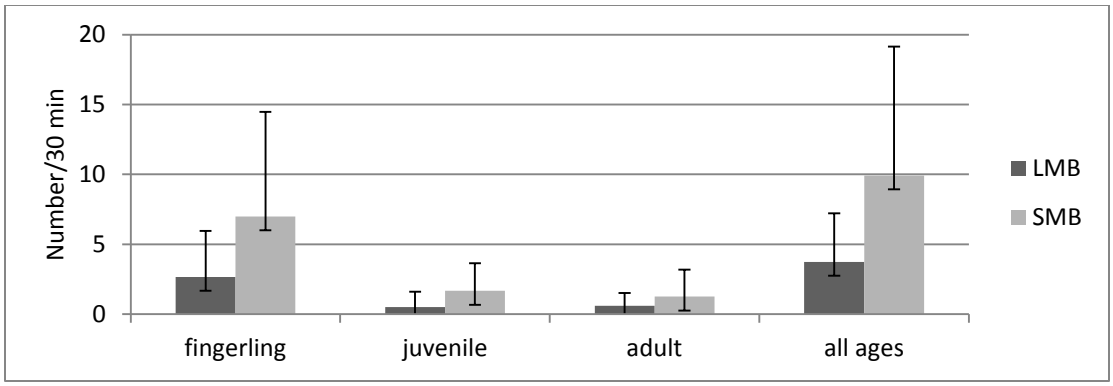

FIGURE 5. Count data from black bass snorkel surveys on Lake Mead, 2016.

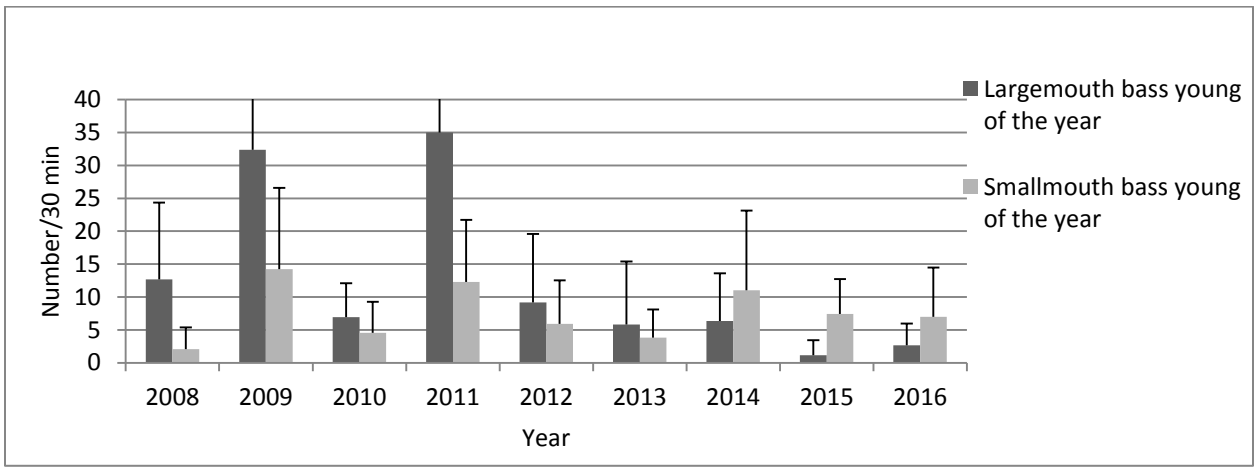

FIGURE 6. Count data from black bass snorkel surveys on Lake Mead, 2008-2016.

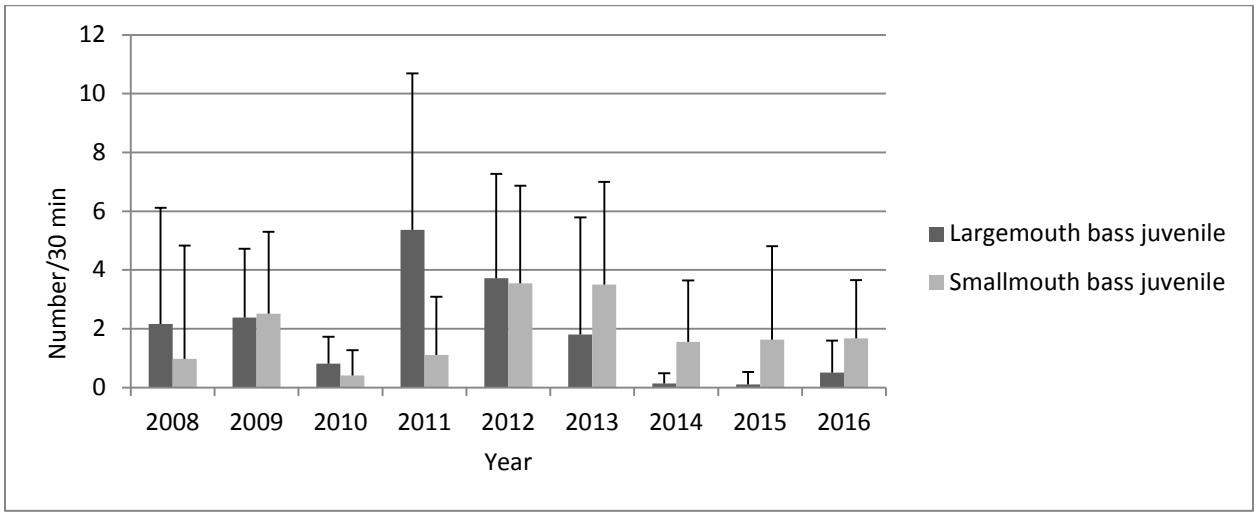

FIGURE 7. Black bass juvenile count rates from snorkel surveys, Lake Mead, 2008-2016.

Electroshocking Surveys

The electroshocking survey was conducted from October 4 to November 1 in conjunction with the gill netting survey. A total of 37 electroshocking sites were sampled (17 of these sites were sampled by NDOW). An additional five sites were completed by NDOW in the Virgin Basin but turned out to be duplicates of AZGFDs effort and are not included in the results. A total of 553 min of effort was expended yielding 1,856 fish of 14 species for a catch rate of 50.3 fish/15 min of effort. Green sunfish and bluegill were the most numerous species, followed by largemouth and smallmouth bass (Table 9).

Other species represented in the catch include channel catfish, black crappie, blue tilapia *Oreochromis aureus*, bullhead catfish *Ameiurus* sp., common carp, gizzard shad, red shiner *Cyprinella lutrensis*, and threadfin shad (Table 9). The black crappie were limited to Overton Arm and Virgin Basin. This is only the second time black crappie has been captured in the Virgin Basin in either the electrofishing survey with records dating back to 2003 or the gill netting survey with records dating back to 1992. The black crappie captured at Virgin Basin this year in the electroshocking survey was caught at Haystack Bay, and back in 2011, the capture was at Boathouse Cove. Two additional black crappie were captured from the accompanying gill netting survey at Lakeside Bays and Boulder Wash, located in the Virgin Basin. Typically, black crappie are limited to the Overton Arm and Gregg Basin.

TABLE 9. Summary catch data by species from the 2016 fall electroshocking survey on Lake Mead.

Species	*n*	CPUE (fish/15 min)	Composition (% of catch)	Average total length		Average weight	
				in	mm	lbs	g
Black crappie	18	0.49	0.97	3.0	75.7	0.014	6
Blue tilapia	43	1.17	2.3	4.8	121	0.1	44
Bluegill	417	11.3	22.5	3.3	84	0.03	14
Bullhead catfish	3	0.08	0.2	7.9	201	0.29	132
Common carp	44	1.19	2.4	22.3	567	5.96	2703
Channel catfish	18	0.49	0.97	8.9	226	0.76	346
Gizzard shad	99	2.68	5.3	13.3	338	1.27	576
Green sunfish	779	21.1	42	2.7	69	0.01	6
Largemouth bass	167	4.53	9	5.8	147	0.19	88
Red shiner	19	0.51	1	2.0	52	0.005	2
Smallmouth bass	142	3.85	7.7	4.6	116.2	0.05	25
Striped bass	21	0.57	1.1	8.2	207	0.3	135
Threadfin shad	86	2.3	4.6	4.2	107	0.02	10
Totals	1,856	50.3	100				

Striped bass CPUE in the electroshocking survey decreased slightly this year to 0.57 fish/15 min of effort, continuing the trend of decreasing CPUE since 2009 (Figure

8). The reasons for this decline are unknown. Largemouth and smallmouth bass showed slight increases in CPUE from that observed in 2015, and channel catfish abundance declined from that observed in 2015 (Figure 8, Table 9).

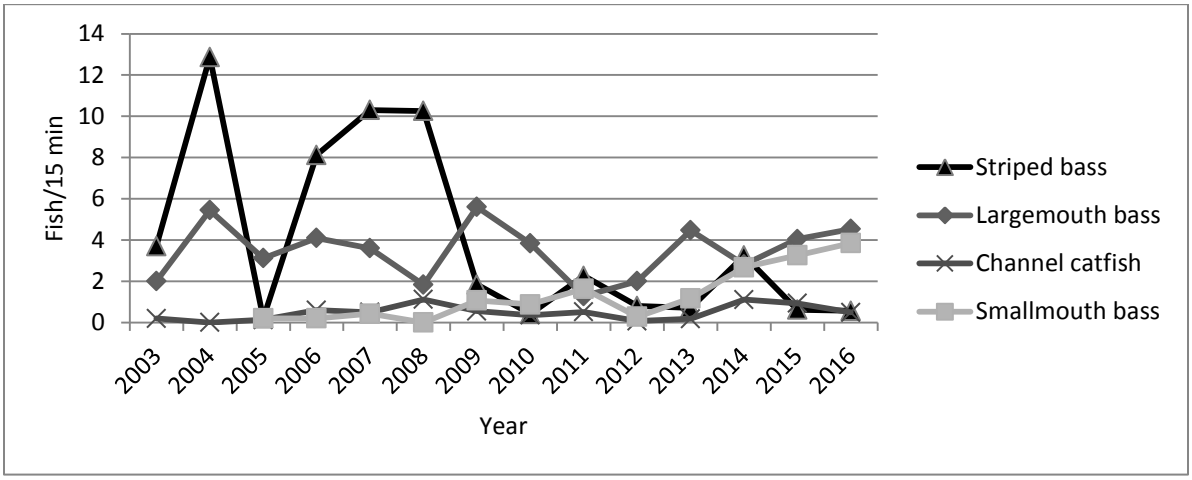

FIGURE 8. Largemouth bass, smallmouth bass, striped bass, and channel catfish CPUE from fall electroshocking surveys on Lake Mead, 2006-2016.

TABLE 10. Catch rates (fish/15 min) of all species captured during electroshocking surveys on Lake Mead, 2011-2016.

Species	Year					
	2011	2012	2013	2014	2015	2016
Black crappie	0.3	0	0.06	0.08	0	0.49
Blue tilapia	0.1	0.07	0.32	0.65	1.84	1.17
Bluegill sunfish	2.77	20.2	23.44	13.84	11.7	11.3
Bullhead catfish	0	0.03	0.09	0.03	0.8	0.08
Common carp	0.36	1.3	1.91	1.43	1.01	1.19
Channel catfish	0.51	0.07	0.18	1.11	0.93	0.49
Gizzard shad	0.62	0.24	2.64	2.73	4.56	2.68
Green sunfish	7.6	7.1	13.78	32.70	24.64	21.1
Largemouth bass	1.28	2.0	4.47	2.81	4.04	4.53
Rainbow trout	0	0	0	0.03	0	0
Red shiner	0	0.17	0.15	0.38	0.36	0.51
Smallmouth bass	1.64	0.28	1.18	2.68	3.26	3.85
Striped bass	2.26	0.8	0.71	3.24	0.62	0.57
Threadfin shad	1.18	2.49	3.53	6.14	2.44	2.3
Mosquitofish[a]	0	0	0.06	0	0	0
Totals	18.43	34.8	52.5	67.8	55.5	50.3

[a]*Gambusia affinis*

Gill–net Survey

The annual fall gill netting survey was conducted October 3-27. Random sites were selected by AZGFD. A total of 100 nets were set for an average of 17.6 hours each, totaling 147 net-nights of effort (NDOW's effort was 50 nets). A total of 1,991 fish were captured for a catch rate of 13.5 fish/net-night (Table 11). The most numerous fish captured was gizzard shad at 62% of the catch, followed by striped bass (11%), common carp (8%), and channel catfish (7%) (Table 11). Other sport fish included largemouth bass (3.9%) and smallmouth bass (3%). Some rare species were also captured including black crappie, bullhead catfish, and walleye.

TABLE 11. Summary of catch data from the 2016 fall Lake Mead gill netting survey.

Species	*n*	Fish/net-night	Composition (% of catch)	Average total length		Average weight		Percent biomass
				in	mm	lbs	g	
Black crappie	12	0.08	0.6	8.5	215	0.5	214	0.2
Blue tilapia	38	0.26	1.9	7.4	188	0.3	145	0.4
Bluegill	9	0.06	0.5	5.3	134	0.1	47	0.03
Bullhead catfish	3	0.02	0.2	10.4	264	0.7	332	0.1
Common carp	159	1.08	8.0	19.0	483	4.0	1,827	20.3
Channel catfish	135	0.92	6.8	15.7	399	0.85	625	5.9
Gizzard shad	1,241	8.44	62.3	15	381	1.4	679	59.6
Green sunfish	13	0.09	0.7	4.6	117	0.08	37	0.1
Largemouth bass	77	0.52	3.9	9.9	251	0.7	312	1.7
Suckermouth catfish[a]	1	0.007	0.1	9.1	230	0.23	105	0.01
Razorback sucker[b]	6	0.04	0.3	22.6	574	5.8	2,653	1.1
Smallmouth bass	59	0.40	3.0	13.5	344	1.5	696	2.9
Striped bass	220	1.50	11.1	15.2	385	1.1	512	2.9
Threadfin shad	17	0.12	0.9	5.2	131	0.04	19	0.02
Walleye[c]	1	0.007	0.1	11.4	290	0.50	225	0.02
Totals	1,991	13.54	100					100.0

[a]*Hypostomus plecostomus,* an aquarium species
[b]*Xyrauchen texanus*
[c]*Sander vitreus*

Striped bass captured in the 2016 gill netting survey averaged 15.2 in (385 mm) TL and weighed 1.1 lb (512 g). Compared to 2015, striped bass average TL (Figure 9) and weight were mostly unchanged. Striped bass were found to be in average to poor condition with K_{FL} factors averaging 1.02 (Table 12) and 45% having a condition factor K_{FL} of less than 1.0. A condition factor of less than 1.0 was considered to be in poor condition. Striped bass condition observed in the 2016 October gill netting survey was consistent with the average condition factors found in the creel survey samples for September and October 2016 (Table 4). By basin, striped bass in Overton Arm had the best condition, followed by Virgin Basin and then Boulder Basin. Striped bass in Gregg

Basin had the lowest condition factor with the highest percentage of fish in poor condition (Table 12).

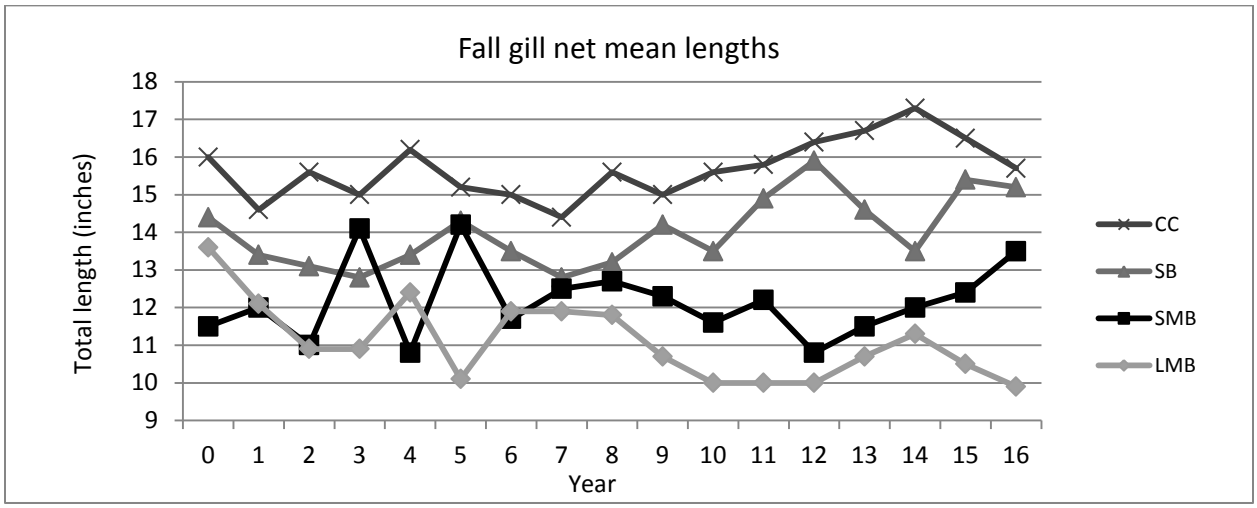

FIGURE 9. Mean total length for channel catfish (CC), striped bass (SB), smallmouth bass (SMB), and largemouth bass (LMB) captured during fall gill netting surveys on Lake Mead, 2000-2016.

TABLE 12. Average condition (relative weight [*Wr*] and Fulton's K_{FL}) of sport fish captured during 2016 gill netting surveys on Lake Mead.

	Wr				K_{FL}	
Basin	Largemouth bass	Smallmouth bass	Channel catfish	Striped bass	Striped bass	Striped bass % in poor condition
Boulder Basin	83	77	88	65	0.99	47
Overton Arm	90	84	91	70	1.07	31
Virgin Basin	85	87	88	67	1.02	52
Gregg Basin	99	96	84	63	0.97	57
Overall average	91	86	88	66	1.02	45

The overall CPUE for striped bass increased by 0.22 fish/net-night compared to last year (Figure 10). This catch rate, however, varied by basin. The basin with the highest striped bass catch rate was Overton Arm with a CPUE of 2.4 fish/net-night. Gregg Basin had the second highest catch rate followed by Boulder Basin, then Virgin Basin with the lowest abundance of striped bass (Table 13). Black bass also varied in abundance by basin with Overton Arm having the highest abundance of largemouth bass and Virgin Basin having the highest abundance of smallmouth bass. Of the four basins, Overton Arm had the highest CPUE of sport fish and Virgin Basin had the lowest CPUE (Table 12). Overall CPUE results were similar with Overton Arm having the highest CPUE at over 21 fish/net-night and Virgin Basin having the lowest CPUE at 7.98 fish/net-night (Table 13).

TABLE 13. Sport fish CPUE (fish/net-night) by basin from the fall 2016 gill netting survey on Lake Mead.

Species	Basin			
	Boulder	Overton Arm	Virgin	Gregg
Largemouth bass	0.44	0.72	0.34	0.59
Smallmouth bass	0.38	0.23	0.57	0.40
Striped bass	1.04	2.40	0.57	1.93
Channel catfish	0.63	1.55	0.69	0.76
Total CPUE (sport fish only)	2.58	4.90	2.16	3.71
Total CPUE (fish/net-night)(all fish)	10.34	21.75	7.98	15.28

Largemouth bass CPUE decreased to 0.52 fish/net-night compared to 0.71 fish/net-night observed in 2015 (Table 14, Figure 10). Mean TL decreased to 9.9 in (251 mm) (Figure 9). Largemouth bass condition was the same as last year with a W_r of 91 (Table 12). This year, Gregg Basin had the best-conditioned largemouth bass with a W_r of 99 while Boulder Basin had the worst W_r at 83 (Table 12). Smallmouth bass CPUE decreased to 0.4 fish/net-night (Table 11) and their size increased just over an inch for an average TL of 13.8 in (344 mm) (Table 11, Figure 9). The average smallmouth bass condition expressed as W_r was 86, with the best-conditioned smallmouth bass located in the Gregg Basin at a W_r of 96 and Boulder Basin having the worst W_r at 77 (Table 12).

Channel catfish CPUE decreased to 0.92 fish/net-night, compared to 1.24 fish/net night last year (Table 11, Table 14). Their average TL decreased from last year to 15.7 in (399 mm) (Figure 9). Channel catfish condition was good with an average W_r of 88, a small increase from 2015. Channel catfish condition was consistent across Overton Arm, Virgin, and Boulder Basins with W_r ranging from 88 to 91(Table 12). Gregg Basin channel catfish were not quite as robust with a W_r of 84. Channel catfish were twice abundant in the Overton Arm as the other basins (Table 13).

Gizzard shad became well established in Lake Mead reaching a maximum CPUE of 11.25 fish/net-night in 2010 (Table 14). They have since maintained a relatively high abundance and are the most numerous fish in the gill netting survey. In 2016, the CPUE was similar to 2015 at 8.44 fish/net-night (Figure 11). The average length was 15 in (381 mm) TL. The population size structure appears to have three modes representing YOY, 1-year, and 2-year old fish with most fish at one and two years of age (Figure 12). Most of these fish are not available as forage for game fish, but can be useful to anglers as cut bait. The YOY gizzard shad are likely only useful as forage prior to the fall before they have reached 6.0 in (152 mm) or greater.

Other species including common carp, tilapia, threadfin shad, bluegill, and black crappie were captured in the gill netting survey. Carp CPUE have been consistent around 1.0 fish/net-night for the past four years (Figure 13). Bluegill and black crappie CPUE have been consistently low over the years with black crappie typically captured in Overton Arm and Gregg Basin.

TABLE 14. Average CPUE (fish/net-night) for each species captured during fall gill netting surveys on Lake Mead, 2006-2016.

Species	Year										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Black crappie	0.01	0.01	0.02	0.13	0.01	0.08	0	0.1	0.04	0.08	0.08
Blue tilapia	0.19	0.31	0.25	0.83	0.20	0.32	0.55	0.34	0.22	0.13	0.26
Bluegill Sunfish	0	0	0.06	0.09	0.02	0.04	0.10	0.06	0.04	0.03	0.06
Bullhead catfish	0.01	0	0	0.01	0.4	0.21	0.06	0.06	0.04	0.05	0.02
Carp	1.93	1.2	1.76	1.30	1.42	0.98	1.64	0.95	1.13	1.02	1.08
Channel catfish	0.79	0.72	0.82	1.11	1.37	1.20	0.75	0.70	0.98	1.24	0.92
Flannelmouth sucker	0.01	0	0	0	0.01	0	0.04	0.06	0	0	0
Gizzard shad	0	0.08	0.73	5.17	11.25	8.29	7.03	9.57	9.24	8.81	8.44
Green Sunfish	0.04	0.02	0.05	0.06	0.17	0.05	0.13	0.07	0.05	0.06	0.09
Largemouth bass	0.56	0.47	0.43	0.60	0.76	1.05	1.07	0.97	0.57	0.71	0.52
Northern walleye	0	0	0	0	0	0	0	0	0.01	0	0.007
Rainbow trout	0	0	0	0	0	0	0	0	0	0	0
Razorback sucker	0	0	0.02	0.03	0.04	0.01	0.03	0.02	0.06	0.01	0.04
Smallmouth bass	0.14	0.14	0.28	0.29	0.80	0.60	0.59	0.67	0.89	0.72	0.40
Striped bass	2.55	2.08	1.69	1.65	1.90	1.48	1.38	1.58	1.25	1.23	1.5
Threadfin shad	1.05	1.47	0.78	0.98	1.51	0.43	0.33	0.39	0.23	0.12	0.12
Total	7.27	6.53	6.89	12.24	19.5	14.75	13.72	15.5	14.75	14.2	13.54

This year, 12 black crappie were captured in Overton Arm and Virgin Basin for a CPUE of 0.08 fish/net-night. Their average TL was 8.5 in (216 mm) and their average weight was 0.5 lbs (214 g) (Table 11). This marks the second year black crappie have been captured in the Virgin Basin. Another black crappie was captured at Haystack Cove during the electroshocking survey this year, and the only previously known capture of black crappie in the Virgin Basin was in 2011 at Boathouse Cove.

Tilapia abundance has fluctuated over the years, though the species has never achieved high abundance in Lake Mead, likely due to winter water temperatures. This species was first captured in the gill netting survey in 1994 and has been captured lake-wide since then. This year, the tilapia catch rate was low at 0.26 fish/net-night (Figure 14) and was captured in all basins except the Virgin Basin. Tilapia made up 1.9% of the catch. Their average length was 7.4 in TL (188 mm) and their average weight was 0.3 lbs (145 g) (Table 11). The highest tilapia abundance was in 2009 at 0.83 fish/net-night (Figure 14).

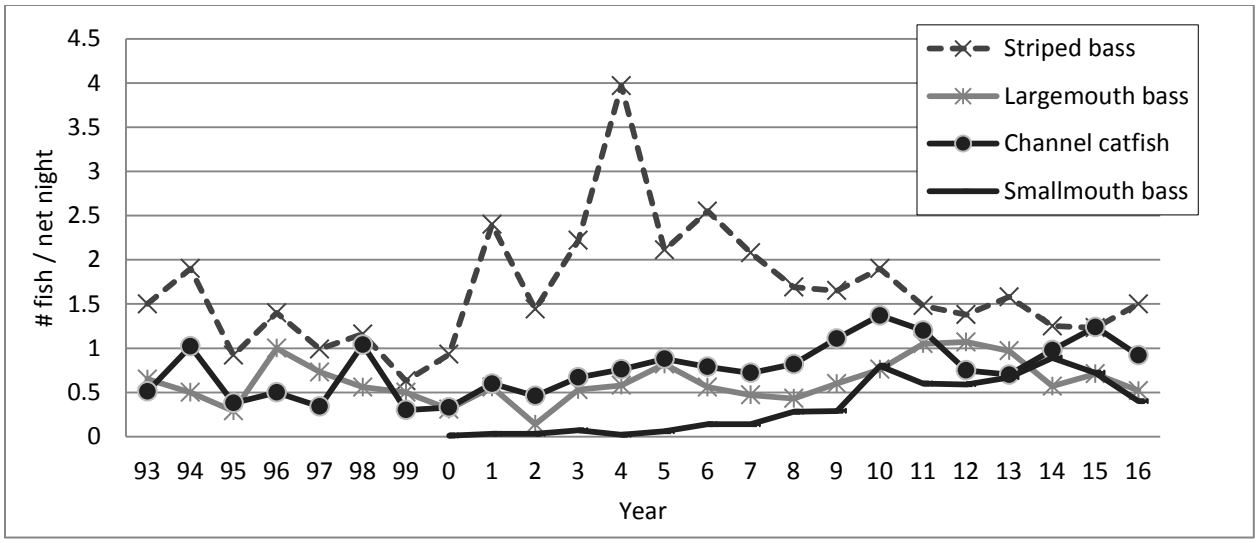

FIGURE 10. CPUE (fish/net-night) for striped bass, largemouth bass, smallmouth bass, and channel catfish from fall gill netting surveys on Lake Mead, 1993-2016.

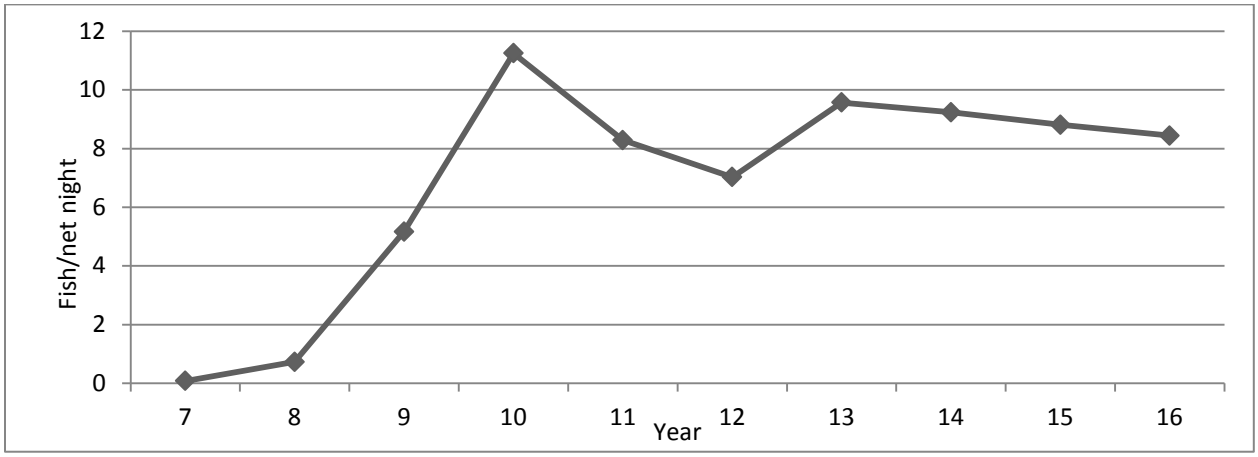

FIGURE 11. Gizzard shad CPUE (fish/net-night) from fall gill netting surveys on Lake Mead, 2007-2016.

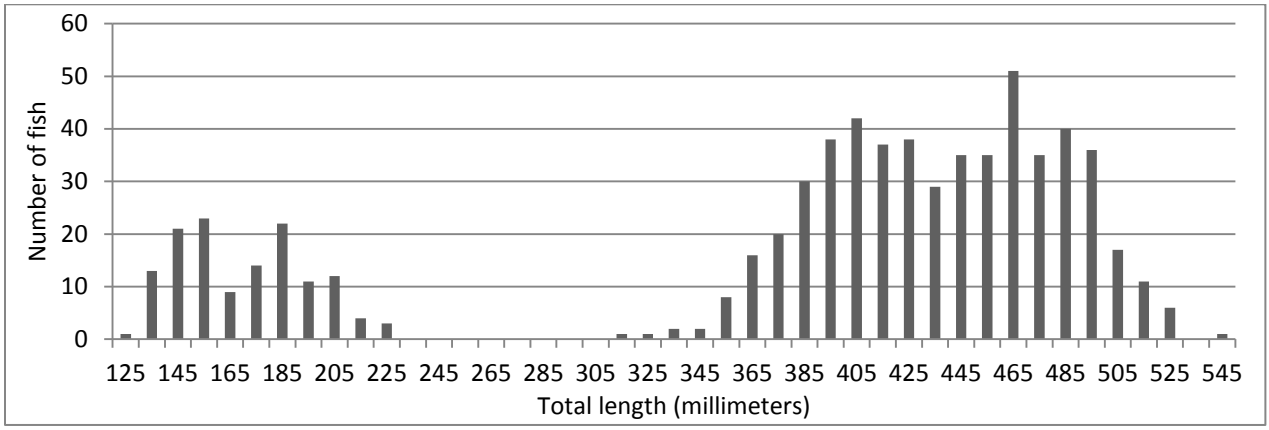

FIGURE 12. Gizzard shad length frequency distribution data from the 2016 fall gill netting survey on Lake Mead.

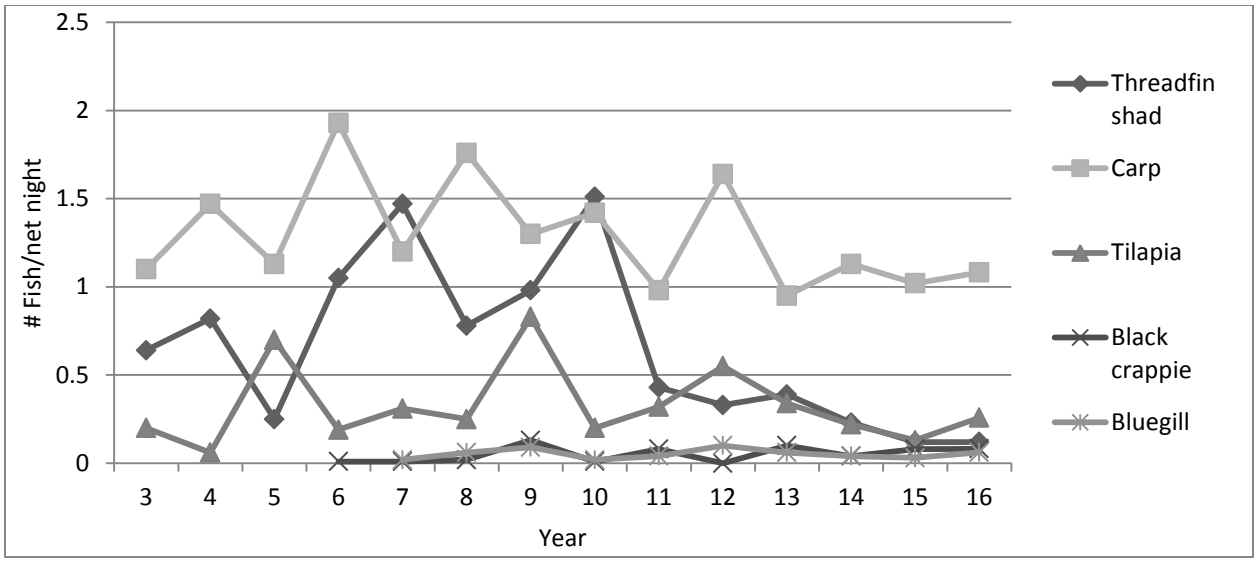

FIGURE 13. CPUE (fish/net-night) for threadfin shad, carp, tilapia, black crappie, and bluegill from fall gill netting surveys on Lake Mead, 2003-2016.

Native razorback sucker are another rare species in Lake Mead. This year, six razorback suckers were caught in the gill netting survey for a CPUE of 0.04 fish/net-night. Five fish were caught at the Overton Arm at the following sites: Glory Hole (1), Rogers Bay (1), Belsmeir Beach (2), and Bluepoint Bay (1). One was caught in the Boulder Basin at Government Wash (Table 15). These fish averaged 574 mm (22.6 in) TL with an average weight of 2,653 g (5.8 lbs). Only one boat was equipped with a PIT scanner, so half of the fish were not scanned. The other fish were scanned, and if they did not have a PIT tag, they were given a new 134 kHz tag. This year no flannelmouth suckers were caught in the gill netting survey.

TABLE 15. Razorback sucker capture summary from the fall gill netting survey on Lake Mead, 2016.

Date	Location	UTM coordinates	Total length (mm)	Weight (g)	Tag number
10/3/2016	Glory Hole	11S 0736993 4027859	614	2,225	Not scanned
10/3/2016	Rogers Bay	11S 0732669 4024747	587	4,780	Not scanned
10/3/2016	Belsmeir Beach	11S 0737290 4030554	565	2,070	3D9.257C60C637
10/3/2016	Belsmeir Beach	11S 0737290 4030554	556	2,550	3DD.003BCC5672
10/4/2016	Bluepoint Bay	11S 0733385 4027193	514	1,610	Not scanned
10/5/2016	Government Wash	11S 0695913 3999471	606	2,680	3D9.1C2C6952FF
Average			574	2,653	

Prey Base Studies

Threadfin shad production was monitored from May 16 through June 20 in the Overton Arm and Boulder Basin of Lake Mead by use of a meter trawl net. A total of 26 separate standard transects were completed. The 2016 lake-wide larval shad

production estimate (peak values) for Lake Mead was below the 26-year average of 66 shad/3,531 ft^3 [100 m^3]), however, it was within 1.0 standard deviation of the mean (Figure 14). Both Overton Arm and Boulder Basin exhibited low shad production with Overton Arm averaging 43 shad/3,531 ft^3 (100 m^3) and Boulder Basin averaging 30 shad/3,531 ft^3 (100 m^3) (Figure 14, Table 16). These values are consistent with the cyclical 3-year boom and bust pattern seen with threadfin shad production.

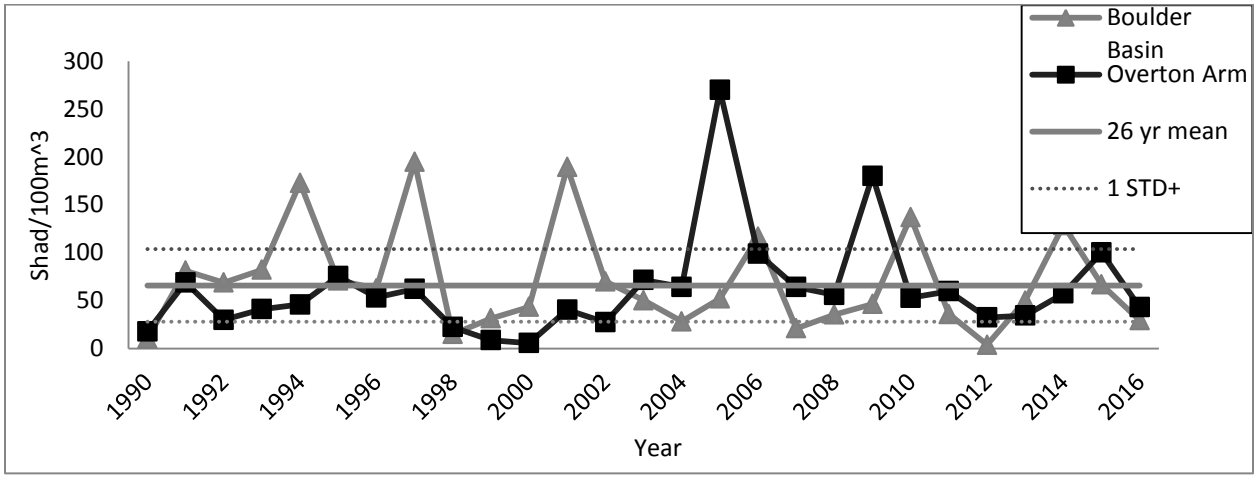

FIGURE 14. Shad densities from trawl surveys during peak production periods, 1990-2016.

TABLE 16. Lake Mead average peak shad production from trawl surveys, 2008-2016. Values are number of shad/100m^3 of water sampled.

Year	Overton Arm stations					Boulder Basin stations					Lake mean
	F-1	F-2	F-3	F-4	Overton Arm Mean	ILVB	MLVB	OLVB*	BB	Boulder Basin Mean	
2008	6	39	84	95	56	44	56		6	36	46
2009	199	295	120	108	180	84	38		18	47	113
2010	1	131	48	32	58	119	281		12	137	95
2011	37	65	77	62	60	12	83		13	36	48
2012	3	57	45	26	33	2	9		2	4	18
2013	2	34	42	62	35	73	69		5	49	42
2014	34	118	39	39	58	187	175		25	129	93
2015	95	129	89	89	100	Dry	124	23	54	67	84
2016	38	74	34	26	43	Dry	41	31	17	30	36
26-year average											66

*New transect started, due to the loss of ILVB from low water conditions.

Striped Bass Fisheries Assessment

Harvested striped bass caught this year were similar in size and condition to last year. The average size was 16.9 in (429 mm) TL and averaged 1.6 lbs (739 g) with an average condition factor of 1.13 K_{FL}. Of the 286 striped bass sampled in the creel surveys, only 12.6% had a condition factor less than 1.0 K_{FL} (a value considered to represent poor condition) (Table 4). Angling preference for striped bass decreased to 69% of the total observed preference (down from 77% last year), while angling pressure

for black bass and indiscriminate anglers increased (Table 3). Harvest rates decreased to 0.55 fish/hour and 3.5 fish/day for successful striped bass preference anglers compared to 0.65 fish/hour and 4.7 fish/day in 2015. The striped bass percent of total observed harvest has remained high at 94.8% (Table 2).

In the fall gill netting survey, 220 striped bass were caught. They averaged 15.1 in (385 mm) TL, weighed an average of 1.1 lbs (512 g) (Table 12), and had an average condition factor of 1.07 K_{FL} (Table 11), a decrease from the 1.15 K_{FL} observed in 2015. There was little change in striped bass total length compared to 2015, with striped bass averaging 15.2 in (386 mm) TL (Figure 10). CPUE in the gill netting survey increased for striped bass from 1.23 fish/net-night in 2015 to 1.5 in 2016 (Table 14, Figure 15). This capture rate falls close to the 24-year mean and is within 1.0 standard deviation from the mean (Figure 15). Striped bass proportional stock density (PSD) (using Equation 1) from the gill netting survey shows the population structure is comprised mostly of small fish with less than five percent of the catchable-sized (≥13 in [330 mm]) striped bass being over 20 in (508 mm) (Figure 16). The length frequency distribution also shows few striped bass over 20 in (508 mm) with a strong year class of 16-19 in (410-490 mm) TL fish (Figure 17).

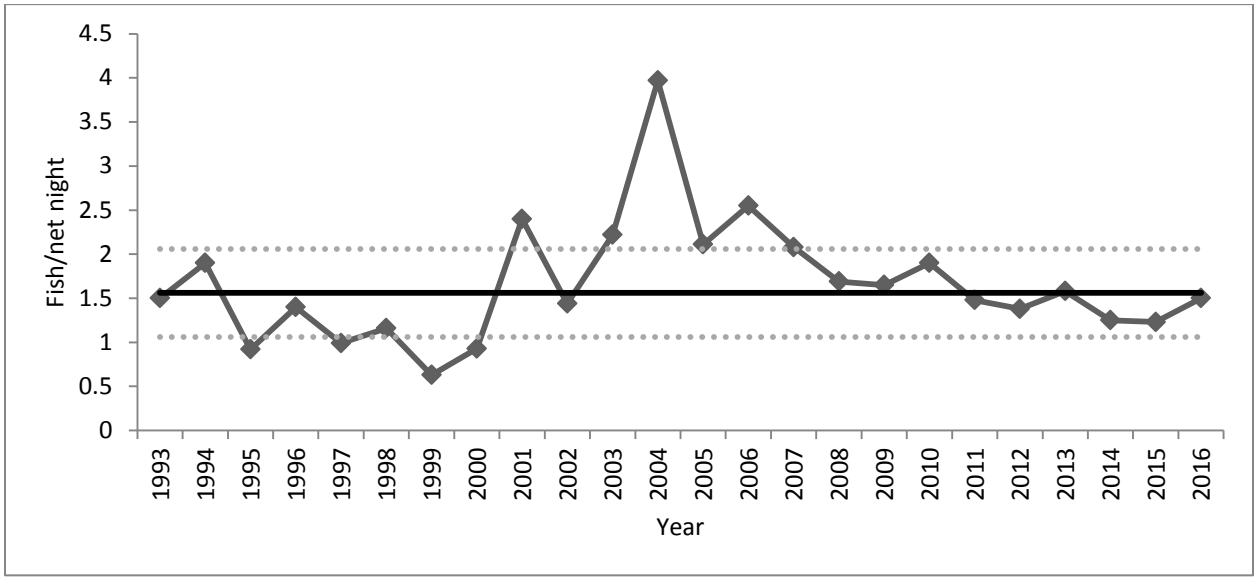

FIGURE 15. Striped bass CPUE from the fall gill netting surveys with mean and 1 standard deviation.

Striped bass proportional stock density is given by the following equation:

$$\text{Striped bass PSD} = \frac{number\ of\ fish \geq 20\ in\ (51\ cm)}{number\ of\ fish\ \geq 13\ in\ (33\ cm)} \times 100$$

Equation adapted from Anderson and Neumann 1996 (1)

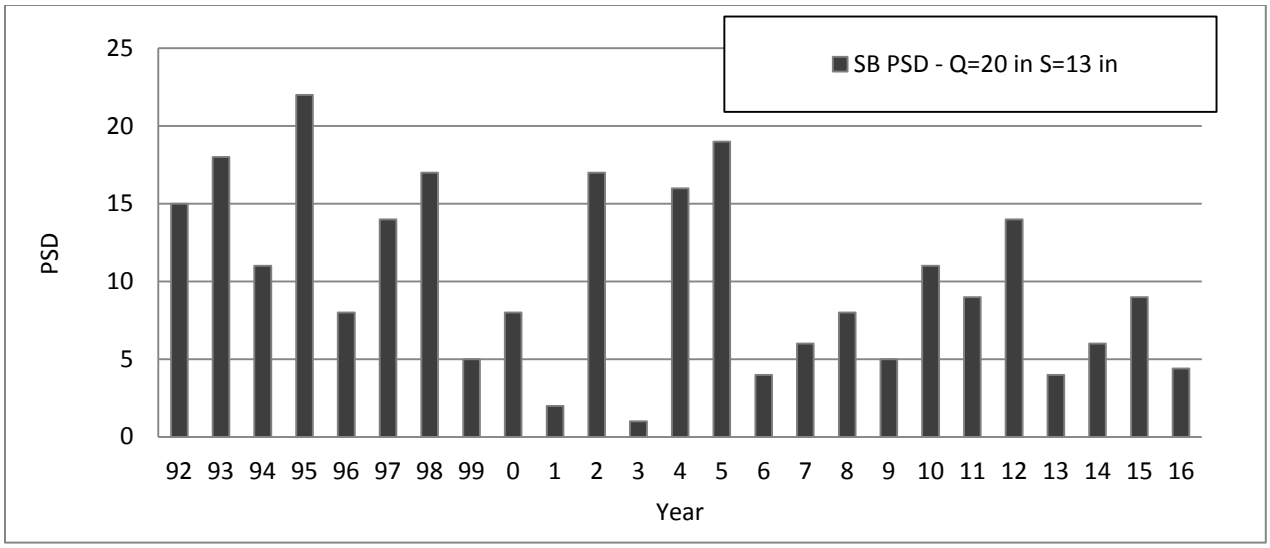

FIGURE 16. Striped bass proportional stock density (PSD) from Lake Mead gill netting surveys, 1992-2016.

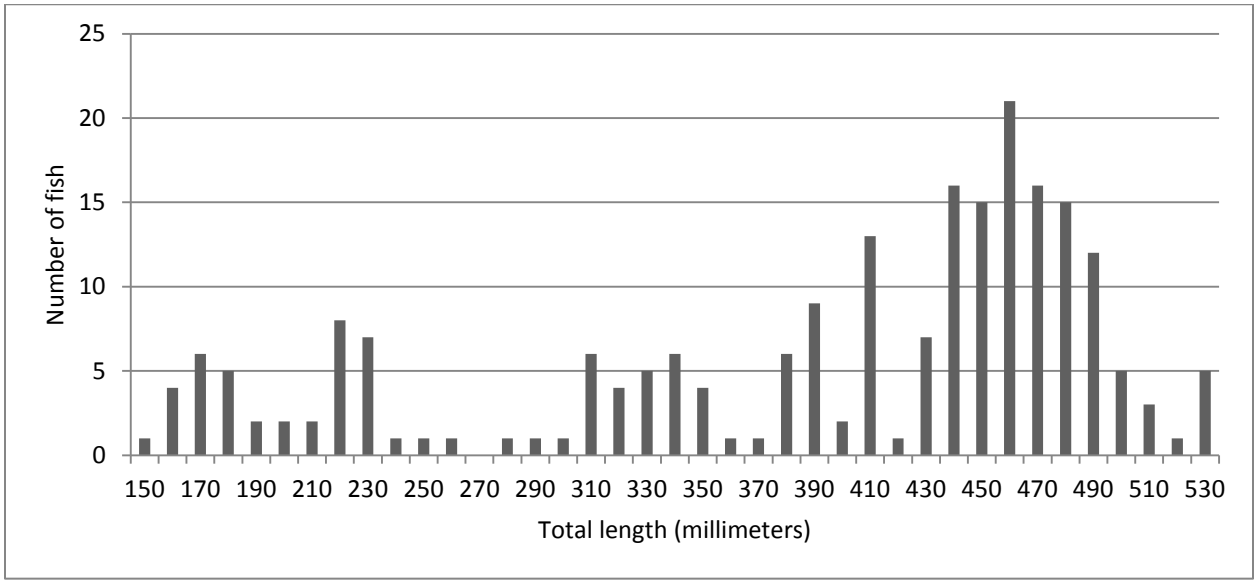

FIGURE 17. Striped bass length frequency distribution from 2016 fall gill netting survey on Lake Mead.

<u>Striped bass stomach content and body condition analysis from tournament caught fish</u>

In addition to the NDOW surveys, striped bass data has been volunteered from tournaments held by the Nevada Striper Club for many years. This information helps to identify changes in diet, body condition, and size of fish over time. Tournaments are typically attended on a quarterly basis in March, June, September, and December (or January). Prior to 2013, sample sizes were variable, anywhere from 21 to 122 fish, and often included the tournament's entire weigh-in catch. In 2013, sample sizes were reduced and kept to near 50 fish per quarter. With this sampling method, the first 50 fish brought to weigh-in are sampled.

During the weigh-in, anglers place plastic tags on their five fish with their name and fish number. The fish is weighed on tournament scales, measured by NDOW staff, information is recorded to match fish number with length and weight information, and then the fish is placed in a cooler with ice. After 50 fish are obtained, they are taken to the fish cleaner where stomach contents are examined and recorded. Stomach contents were calculated as percentage of occurrence. Body condition was calculated using Fulton's K_{FL}. Additionally, subsamples of fish had scales and otoliths collected for aging.

A total of 199 fish were sampled with an average TL of 499 mm (19.6 in) and an average weight of 998 g (2.2 lbs). The average condition factor K_{FL} was 1.01 with 48% in poor condition and having a K_{FL} <1.0, a value that indicates poor body condition. By season, the largest fish were caught in September at nearly 21 in (526 mm) TL and the smallest fish were caught in the winter at an average of 18.5 in (471 mm) TL. Striped bass were still in good condition by the March tournament, but began to decrease in body condition by June with a condition factor K_{FL} of 0.99 and 56% in poor condition. By September, their condition plummeted even further with condition K_{FL} dropping to 0.92 and 82% in poor condition (Table 17). This illustrates how during the summer, the larger striped bass are separated from the food source by the thermocline and do not have access to shallow waters such as in Las Vegas Bay which has plentiful food resources. By the December tournament, the larger striped bass condition began to improve as water temperatures dropped and they were able to forage in shallow water.

It is expected the stomach contents will reflect the access and availability of food resources for the striped bass. In March and June, stomach contents were primarily lower quality food items of anchovy, quagga mussels, or clams, and little in the way of shad or fish mass. This diet led to a drop in condition factor by September. Shad and other fish were available in the fall and winter and striped bass condition began to improve by December. By December, the diet was comprised of higher quality food items of shad, fish, and crayfish (Table 17). An interesting find this year was the quagga mussels found in the stomachs in June were different from previous occurrences and were tightly packed into the stomach instead of just one or two shells, indicating that the fish may be purposely eating the mussels instead of the mussels being incidental to feeding on the substrate. Another interesting find was an angler who was cleaning striped bass asked about the stomach contents of his fish. His two striped bass had stomachs full of New Zealand mud snails. This is the first documentation of striped bass feeding on New Zealand mud snails.

Black Bass Fisheries Assessment

Summer dive surveys showed a higher abundance of smallmouth bass over largemouth bass in all age classes (Figure 5). Young of the year smallmouth bass observations were unchanged from last year and were observed 2.5 times more abundant than YOY largemouth bass (Table 8, Figure 6). In the juvenile size class, smallmouth bass were observed 3.4 times more frequently than largemouth bass (Table

8, Figure 7). YOY largemouth bass observations were low, but increased over last year.

TABLE 17. Summary of stomach contents, length, weight, and condition of tournament-caught striped bass samples, 2016. Lengths are in millimeters (mm) and weight in grams (g).

	% of food item by occurrence						Length, weight, and condition			
Date	Shad	Fish mass	Crayfish	Anchovy	Quagga mussel or clams	Plankton	Mean length mm	Mean weight g	Mean condition K_{FL}	% below K_{FL} 1.0
3/13/2016	6.0	2.0	0	32.0	2.0	8.0	483	993	1.1	10
6/12/2016	0	9.6	1.9	54.0	7.7	3.8	514	1070	0.99	56
9/11/2016	12.0	10.0	2.0	14.0	4.0	4.0	526	1085	0.92	82
12/11/2016	10.6	12.8	10.6	8.5	0	4.3	471	855	1.02	40
Average							499	998	1.01	48

Gill netting and electroshocking surveys did not follow the same trend as the summer dive surveys. Largemouth bass showed a decrease in abundance in the gill netting survey with CPUE decreasing to 0.52 fish/net-night compared to 0.71 fish/net-night in 2015. Smallmouth bass decreased in abundance from 0.72 to 0.40 fish/net-night compared to last year (Table 14, Figure 18). While black bass abundance has declined, the catch rates remained within 1.0 STD of the 16-year mean for largemouth bass (Figure 18). The electroshocking survey rates, by comparison, show both largemouth and smallmouth bass CPUE increased with largemouth more abundant than smallmouth bass. Largemouth bass went from a CPUE of 4.04 fish/15 min in 2015 to 4.53 fish/15 min in 2016 and smallmouth bass CPUE went from 3.26 fish/15 min in 2015 to 3.85 fish/15 min in 2016 (Table 9).

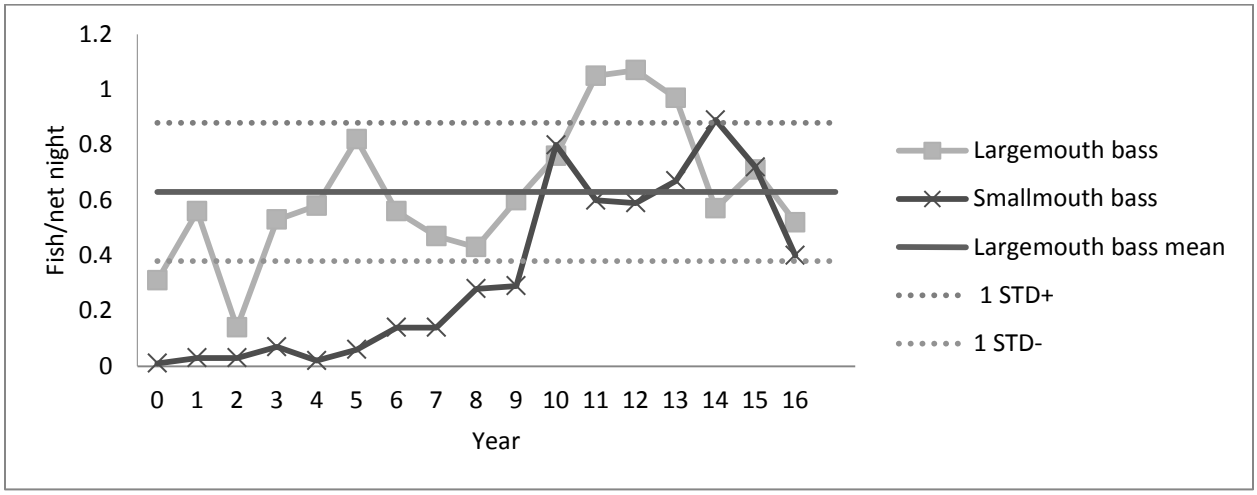

FIGURE 18. Largemouth and smallmouth bass CPUE from fall gill netting surveys, 2000-2016.

From the lake-wide gill netting survey sample, the age structure of the largemouth bass fishery is made up of mostly younger fish measuring 6-10 in (160-250

mm) TL, with fewer fish at 11-13 in (280-330 mm) TL (Figure 19). While the length frequency distribution shows the population is comprised of many smaller fish, the proportional stock density (PSD) indicates the largemouth bass fishery is increasing in the number of fish greater than 12 in (305 mm) TL. The PSD (using equation 2) for largemouth bass indicates 58% of the population is 12 in (305 mm) TL (quality length) or greater, 18% of the population is made up of fish 15 in (381 mm) TL (preferred length) or greater, and 2% of the population is 20 in (508 mm) TL (memorable length) or greater (Figure 20). With these values, largemouth bass is best classified as a balanced fishery (Anderson and Neumann 1996).

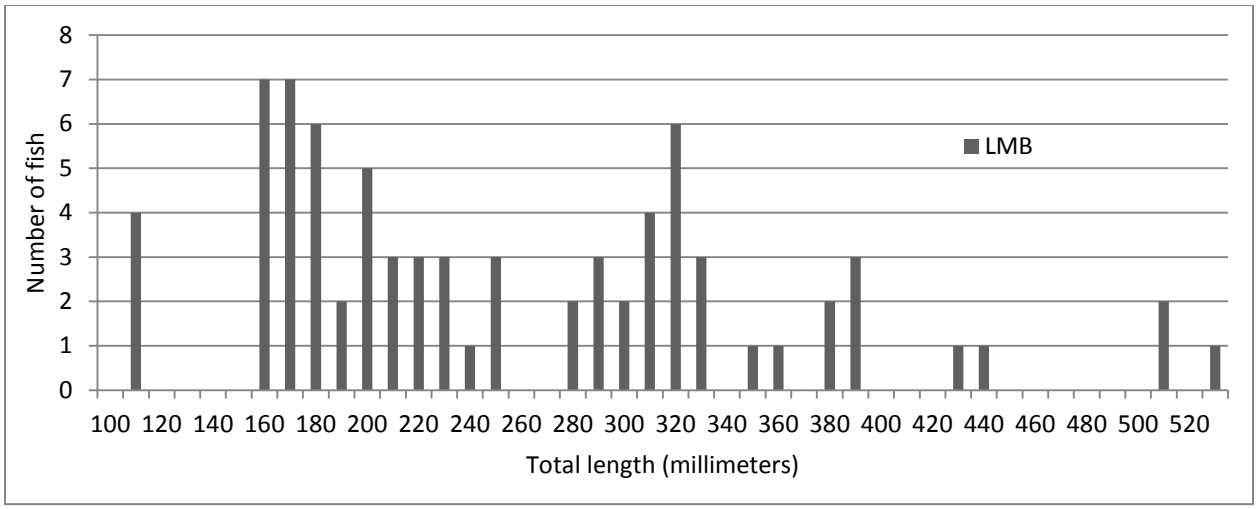

FIGURE 19. Largemouth bass length frequency distribution, 2016 Lake Mead gill netting survey.

Largemouth bass proportional stock densities given by the following equations:

$$\text{Largemouth bass PSD quality length} = \frac{number\ of\ fish \geq 12\ in\ (30\ cm)}{number\ of\ fish\ \geq 8\ in\ (20\ cm)} \times 100$$

$$\text{Largemouth bass RSD preferred length} = \frac{number\ of\ fish \geq 15\ in\ (38\ cm)}{number\ of\ fish\ \geq 8\ in\ (20\ cm)} \times 100$$

$$\text{Largemouth bass RSD memorable length} = \frac{number\ of\ fish \geq 20\ in\ (51\ cm)}{number\ of\ fish\ \geq 8\ in\ (20\ cm)} \times 100$$

Equation adapted from Anderson and Neumann 1996 (2)

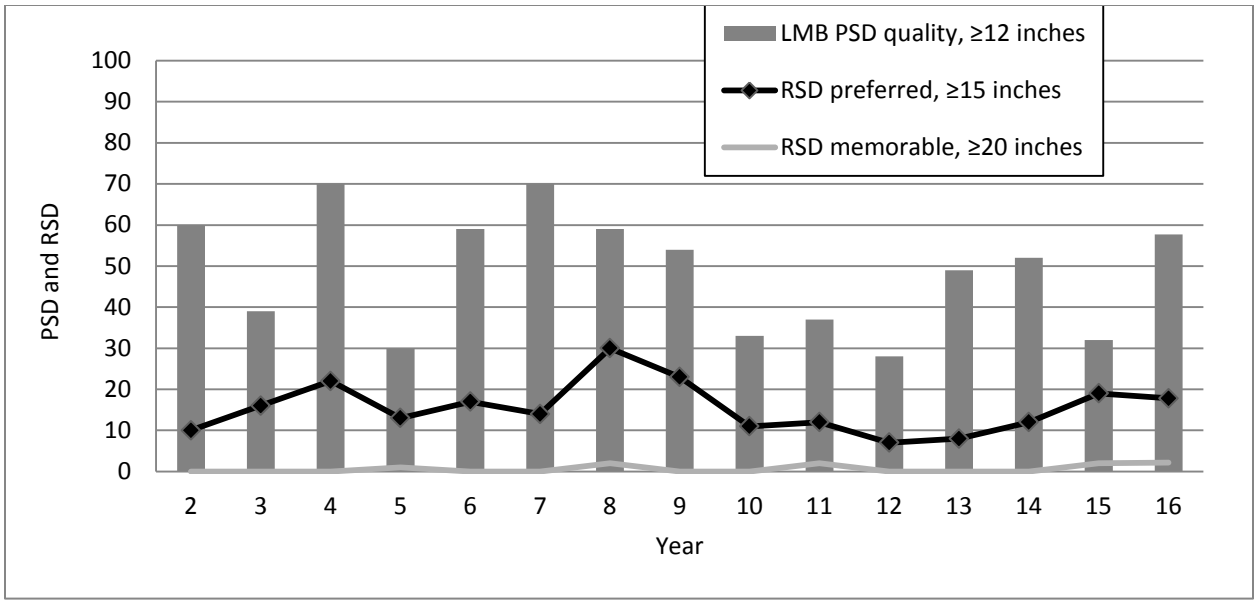

FIGURE 20. Largemouth bass proportional stock density (PSD) and relative stock density (RSD) from fall gill netting surveys on Lake Mead, 2002-2016.

The smallmouth bass length frequency distribution shows the population is comprised of a higher percentage of larger fish than the largemouth bass population (Figure 21). Most of these fish ranged from 12-20 in (300-500 mm) TL. The PSD (using equation 3) shows almost 87% of the sample are over 11 in (279 mm) TL (quality length) or greater, 64% are 14 in (356 mm) TL (preferred length) or greater, and 23% are 17 in (432 mm) TL (memorable length) or greater (Figure 22). These results show the population is shifting to larger fish of more preferred and memorable length fish available for anglers.

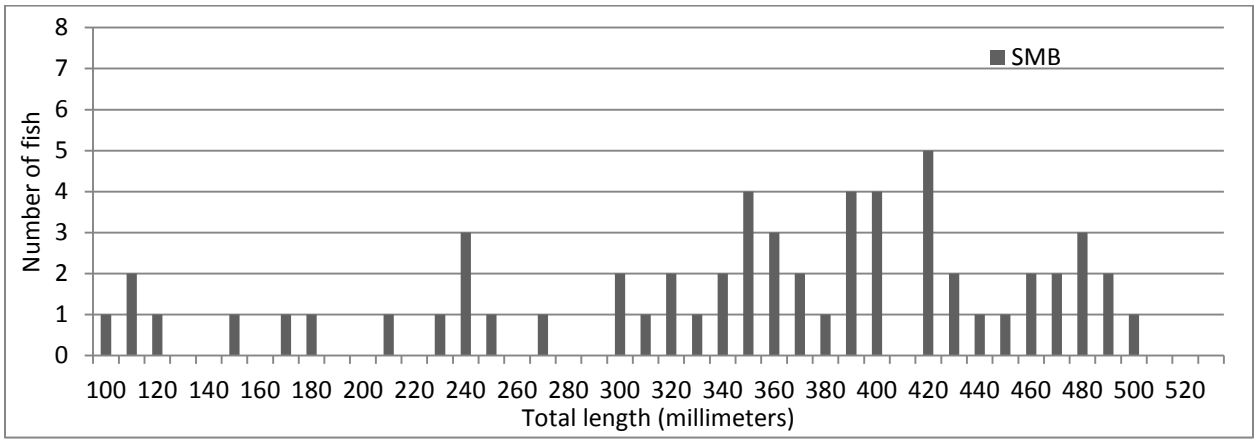

FIGURE 21. Smallmouth bass length frequency distribution, 2016 Lake Mead gill netting survey.

Smallmouth bass proportional stock densities given by the following equations:

$$\text{Smallmouth bass PSD quality length} = \frac{number\ of\ fish \geq 11\ in\ (28\ cm)}{number\ of\ fish\ \geq 7\ in\ (18\ cm)} \times 100$$

$$\text{Smallmouth bass RSD preferred length} = \frac{number\ of\ fish \geq 14\ in\ (36\ cm)}{number\ of\ fish\ \geq 7\ in\ (18\ cm)} \times 100$$

$$\text{Smallmouth bass RSD memorable length} = \frac{number\ of\ fish \geq 17\ in\ (43\ cm)}{number\ of\ fish\ \geq 7\ in\ (18\ cm)} \times 100$$

Equation adapted from Anderson and Neumann 1996 (3)

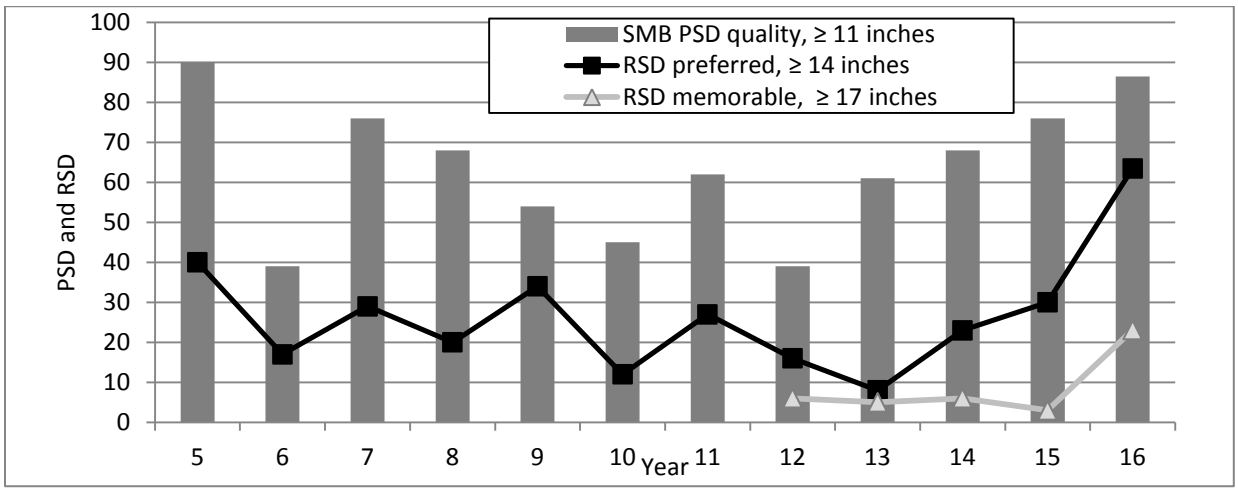

FIGURE 22. Smallmouth bass proportional stock density (PSD) and relative stock density (RSD) from fall gill netting surveys on Lake Mead, 2005-2016.

Smallmouth bass continue to be brought to tournament weigh-ins in large numbers. This year, smallmouth bass averaged 54% of the weigh-in, with September tournaments having the highest percentage of smallmouth bass at 57%. Samples taken from tournament mortalities found largemouth bass averaged 16.4 in (416 mm) TL, with an average weight of 2.2 lbs (1,007 g) and an average W_r of 88; smallmouth bass averaged 15.1 in (384 mm) TL with an average weight of 1.6 lbs (728 g) and an average W_r of 82 (Table 6). Largemouth bass W_r decreased this year compared to last year's W_r of 93, while smallmouth bass W_r remained the same. Despite a decline in recreational angler use on Lake Mead, bass tournament use is steady. A total of 49 bass tournaments were permitted through the National Park Service for Lake Mead with 35 of those tournaments held on the NV side of the lake and 14 on the AZ side. Four of the NV tournaments were permitted for 100 or more anglers.

Channel Catfish Assessment

Channel catfish abundance remains high despite a small decrease in CPUE in the gill netting survey to 0.92 fish/net-night compared to 1.24 fish/net-night last year (Table 11, Table 14). Their average TL decreased to 15.7 in (399 mm) (Figure 10), yet their PSD remains the same as the last two years. The PSD shows that 70% of the sample, stock size (280 mm (11 in) TL) and greater, was over 410 mm (16 in) TL (Figure 23). Figure 24 shows the distribution of channel catfish in this year's survey had a large number of fish between 17 and 21 in (440-530 mm) TL. Channel catfish were in good condition with an average W_r of 88, a small increase from 2015. Channel catfish condition was consistent across Overton Arm, Virgin, and Boulder Basins with W_r ranging from 88 to 91 (Table 12). Gregg Basin channel catfish were not quite as robust with a W_r of 84. Channel catfish were twice as abundant in the Overton Arm as in the other basins (Table 13). Angler preference and harvest of channel catfish remains low with angling effort at 1.7% of the total effort (Table 3) and harvest at 2.6% of the total harvest (Table 2).

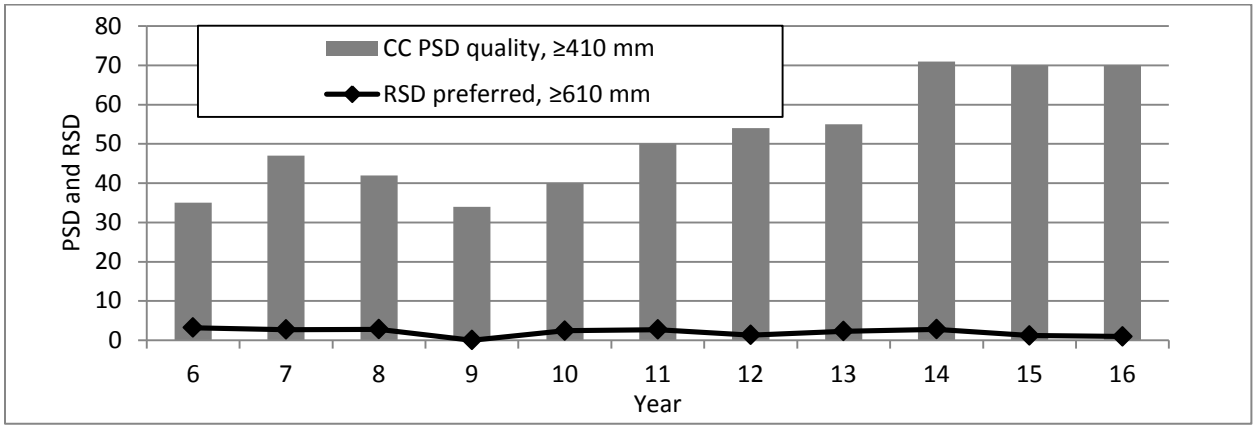

FIGURE 23. Channel catfish (CC) proportional stock density (PSD) and relative stock density (RSD) from fall gill netting surveys, 2006-2016.

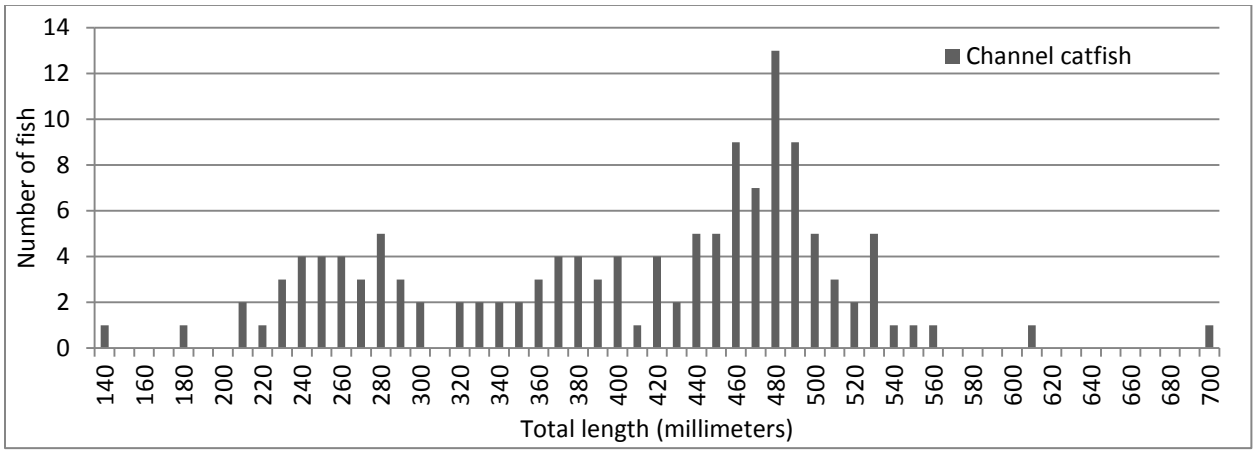

FIGURE 24. Channel catfish length frequency distribution from the fall gill netting survey, 2016.

Salmonid Fisheries Assessment

No trout were stocked, and no trout species were captured in Lake Mead surveys in 2016.

Lake Mead Fisheries Habitat Enhancement Study

Aquatic vegetation is important as cover for young fish to avoid predation, as a food source and habitat for aquatic invertebrates, and as a place for adult bass to congregate and feed. With Lake Mead's fluctuating lake elevations, aquatic vegetation is limited. During times of lake elevation increases, shorelines flood and provide inundated tamarisk and other vegetation as fish cover. However, these times are short lived and conditions soon return to an environment devoid of cover.

Artificial habitat has been used successfully in reservoirs for many years to increase cover and attract fish. Lake Mohave is one such reservoir where artificial habitat attracts and concentrates fish in an otherwise barren substrate. The purpose of this multi-year study is to identify habitat structures that can be deployed in Lake Mead, identify areas of Lake Mead suitable for habitat enhancement, and demonstrate successful movement of habitat structures. Because of Lake Mead's fluctuating lake elevation and current drought conditions, these habitat structures will need to be moveable. A pre-project demonstration takes place at Bass Cove in Lake Mohave under the current Lake Mohave Fisheries Enhancement Study. Upon successful validation of movement and effectiveness at attracting fish, habitat structures will be proposed to the National Park Service for use in Lake Mead.

Potential habitat sites

During the first year of the study (2014), suitable sites in Lake Mead were located across the Boulder Basin to include Boulder Beach near the fishing pier, Finger/Fire Bowl Cove, and Lovers Cove. These sites were chosen due to their gradual depth contours from 25-50 ft (7.5-15m), their proximity to launch ramps, and extended distance from endangered razorback sucker habitat (NDOW[b]). As lake levels change, additional suitable sites may be discovered.

Habitat

Habitat structures were primarily based on PVC designs currently in use at Lake Mohave (Figure 25 and 26). Additional designs including Fishiding (reclaimed PVC siding material) (Figure 27) and catfish condos (Figure 28) were included in the study. In 2015, 47 Fishiding structures, two PVC structures, and four catfish condos were deployed at Bass Cove (NDOW[b]). In 2016, an additional two PVC structures were installed on February 24.

FIGURE 25. Three-cube PVC habitat structure.

FIGURE 26. Four-cube PVC habitat structure.

FIGURE 27. Reclaimed PVC (Fishiding) artificial habitat structure.

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FIGURE 28. Catfish condo habitat structure.

Habitat Assessment

In 2016, the installed habitat in Lake Mohave was assessed through a spring gill netting survey, spring and fall electroshocking surveys, creel surveys, and a fall hook-and-line survey.

Gill Netting Survey

The spring gill netting survey was conducted on Lake Mohave between April 5 and 12 and was a multi-agency effort with AZGFD and the Bureau of Reclamation. The netting sites were randomly selected by AZGFD. Gill nets were set according to NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs for gill netting warmwater species. An exception to the guidelines is the gill nets used by NDOW on Lake Mohave are multifilament experimental gill nets, 150 ft (46 m) in length with five 30-ft (9.0 m) panels typically ranging in mesh size from 0.75 to 3.0 in (19 to 76 mm). Nets were set overnight and not deeper than 40 ft (12 m), with some set in areas having artificial habitat. Fish were identified to species, weighed, measured, and released back to the lake. This survey is part of the general sport fish monitoring program for Lake Mohave, though a portion of the nets were set in habitat coves to assess the structures.

A total of 50 nets were set overnight for 50 net-nights of effort, with a net-night of effort defined as one net set overnight. NDOWs portion of the effort was 10 nets. The lake-wide CPUE was 6.08 fish/net-night. By comparison in areas of artificial habitat, Bass, Carp, Box, and Solicitor Coves had a CPUE of 13.0, 7.0, 6.0, and 9.0 fish/net-night, respectively (Figure 29, Table 18). The overall CPUE at Box and Carp Coves was similar to the lake-wide average, while the CPUE at Solicitor and Bass Coves was much higher. When looking at sport fish only, the lake wide average CPUE was 2.74 fish/net-night. By comparison, all habitat coves had higher catch rates than the lake-wide average, with Bass and Solicitor coves having the highest sportfish catch rates of the habitat coves (Figure 29, Table 18). Moreover, Bass Cove had twice as many fish and sport fish than did the lake-wide average.

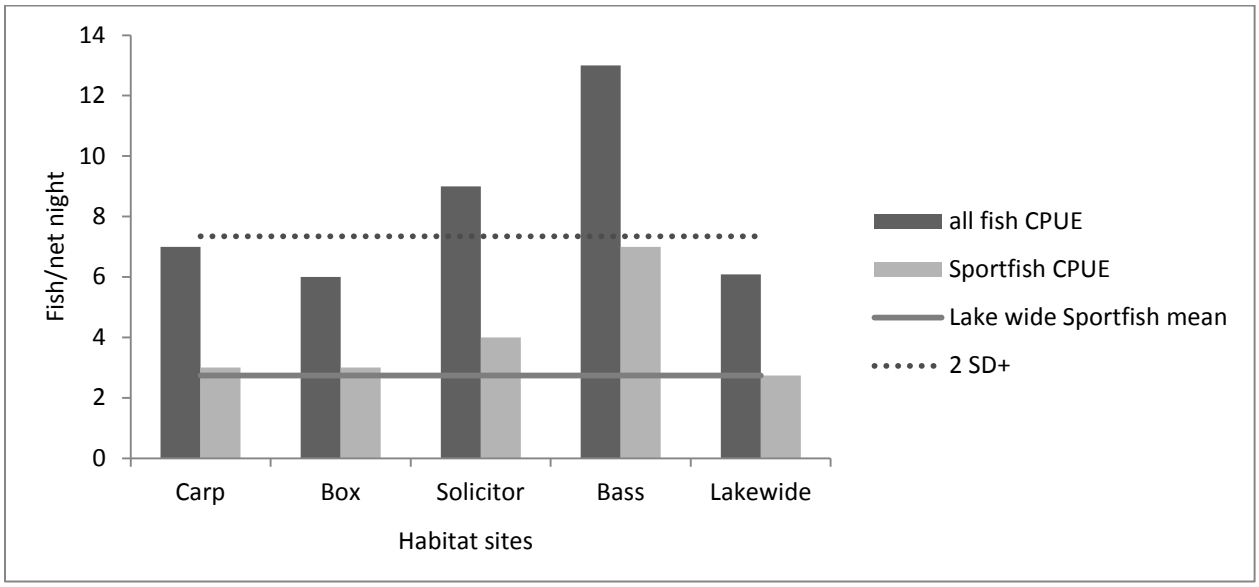

FIGURE 29. Lake Mohave spring gill netting CPUE for habitat sites vs. the lake-wide average, for the categories "all fish" and "sport fish only", 2016.

TABLE 18. Spring gill netting survey summary, Lake Mohave, 2016.

Site	# fish	All fish CPUE	# sport fish	sport fish CPUE
Lake-wide	304	6.08	137	2.74
Bass Cove (with habitat)	13	13	7	7
Carp Cove (with habitat)	7	7	3	3
Box Cove (with habitat)	6	6	6	6
Solicitor Cove (with habitat)	9	9	4	4

Electroshocking Survey

An electroshocking survey was carried out in the spring with the primary objective for assessing general fisheries management; however, several artificial habitat sites were surveyed. A total of 21 sites were surveyed, with NDOW's portion of the effort being 11 sites. Additional electroshocking was done at two habitat sites and a control site occurred in the fall. A Clark aluminum boat equipped with a Coffelt shocking boom and a Smith-Root VVP-15B electrical box was used according to boat electroshocking methods described in NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs were used. Fish were identified to species, measured, weighed, and released back to the lake. Each site was sampled for a total of 900 seconds of "on" pedal time. Results are reported as fish/15 min of effort.

The spring survey yielded 289 fish for a lake-wide CPUE of 13.8 fish/15 min. When looking at sport fish only, the lake-wide CPUE was 2.7 fish/15 min (Table 19). Comparing habitat sites to the lake-wide average, Bass and Box coves were above the lake wide average with Box Cove having more sport fish (Table 19). Bass Cove showed little difference from the lake-wide average and Carp Cove was well below the lake-wide average in terms of sport fish. All habitat coves had similar CPUE for all fish (Figure 30).

TABLE 19. Spring electroshocking survey summary, Lake Mohave, 2016.

Site	# fish	All fish CPUE	# sport fish	sport fish CPUE
Lake-wide	289	13.8	54	2.7
Bass Cove (with habitat)	10	10	3	3
Box Cove (with habitat)	8	8	5	5
Carp Cove (with habitat)	9	9	1	1

The fall electroshocking survey was carried out on 11/15/2016 during the evening hours. The same protocols were used for 900 seconds of "on" pedal time at each cove. Two habitat coves (Bass and Solicitor) and one non-habitat cove (Painted Canyon) were sampled. The results show Solicitor Cove had the most fish and CPUE of the three coves; however, when looking at just sport fish, the control cove had the highest number of fish and CPUE (Table 20). This electroshocking survey suggests fish utilize habitat structures less in the late fall than in the spring.

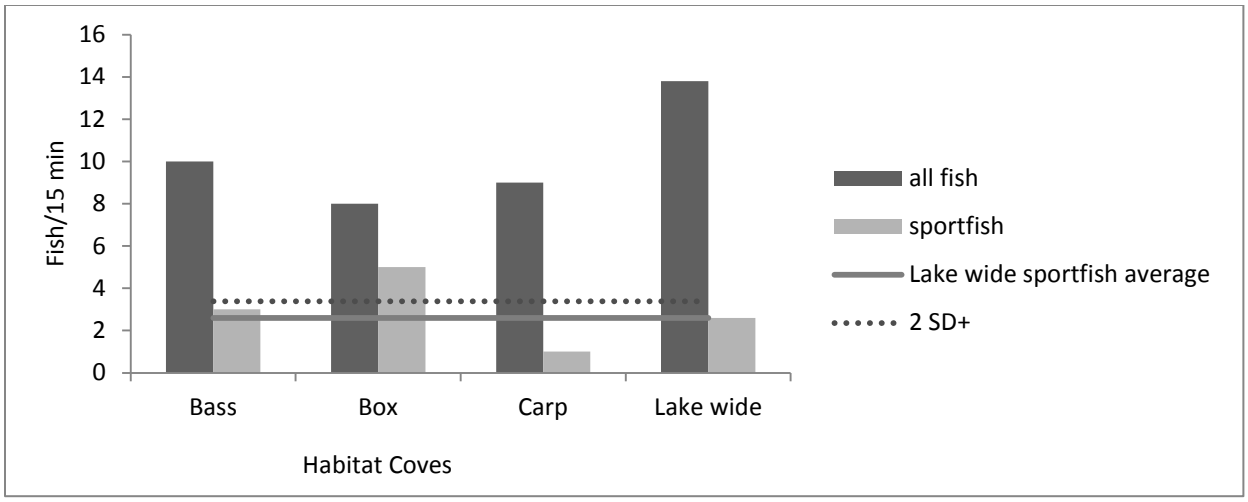

FIGURE 30. Lake Mohave spring electroshocking CPUE for habitat sites vs. the lake-wide average, for the categories "all fish" and "sportfish only", 2016.

TABLE 20. Fall electroshocking survey summary, Lake Mohave, 2016.

Site	# fish	All fish CPUE	# sport fish	sport fish CPUE
Bass Cove (with habitat)	32	32	18	18
Solicitor Cove (with habitat)	118	118	26	26
Painted Canyon Cove (Control no habitat)	73	73	42	42

Creel Surveys

A total of 16 days of creel surveys were conducted at Cottonwood Cove at Lake Mohave, seven of these days were part of the general fisheries monitoring program with an additional nine days of effort provided by the Lake Mead Conservation Aid. Anglers were asked where they fished, if they fished in habitat coves, amount of effort, species desired, type of fishing, bait used, and state of origin.

Out of 73 anglers contacted, only three fishing parties were surveyed that mentioned they fished at habitat sites. Often anglers did not know the name of the cove they fished and only gave a vague reference to fishing location. In May, two anglers fished Box and Solicitor habitat coves and had catch rates of 0.09 fish/hour and 0.5 fish/angler. Another party fished Bass Cove habitat site in July and had catch rates of 1.33 fish/hour and 6.0 fish/angler, and in August, another party fished Box and Solicitor habitat coves and had catch rates of 0.23 fish/hour and 1.5 fish/angler. By comparison, the average for all anglers surveyed out of Cottonwood Cove was 0.42 fish/hour and 2.1 fish/angler. While our results show that Bass Cove had higher catch rates than the lake-wide average (Table 21), this small sample size is too small and inconclusive.

TABLE 21. Summary of creel survey contacts from Cottonwood Cove landing that fished habitat coves and non-habitat coves in 2016.

Date	Cove	Anglers	Hours	fish/hour	fish/angler
5/3/16	Box & Solicitor	2	11	0.09	0.5
7/14/16	Bass	2	9	1.33	6
8/6/16	Box & Solicitor	2	13	0.23	1.5
All year	Lake-wide	73	371	0.42	2.1

Because so few anglers were contacted that fished habitat sites, hook-and-line sampling was considered in order to get a better understanding of fishing success at the habitat site. On August 30, Bass Cove was sampled along with another habitat cove (Box Cove), and a non-habitat cove (Painted Canyon Cove) by two samplers. One sampler was successful at Bass Cove for a catch rate of 1.0 smallmouth bass/43 min effort. The smallmouth bass was approximately 11 in (279 mm) TL. The other sampler was unsuccessful. Both samplers were unsuccessful at Box and Painted Canyon Cove in 43 and 60 minutes of effort, respectively. Hook and line sampling will continue next year to better assess fishing success at the habitat sites.

Lake Mead Smallmouth Bass Age and Growth Study

Smallmouth bass were not purposely stocked to Lake Mead, and it is unknown how they got into the lake. They began showing up in small numbers in tournament catches in 1999 and in the gill netting surveys in 2000, and initial catches were limited to the Overton Arm. By 2010, their abundance equaled that of largemouth bass and they were found throughout the lake. They are now common in fisheries surveys and tournament catches and are an important sport fish for Lake Mead anglers. Currently, little is known of smallmouth bass growth rates in Lake Mead. The purpose of this study is to develop a length at age table using analyses of hard parts (e.g., scales or otoliths) and back calculation of past growth to better understand smallmouth bass growth rates and population size structure in Lake Mead.

The approaches of this study are to:

1. Obtain scale samples from smallmouth bass captured from trammel netting, gill netting, electroshocking, and bass tournaments during the fall. Otoliths will be obtained from any mortality.
2. Collect samples over a three-year period with a record of date, location, GPS coordinates, and length and weight data for each fish.
3. During general management activities, tag smallmouth bass with Floy tags to observe growth of recaptured fish and to validate back calculated growth in scale analysis. When fish are tagged, scales will be collected along with date, length, weight, location, and GPS coordinates.
4. Analyze and age scales using a microscope with camera, or by the use of a microprojector or microfiche projector. Analyze and age scales and otoliths using accepted methods.

5. Develop an age at length table and an analysis of smallmouth bass population age structure.

In the first year of this study (2015), a total of 127 scale samples and 89 otoliths were collected. Scales were removed from the left side of the fish just behind the pectoral fin using a scraping motion with a knife. Scales were placed into labeled scale-envelopes. Most of the samples were obtained from bass tournament mortalities (n = 104) and the rest (*n = 23*) came from the gill netting survey (Table 22, Appendix 1). The fish ranged in size from 6 in (152 mm) to 19 in (483 mm) TL. In 2016, a total of 100 scale samples and 85 otolith samples were collected, with 13 scale and eight otolith samples from the gill netting survey and 81 scale and 77 otolith samples collected from tournament mortalities. An additional six scale samples were obtained from trammel netting (Table 22). In addition to scale samples, five smallmouth bass were Floy-tagged (Appendix 2).

The scales were cleaned by placing in warm water and then rubbing debris off with a paper towel. They were then mounted on glass microscope slides with either five or six scales per slide. The slides were labeled with sample number, species, and date. The fish length data was kept separate from the scales to avoid any influence it may have in aging of the scale. After some research, it was decided that it would be best to use scales and otoliths collected from the gill netting survey for the study because of the randomization of the gill netting survey, and that the collection methods were not size selective; however, after trying to age older scales, the need of an otolith for comparison became necessary, and many of the gill netting scale samples were not paired with otoliths. Next year, the 2015 tournament scales with paired otoliths will be analyzed. In addition, next year some of the samples taken from fish in the gill netting survey may need to be sacrificed in order to get enough otoliths for aging.

TABLE 22. Number of smallmouth bass scales and otoliths collected by year and by survey type, 2015-16.

Survey type	2015		2016	
	Scales	Otoliths	Scales	Otoliths
Gill net	23	9	13	8
Tournaments	104	80	81	77
Trammel netting	0	0	6	0
Total	127	89	100	85

This year the 23 smallmouth bass scale samples from the 2015 gill netting survey were aged along with otoliths (*n* = 9). Scales were read by a biologist and a technician using a stereo zoom microscope. Scales were photographed at 10X with a three-megapixel camera and measurements were taken using the calibrated measuring software that accompanied the camera. Otoliths were sectioned and mounted on microscope slides using a variable speed drill and 13 centimeter (cm) sanding disc with 320 grit sandpaper as described by Maceina (1988). Only those scales with ages that could be agreed upon were used to back calculate lengths. Back calculation of annular growth was achieved by using the direct proportion method (Devries and Frie 1996).

Table 23 summarizes length at age data for 15 samples. Back calculations show these fish averaged 5.3 in (135 mm) TL at age 1; 8.5 in (216 mm) at age 2; 10.9 in (277 mm) at age 3; 12.1 in (307 mm) at age 4; and 13.0 in (330 mm) at age 5. Only one fish was aged at beyond 5 years. This fish was aged at 11 years old, with age verified from a sectioned otolith (Figure 31). This fish had slower growth rates than the younger fish. At age 6 and 7, it was closer in size to a 4-year old fish of 12-13 in (305-330 mm).

Comparison of Lake Mead smallmouth bass growth rates shows smallmouth bass have faster growth rates than the North American average (Table 24) for age 1 to 3 fish. By age 4, however, the size at age is comparable and by age 6, the national average is greater than Lake Mead's growth, at least compared to the eleven year old fish. Additionally, a greater number of older fish need to be aged to make a better comparison. The number of aged samples for this study is still small, and as the sample size grows, the mean growth rates may change. To date, no Floy-tagged fish have been reported to help verify annual growth.

TABLE 23. Mean back calculated lengths for smallmouth bass collected in the gill netting survey of 2015.

Year class	*n*	Length at age in inches (millimeters) at each annulus										
		1	2	3	4	5	6	7	8	9	10	11
2014	3	4.6 (118)										
2013	4	5.3 (136)	8.5 (216)									
2012	3	5.6 (142)	8.9 (226)	11.9 (302)								
2011	2	5.4 (137)	8.7 (220)	10.9 (276)	13.1 (333)							
2010	2	5.6 (143)	9.5 (242)	11.4 (289)	12.8 (324)	14.3 (362)						
2004*	1	5.4 (138)	6.8 (173)	9.3 (237)	10.3 (262)	11.7 (298)	12.5 (319)	13.1 (334)	13.7 (348)	14.3 (364)	15.6 (396)	16.3 (413)
Mean		5.3 (135)	8.5 (216)	10.9 (277)	12.1 (307)	13.0 (330)	12.5 (319)	13.1 (334)	13.7 (348)	14.3 (364)	15.6 (396)	16.3 (413)

*age verified by otolith

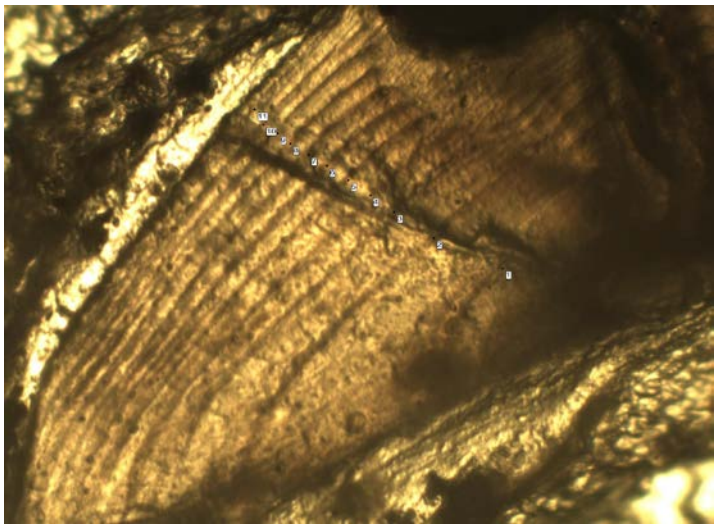

Figure 31. Smallmouth bass sectioned otolith image, photographed at 30X magnification.

TABLE 24. Mean total lengths from smallmouth bass growth data from throughout North America (Coble 1975).

Age	1	2	3	4	5	6	7	8	9
Length	3.7	6.7	9.2	11.0	12.7	14.1	15.0	15.9	16.9
in (mm)	(94)	(170)	(234)	(279)	(323)	(358)	(381)	(404)	(429)

Largemouth Bass and Striped Bass Age and Growth Study

Many changes have occurred at Lake Mead over the past decade including drought conditions and the introduction of invasive species. Quagga mussels and gizzard shad are two invasive species that were discovered in Lake Mead in 2007. Both of these species have the potential to affect growth rates of sport fish through competition for habitat and food resources. This study will allow for the comparison of current striped bass scale samples with scale samples collected prior to the invasion of quagga mussel and gizzard shad to see if growth rates have changed during this time. Largemouth bass scale analysis will be compared to published growth rates (Allan and Roden 1978; Jonez and Sumner 1954). The development of a length at age table using scale analysis and back calculation of past growth (DeVries and Frie 1996) will provide a better understanding of largemouth bass and striped bass growth rates and the current population size structure compared to previous years. In addition to scale and otolith sample analysis, striped bass and largemouth bass live captures from netting surveys will be Floy tagged so that growth can be observed in recaptured fish.

The approaches to the study are to:

1. Obtain scale samples from largemouth bass and striped bass captured from trammel netting, gill netting, and electrofishing surveys during the fall. Obtain otolith samples in the event of smallmouth bass mortality during netting. Scales

and otoliths may also be obtained from largemouth bass and striped bass tournament mortalities.

2. During general management activities, Floy tag largemouth bass and striped bass for observing growth in recaptured fish and validate results of back calculated growth of scale. When fish are tagged, scales will be collected along with date, length, weight, location, and GPS coordinates.
3. Collect samples over a three-year period with a record of date, location, GPS coordinates, and length and weight data for each fish.
4. Store scales and otoliths in envelopes or vials and prepare for analysis.
5. Analyze and age scales using a stereo zoom microscope with camera or by the use of a microprojector or microfiche projector. Analyze and age scales and otoliths using accepted methods.
6. Develop a length at age table and an analysis of largemouth bass and striped bass population age structure and compare to scales collected during the 1980s and/or compare to scale analysis from previous years or published data.

This study began in 2016 with scales and otoliths to be collected during a three-year period, ending with the collection of samples in 2018. In anticipation of the study, some scales and otoliths were collected in 2015 (Table 25) and will be included. In 2016, a total of 53 largemouth bass scales and 29 otoliths were collected and 86 scales and 77 otolith samples of striped bass were collected (Table 25, Appendix 1). Twenty-four fish were Floy-tagged, which included 16 largemouth bass and eight striped bass (Appendix 2).

Scales were read by a technician and a biologist using a stereo zoom microscope. Scales were photographed at 10X with a three-megapixel camera and measurements were taken using the calibrated measuring software that accompanied the camera. Otoliths were sectioned and mounted on microscope slides using a variable speed drill and 13 cm sanding disc as described by Maceina (1988). Fine, 320-grit sandpaper was used to grind the otoliths down. Often times the same scales were interpreted differently by the readers, so only those scales that ages could be agreed upon were used to back calculate lengths.

TABLE 25. Number of smallmouth bass scales and otoliths collected by year and by survey type, 2015-16.

Survey type	2015		2016		2015		2016	
	LMB		LMB		STB		STB	
	Scales	Otoliths	Scales	Otoliths	Scales	Otoliths	Scales	Otoliths
Gillnet	33	8	13	6	74	53	54	50
Tournaments	7	1	24	23	17	1	24	19
Trammel netting	0	0	12	0	0	0	0	0
Creel	1	0	0	0	36	29	8	8
Electrofishing	0	0	4	0	0	0	0	0
Total	41	10	53	29	127	83	86	77

Striped Bass

A total of 127 striped bass scales were collected in 2015 along with 83 otoliths. The 20 fish that were aged ranged from three to seven years of age. Back calculation of the annular growth rings was achieved by using the direct proportion method (Devries and Frie 1996). Results show these fish averaged from 6.7 in (171 mm) TL at age 1; 10.1 in (257 mm) at age 2; 12.4 in (315 mm) at age 3; 13.9 in (353 mm) at age 4; 15.2 in (387 mm) at age 5; 16.3 in (413 mm) at age 6; and 17.6 in (447 mm) at age 7 (Table 26). These growth rates are much lower than rates published in 1978 (Allan and Roden 1978) for both stocked fish and wild produced fish (Table 27). Even age-1 fish were slightly larger than current age-1 striped bass at 7.7 to 9.7 in (196-246 mm) TL. By age-3, the historical striped bass population was nearly double the length of current age-3 fish. This year's average harvest size of 16.9 in (429 mm) puts the average age of striped bass harvest at six years old. From these early findings, it appears striped bass growth rates have declined from historical growth rates, however, it is still early into the study and the sample size is small. As the sample size increases, these values may change over time.

TABLE 26. Mean back calculated lengths for striped bass collected in the gill netting survey of 2015.

Year class	*n*	Length at age in inches (millimeters) at each annulus						
		1	2	3	4	5	6	7
2012	4	7.5 (190)	11.1 (282)	13.7 (347)				
2011	4	7.2 (184)	10.4 (265)	12.4 (315)	14.7 (374)			
2010	4	6.7 (170)	9.4 (238)	11.9 (302)	13.9 (354)	15.9 (405)		
2009	6	6.3 (160)	9.5 (242)	12.0 (306)	13.3 (339)	14.6 (372)	15.8 (402)	
2008	2	6.0 (155)	10.2 (260)	12.0 (305)	13.7 (348)	15.2 (387)	16.7 (425)	17.6 (447)
Mean		6.7 (171)	10.1 (257)	12.4 (315)	13.9 (353)	15.2 (387)	16.3 (413)	17.6 (447)

TABLE 27. Published growth rates of striped bass from Lake Mead (Johnson and Roden 1977), published in Allan and Roden 1978.

Striped bass	Length at age in inches (millimeters) at each annulus						
	1	2	3	4	5	6	7
Stocked fish	7.7[1] (196)	14.8 (376)	21.2 (538)	26.7 (678)	30.7 (780)	33.2 (843)	36.0 (914)
Wild fish	9.7[1] (246)	19.3 (490)	25.2 (640)	28.3 (719)	30.4 (772)		

[1]Fork length

Largemouth bass

A total of 41 scale and 10 otolith samples were collected in 2015 with 33 scales and eight otoliths from the gill netting survey, seven scales and two otoliths from tournaments, and one scale sample from a creel survey (Table 25). Thirty-four of these scales were read and only six readings were agreed upon between the two scale readers. Few otoliths were aged and some did not section well enough to read in order to validate the scale ages. Back calculation of annular growth was achieved by using

the direct proportion method (Devries and Frie 1996). The calculated growth for the six fish is listed in Table 28. Age-1 largemouth bass averaged 3.9 in (99 mm); age-2 averaged 5.7 in (145 mm); age-3 averaged 7.3 in (185 mm); age-4 averaged 8.8 in (224 mm); and age-5 averaged 9.7 in (245 mm). These lengths at age values are very different from published growth rates for largemouth bass at Lake Mead (Table 29), and the lack of otoliths to validate the aging may partially contribute to this difference. Next year, scales will be validated with otoliths to get better aging data.

TABLE 28. Mean back calculated lengths for largemouth bass collected in the gill netting survey of 2015.

		Length at age in inches (millimeters)				
Year class	*n*	1	2	3	4	5
2013	1	5.0 (127)	6.2 (158)			
2012	1	3.6 (91)	4.9 (125)	6.7 (170)		
2011	3	4.5 (115)	6.5 (166)	8.1 (207)	9.1 (231)	
2010	1	4.0 (101)	5.2 (131)	7.0 (178)	8.5 (217)	9.7 (245)
Mean		3.9 (99)	5.7 (145)	7.3 (185)	8.8 (224)	9.7 (245)

TABLE 29. Published growth rates of largemouth bass from Lake Mead (Allan and Roden, 1978).

	Length at age in inches (millimeters) at each annulus					
Largemouth bass	1	2	3	4	5	6
Before introduction of threadfin shad	5.3	10.3	13.7	16.4	18.5	20.5
(Jonez and Sumner, 1954)	(135)	(262)	(348)	(417)	(470)	(521)
After introduction of threadfin shad	7.9	12.4	14.1			
(Minckley, 1972)	(201)	(315)	(358)			

GENERAL MANAGEMENT REVIEW

The approaches for the general management objective were completed. The objectives were met through creel surveys, tournament data collection, gillnetting, electroshocking, dive surveys, shad trawls, striped bass stomach content analysis, construction of artificial habitat, and surveying of potential habitat sites. The second year of the smallmouth bass age and growth study approaches were met through the collection of scales and otoliths, Floy tagging of fish, and aging of scales and otoliths using accepted methods. The first year of the largemouth bass and striped bass age and growth study approaches were met through the collection of scales and otoliths, Floy tagging of fish, and the aging of scales and otoliths using accepted methods.

RECOMMENDATIONS

- Continue with the current creel program using stratified random sampling of at least 100 days. More creel days should be shifted to Echo Bay during the winter period due to increased angler use from out-of-state anglers. This can be accomplished by switching the sampling probabilities of Callville (0.22) and Echo Bay (0.11) in the winter.

- Seasonal gill netting surveys and summer dive investigations should be continued.
- Continue collecting black bass catch data at tournaments to track trends in the black bass fishery.
- Continue with assigned electroshocking transects during the fall survey.
- Continue the quarterly checking of stomach samples of tournament striped bass to detect changes in diet.
- Continue weekly shad trawling transects during the peak spawning season.
- Continue to investigate the feasibility and effectiveness of moveable underwater habitat structures for future deployment in Lake Mead.
- Continue the Age and Growth Study of smallmouth bass to obtain baseline data on the species.
- Study the growth rates of largemouth bass and striped bass to detect changes since the invasion of quagga mussels and gizzard shad.

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Date: March 10, 2017

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Appendix 1. Scale and otolith data collections of striped bass (SB), largemouth bass (LMB), and smallmouth bass (SMB), 2015-2016.

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1001	7/17/2015	SB	Creel	Hatchery Cove	446	417	660	
1002	7/17/2015	SB	Creel	Hatchery Cove	490	457	1020	x
1003	7/17/2015	SB	Creel	Hatchery Cove	452	430	820	
1004	7/17/2015	SB	Creel	Hatchery Cove	460	428	690	x
1005	7/17/2015	SB	Creel	Hatchery Cove	404	383	560	
1006	7/17/2015	SB	Creel	Hatchery Cove	526	493	1140	
1007	7/23/2015	LMB	Creel	The Narrows	390	375	690	
1008	8/3/2015	SB	Creel	The Narrows	469	440	910	x
1009	8/3/2015	SB	Creel	The Narrows	430	402	660	x
1010	8/3/2015	SB	Creel	The Narrows	445	415	840	x
1011	8/3/2015	SB	Creel	The Narrows	516	490	1220	x
1012	8/3/2015	SB	Creel	The Narrows	410	385	610	x
1013	8/3/2015	SB	Creel	The Narrows	445	420	790	x
1014	8/3/2015	SB	Creel	The Narrows	420	400	670	x
1015	8/3/2015	SB	Creel	The Narrows	472	442	880	x
1016	8/3/2015	SB	Creel	The Narrows	470	430	900	x
1017	8/3/2015	SB	Creel	The Narrows	420	390	690	x
1018	8/3/2015	SB	Creel	The Narrows	420	390	650	x
1019	8/3/2015	SB	Creel	The Narrows	460	425	810	x
1020	8/3/2015	SB	Creel	The Narrows	465	430	780	x
1021	8/3/2015	SB	Creel	The Narrows	475	455	900	x
1022	8/3/2015	SB	Creel	The Narrows	440	415	710	x
1023	8/3/2015	SB	Creel	The Narrows	454	423	810	x
1024	8/3/2015	SB	Creel	The Narrows	338	318	390	x
1027	9/13/2015	SB	Tournament	Unknown	545	503	1270	
1028	9/13/2015	SB	Tournament	Unknown	498	460	953	
1029	9/13/2015	SB	Tournament	Unknown	475	450	953	
1030	9/13/2015	SB	Tournament	Unknown	490	450	907	
1031	9/13/2015	SB	Tournament	Unknown	490	455	975	x
1032	9/13/2015	SB	Tournament	Unknown	475	442	839	
1033	9/13/2015	SB	Tournament	Hatchery Cove	524	485	1225	
1034	9/13/2015	SB	Tournament	Hatchery Cove	555	510	1270	
1035	9/13/2015	SB	Tournament	Unknown	499	465	1111	
1036	9/13/2015	SB	Tournament	Unknown	485	445	998	
1037	9/13/2015	SB	Tournament	Hatchery Cove	503	467	1202	
1038	9/13/2015	SB	Tournament	Unknown	626	585	2223	
1040	9/13/2015	SB	Tournament	Unknown	558	520	1588	
1041	9/13/2015	SB	Tournament	Unknown	535	498	1361	
1042	9/13/2015	SB	Tournament	Unknown	532	495	1338	
1043	9/13/2015	SB	Tournament	E of Black Point	540	501	1338	
1044	9/14/2015	SMB	Tournament	Unknown	386	367	790	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1045	9/14/2015	SMB	Tournament	Unknown	400	380	910	x
1046	9/14/2015	SMB	Tournament	Unknown	440	415	990	x
1047	9/14/2015	SMB	Tournament	Unknown	407	385	780	x
1048	9/14/2015	SMB	Tournament	Unknown	407	390	890	x
1049	9/14/2015	SMB	Tournament	Unknown	400	380	750	x
1050	9/14/2015	SMB	Tournament	Unknown	348	330	590	x
1051	9/14/2015	SMB	Tournament	Unknown	352	335	590	x
1052	9/14/2015	SMB	Tournament	Unknown	352	335	570	x
1053	9/14/2015	SMB	Tournament	Unknown	330	310	430	x
1054	9/14/2015	SMB	Tournament	Unknown	380	362	780	x
1055	9/14/2015	SMB	Tournament	Unknown	400	380	870	x
1056	9/14/2015	SMB	Tournament	Unknown	430	410	970	x
1057	9/14/2015	SMB	Tournament	Unknown	348	332	590	x
1058	9/14/2015	SMB	Tournament	Unknown	360	350	550	x
1059	9/14/2015	SMB	Tournament	Unknown	353	335	580	x
1060	9/14/2015	SMB	Tournament	Unknown	375	355	620	x
1061	9/14/2015	SMB	Tournament	Unknown	418	398	1000	
1062	9/14/2015	SMB	Tournament	Unknown	417	398	960	
1063	9/14/2015	SMB	Tournament	Unknown	387	370	700	
1064	9/14/2015	SMB	Tournament	Unknown	406	383	790	
1065	9/14/2015	SMB	Tournament	Unknown	400	380	790	
1066	9/14/2015	SMB	Tournament	Unknown	463	444	1380	
1067	9/14/2015	LMB	Tournament	Unknown	450	432	1150	
1068	9/14/2015	SMB	Tournament	Unknown	452	432	1010	
1069	9/14/2015	LMB	Tournament	Unknown	455	435	1330	
1070	9/14/2015	LMB	Tournament	Unknown	403	387	980	
1071	9/14/2015	SMB	Tournament	Unknown	358	340	560	
1072	9/14/2015	SMB	Tournament	Unknown	435	410	1250	
1073	9/14/2015	SMB	Tournament	Unknown	405	385	810	
1074	9/14/2015	LMB	Tournament	Unknown	333	318	520	
1075	9/14/2015	SMB	Tournament	Unknown	405	385	850	
1076	9/14/2015	SMB	Tournament	Unknown	348	330	520	
1077	9/14/2015	SMB	Tournament	Unknown	380	358	690	
1078	9/14/2015	SMB	Tournament	Unknown	428	408	1130	
1079	9/14/2015	SMB	Tournament	Unknown	375	360	680	x
1080	9/14/2015	LMB	Tournament	Unknown	355	341	540	x
1081	9/14/2015	SMB	Tournament	Unknown	330	300	420	x
1082	9/14/2015	SMB	Tournament	Unknown	439	414	1060	x
1083	9/14/2015	SMB	Tournament	Unknown	457	435	1220	x
1084	9/15/2015	SMB	Tournament	Unknown	373	353	600	x
1085	9/15/2015	SMB	Tournament	Unknown	361	341	560	x
1086	9/15/2015	SMB	Tournament	Unknown	428	407	1110	x
1087	9/15/2015	SMB	Tournament	Unknown	400	384	860	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1088	9/15/2015	SMB	Tournament	Unknown	369	347	660	
1089	9/15/2015	SMB	Tournament	Unknown	350	330	580	x
1090	9/15/2015	SMB	Tournament	Unknown	370	350	610	
1091	9/15/2015	SMB	Tournament	Unknown	361	347	530	x
1092	9/15/2015	SMB	Tournament	Unknown	440	422	1260	x
1093	9/15/2015	SMB	Tournament	Unknown	355	338	560	
1094	9/15/2015	SMB	Tournament	Unknown	395	376	690	x
1095	9/15/2015	SMB	Tournament	Unknown	390	365	820	x
1096	9/15/2015	SMB	Tournament	Unknown	403	380	780	x
1097	9/15/2015	SMB	Tournament	Unknown	390	374	740	x
1098	9/15/2015	SMB	Tournament	Unknown	392	372	780	x
1099	9/15/2015	SMB	Tournament	Unknown	360	342	570	x
1100	9/15/2015	SMB	Tournament	Unknown	397	377	780	
1101	9/15/2015	SMB	Tournament	Unknown	405	389	880	x
1102	9/15/2015	SMB	Tournament	Unknown	324	315	480	x
1103	9/15/2015	SMB	Tournament	Unknown	385	365	670	x
1104	9/15/2015	SMB	Tournament	Unknown	365	350	630	x
1105	9/15/2015	SMB	Tournament	Unknown	360	339	540	x
1106	9/15/2015	SMB	Tournament	Unknown	341	327	500	x
1107	9/15/2015	SMB	Tournament	Unknown	345	328	510	x
1108	9/15/2015	SMB	Tournament	Unknown	400	385	890	x
1109	9/15/2015	SMB	Tournament	Unknown	378	358	700	x
1110	9/15/2015	SMB	Tournament	Unknown	410	390	900	
1111	9/15/2015	SMB	Tournament	Unknown	370	349	620	x
1112	9/15/2015	SMB	Tournament	Unknown	482	459	1490	x
1113	9/15/2015	SMB	Tournament	Unknown	439	416	1100	x
1114	9/15/2015	SMB	Tournament	Unknown	365	347	660	x
1115	9/15/2015	LMB	Tournament	Unknown	465	445	1050	x
1116	9/15/2015	SMB	Tournament	Unknown	330	312	440	x
1117	9/15/2015	SMB	Tournament	Unknown	440	415	1090	x
1118	9/15/2015	SMB	Tournament	Unknown	402	378	710	x
1119	9/15/2015	SMB	Tournament	Unknown	387	368	820	x
1120	9/15/2015	SMB	Tournament	Unknown	410	395	970	x
1121	9/15/2015	SMB	Tournament	Unknown	363	345	610	
1122	9/15/2015	SMB	Tournament	Unknown	325	312	430	x
1123	9/16/2015	SMB	Tournament	Unknown	393	374	900	x
1124	9/16/2015	SMB	Tournament	Unknown	347	331	580	x
1125	9/16/2015	SMB	Tournament	Unknown	382	365	790	x
1126	9/16/2015	SMB	Tournament	Unknown	430	410	900	x
1127	9/16/2015	SMB	Tournament	Unknown	395	370	790	x
1128	9/16/2015	SMB	Tournament	Unknown	395	378	830	x
1129	9/16/2015	SMB	Tournament	Unknown	328	312	420	x
1130	9/16/2015	SMB	Tournament	Unknown	430	405	970	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1131	9/16/2015	SMB	Tournament	Unknown	362	345	570	x
1132	9/16/2015	SMB	Tournament	Unknown	335	319	520	x
1133	9/16/2015	SMB	Tournament	Unknown	390	367	720	x
1134	9/16/2015	SMB	Tournament	Unknown	393	373	890	x
1135	9/16/2015	SMB	Tournament	Unknown	338	321	510	x
1136	9/16/2015	SMB	Tournament	Unknown	345	325	550	x
1137	9/16/2015	SMB	Tournament	Unknown	324	306	480	x
1138	9/16/2015	SMB	Tournament	Unknown	338	322	450	x
1139	9/16/2015	SMB	Tournament	Unknown	331	315	430	x
1140	9/16/2015	SMB	Tournament	Unknown	325	312	490	x
1141	9/16/2015	SMB	Tournament	Unknown	352	332	560	x
1142	9/16/2015	SMB	Tournament	Unknown	392	376	770	x
1143	9/16/2015	SMB	Tournament	Unknown	411	392	880	x
1144	9/16/2015	SMB	Tournament	Unknown	375	358	680	x
1145	9/16/2015	SMB	Tournament	Unknown	336	320	470	x
1146	9/23/2015	SB	Creel	Las Vegas Bay	375	346	550	x
1147	9/23/2015	SB	Creel	Las Vegas Bay	394	370	640	x
1148	9/23/2015	SB	Creel	Las Vegas Bay	315	294	320	x
1149	9/23/2015	SB	Creel	Las Vegas Bay	392	365	620	x
1150	9/23/2015	SB	Creel	Las Vegas Bay	540	500	1220	x
1151	9/23/2015	SB	Creel	Las Vegas Bay	398	370	600	x
1152	9/23/2015	SB	Creel	Las Vegas Bay	299	278	290	x
1153	9/23/2015	SB	Creel	Las Vegas Bay	382	352	510	x
1154	10/2/2015	LMB	Tournament	Unknown	357	344	410	x
1155	10/2/2015	SMB	Tournament	Unknown	388	368	700	x
1156	10/2/2015	SMB	Tournament	Unknown	340	324	560	x
1157	10/2/2015	SMB	Tournament	Unknown	435	417	1060	x
1158	10/2/2015	SMB	Tournament	Unknown	425	410	1030	x
1159	10/2/2015	SMB	Tournament	Unknown	420	409	1070	x
1160	10/2/2015	SMB	Tournament	Unknown	386	368	820	x
1161	10/2/2015	SMB	Tournament	Unknown	359	342	560	x
1162	10/19/2015	SB	Gill Netting	The Cliffs	494	459	1150	
1163	10/5/2015	SB	Gill Netting	Black Island	400	378	670	x
1164	10/5/2015	SMB	Gill Netting	Black Island	237	228	160	x
1165	10/5/2015	SMB	Gill Netting	Black Island	270	260	240	
1166	10/5/2015	SMB	Gill Netting	Roadrunner	403	381	860	
1167	10/5/2015	SMB	Gill Netting	Roadrunner	420	400	1040	
1168	10/5/2015	SMB	Gill Netting	Roadrunner	418	402	940	x
1169	10/5/2015	SB	Gill Netting	Swallow Bay	390	364	520	x
1170	10/5/2015	SB	Gill Netting	Swallow Bay	372	348	480	x
1171	10/5/2015	SB	Gill Netting	Swallow Bay	448	422	830	x
1172	10/5/2015	SB	Gill Netting	Swallow Bay	384	358	490	x
1173	10/6/2015	SB	Gill Netting	Roger's Bay	374	350	520	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1174	10/6/2015	LMB	Gill Netting	Roger's Bay	221	210	130	x
1175	10/6/2015	LMB	Gill Netting	Roger's Bay	200	193	100	x
1176	10/6/2015	SB	Gill Netting	Twin Peaks	172	160	20	x
1177	10/6/2015	LMB	Gill Netting	Calico	216	209	150	
1178	10/6/2015	SB	Gill Netting	Echo Bay	426	397	720	x
1179	10/6/2015	SB	Gill Netting	Echo Bay	360	339	500	x
1180	10/6/2015	SB	Gill Netting	Echo Bay	488	455	1130	x
1181	10/6/2015	SB	Gill Netting	Echo Bay	417	389	730	
1182	10/6/2015	LMB	Gill Netting	Echo Bay	568	530	2730	
1183	10/7/2015	LMB	Gill Netting	Cathedral Cove	255	245	200	
1184	10/7/2015	LMB	Gill Netting	Gunsight	194	186	80	x
1185	10/7/2015	SMB	Gill Netting	Gunsight	425	405	1060	x
1186	10/7/2015	SB	Gill Netting	Gunsight	325	303	320	x
1187	10/7/2015	SMB	Gill Netting	Quail Bay	213	204	130	x
1189	10/7/2015	SMB	Gill Netting	Quail Bay	299	283	350	x
1190	10/12/2015	SMB	Gill Netting	Battleship Rock	330	315	460	x
1191	10/12/2015	SB	Gill Netting	Battleship Rock	214	200	60	x
1192	10/12/2015	SB	Gill Netting	Battleship Rock	508	469	880	x
1193	10/12/2015	SB	Gill Netting	Water Barge	338	314	430	x
1194	10/12/2015	SMB	Gill Netting	Water Barge	291	278	330	
1195	10/12/2015	SMB	Gill Netting	Water Barge	400	380	750	
1196	10/12/2015	SMB	Gill Netting	Water Barge	296	280	380	x
1197	10/12/2015	SB	Gill Netting	Lover's Cove	390	360	530	x
1198	10/19/2015	SB	Gill Netting	The Cliffs	440	412	750	x
1199	10/19/2015	SB	Gill Netting	The Cliffs	480	450	990	x
1200	10/19/2015	SB	Gill Netting	The Cliffs	503	470	1120	x
1201	10/19/2015	SB	Gill Netting	The Cliffs	444	416	890	x
1202	10/19/2015	SB	Gill Netting	The Cliffs	465	439	830	x
1203	10/19/2015	SB	Gill Netting	The Cliffs	464	432	860	x
1204	10/19/2015	LMB	Gill Netting	Horsepower	397	382	860	
1205	10/19/2015	SB	Gill Netting	Horsepower	523	490	1460	x
1206	10/19/2015	SB	Gill Netting	Horsepower	350	329	450	x
1207	10/19/2015	SB	Gill Netting	Horsepower	548	515	1480	x
1208	10/19/2015	SB	Gill Netting	Horsepower	335	316	420	x
1209	10/19/2015	SB	Gill Netting	The Cliffs	480	455	990	x
1212	10/19/2015	SB	Gill Netting	Horsepower	341	320	420	x
1213	10/19/2015	SB	Gill Netting	Horsepower	358	335	460	x
1214	10/22/2015	SB	Gill Netting	Gov't Wash	325	315	300	x
1215	10/22/2015	LMB	Gill Netting	Gov't Wash	229	220	150	
1216	10/22/2015	SB	Gill Netting	Gov't Wash	398	371	670	x
1217	10/22/2015	LMB	Gill Netting	Indian Canyon	296	283	340	
1218	10/22/2015	SMB	Gill Netting	Indian Canyon	302	288	380	
1219	10/26/2015	SB	Gill Netting	Stewart's Bay	430	405	740	

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1220	10/26/2015	SB	Gill Netting	Stewart's Bay	369	348	520	
1221	10/26/2015	SB	Gill Netting	Stewart's Bay	207	196	104	x
1222	10/26/2015	SB	Gill Netting	Stewart's Bay	327	310	360	x
1223	10/26/2015	SB	Gill Netting	Stewart's Bay	343	324	440	x
1224	10/22/2015	SB	Gill Netting	Gov't Wash	403	378	670	x
1225	10/22/2015	SB	Gill Netting	Gov't Wash	120	112	10	
1226	10/22/2015	SB	Gill Netting	Gov't Wash	405	376	610	x
1227	10/22/2015	SB	Gill Netting	Gov't Wash	230	215	110	x
1228	10/22/2015	SB	Gill Netting	Gov't Wash	376	353	540	x
1229	10/22/2015	SB	Gill Netting	Gov't Wash	354	330	450	x
1230	10/22/2015	SB	Gill Netting	Gov't Wash	234	218	130	x
1231	10/22/2015	SB	Gill Netting	Gov't Wash	385	364	540	x
1232	10/22/2015	SB	Gill Netting	Gov't Wash	405	377	650	x
1233	10/22/2015	SB	Gill Netting	Gov't Wash	409	382	670	x
1234	10/22/2015	SB	Gill Netting	Gov't Wash	233	217	150	x
1235	10/22/2015	SB	Gill Netting	Gov't Wash	494	461	1200	x
1236	10/22/2015	SB	Gill Netting	Gov't Wash	231	221	130	x
1237	10/22/2015	SB	Gill Netting	Gov't Wash	230	215	130	x
1238	10/22/2015	LMB	Gill Netting	Indian Canyon	217	210	130	x
1239	10/22/2015	LMB	Gill Netting	Indian Canyon	397	385	930	x
1240	10/26/2015	SB	Gill Netting	Stewart's Bay	355	336	480	x
1241	10/26/2015	SB	Gill Netting	Stewart's Bay	317	300	340	x
1242	10/26/2015	SB	Gill Netting	Stewart's Bay	353	338	480	x
1243	10/26/2015	SB	Gill Netting	Stewart's Bay	210	199	106	x
1244	10/26/2015	SB	Gill Netting	Stewart's Bay	182	170	61	x
1245	10/26/2015	LMB	Gill Netting	Stewart's Bay	205	198	100	x
1246	10/26/2015	SB	Gill Netting	Stewart's Bay	226	212	138	x
1247	10/26/2015	LMB	Gill Netting	Bluepoint Bay	258	250	210	
1248	10/26/2015	LMB	Gill Netting	Bluepoint Bay	209	199	105	
1249	10/26/2015	LMB	Gill Netting	Bluepoint Bay	226	218	145	
1250	10/22/2015	LMB	Gill Netting	Indian Canyon	298	294	370	x
1251	10/22/2015	SMB	Gill Netting	Indian Canyon	370	354	680	x
1252	10/26/2015	SMB	Gill Netting	Cottonwood	400	380	770	
1253	10/26/2015	SMB	Gill Netting	Cottonwood	155	146	44	
1254	10/26/2015	LMB	Gill Netting	Cottonwood	254	244	230	
1255	10/26/2015	SMB	Gill Netting	Cottonwood	200	192	103	
1256	10/26/2015	LMB	Gill Netting	Cottonwood	234	225	170	x
1257	10/26/2015	SMB	Gill Netting	Cottonwood	290	278	310	x
1258	10/26/2015	SMB	Gill Netting	S-Cove	401	380	910	
1259	10/26/2015	LMB	Gill Netting	S-Cove	339	325	520	
1260	10/26/2015	SMB	Gill Netting	S-Cove	300	285	330	
1261	10/26/2015	SMB	Gill Netting	S-Cove	300	287	380	
1262	12/5/2015	SMB	Tournament	unknown	375	359	640	

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1263	12/13/2015	SB	Tournament	unknown	515	486	1157	
1264	12/13/2015	SB	Tournament	unknown	570	533	1474	
1265	12/13/2015	SB	Tournament	unknown	547	514	1520	
1266	12/13/2015	SB	Tournament	unknown	515	486	1338	
1268	12/13/2015	SB	Tournament	unknown	510	474	1225	
1269	12/13/2015	SB	Tournament	unknown	512	478	1270	
1270	12/13/2015	SB	Tournament	unknown	525	493	1225	
1271	12/13/2015	SB	Tournament	unknown	509	477	1089	
1272	12/13/2015	SB	Tournament	unknown	506	470	1270	
1273	12/13/2015	SB	Tournament	unknown	515	485	1429	
1274	12/13/2015	SB	Tournament	unknown	523	493	1202	
1276	12/13/2015	SB	Tournament	unknown	543	510	1497	
1277	12/13/2015	SB	Tournament	unknown	547	519	1474	
1278	12/13/2015	SB	Tournament	unknown	520	495	1293	
1279	12/13/2015	SB	Tournament	unknown	517	486	1338	
1280	12/13/2015	SB	Tournament	unknown	520	495	1293	
1281	12/13/2015	SB	Tournament	unknown	518	488	1225	
3001	10/6/2015	SMB	Gill Netting	James Bay	331	318	450	
3002	10/5/2015	SMB	Gill Netting	James Bay	250	236	180	
3003	10/6/2015	LMB	Gill Netting	Bearing Cove	170	150	60	
3004	10/6/2015	LMB	Gill Netting	Hamblin Bay	450	400	1410	
3005	10/6/2015	LMB	Gill Netting	Hamblin Bay	400	350	690	
3006	10/7/2015	LMB	Gill Netting	South Beach	322	309	420	
1300	3/23/2016	SMB	Trammel net	Echo Bay	396	377	818	
1301	3/23/2016	LMB	Trammel net	N/A	301	285	248	
1302	3/24/2016	LMB	Trammel net	The Meadows	204	198	---	
1303	3/24/2016	LMB	Trammel net	The Meadows	204	198	96	
1304	3/24/2016	LMB	Trammel net	The Meadows	264	251	---	
1305	3/24/2016	LMB	Trammel net	The Meadows	208	199	---	
1306	3/24/2016	LMB	Trammel net	The Meadows	268	256	---	
1307	3/24/2016	LMB	Trammel net	The Meadows	251	243	194	
1308	3/24/2016	LMB	Trammel net	The Meadows	236	228	130	
1309	3/23/2016	LMB	Electroshocking	The Meadows	515	412	480	
1310	3/23/2016	LMB	Electroshocking	The Meadows	209	---	140	
1311	3/23/2016	LMB	Electroshocking	The Meadows	406	382	890	
1312	3/24/2016	LMB	Trammel net	Meadows	331	320	415	
1314	3/24/2016	LMB	Trammel net	Meadows	365	352	685	
1315	3/24/2016	LMB	Trammel net	Meadows	375	360	670	
1316	3/23/2016	SMB	Trammel net	Echo Bay	231	221	142	
1317	3/22/2016	LMB	Trammel net	Echo Bay	426	410	998	
1318	3/22/2016	SMB	Trammel net	Echo Bay	313	296	308	
1319	3/22/2016	SMB	Trammel net	Echo Bay	377	356	898	
1320	3/22/2016	SMB	Trammel net	Echo Bay	295	282	320	

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1321	3/22/2016	SMB	Trammel net	Echo Bay	364	349	558	
1322	4/3/2016	LMB	Tournament	unknown	428	415	1020	x
1323	4/3/2016	SMB	Tournament	unknown	389	370	720	
1324	4/8/2016	LMB	Tournament	Unknown	428	410	1040	x
1325	4/8/2016	SMB	Tournament	Unknown	446	425	1090	x
1326	4/8/2016	LMB	Tournament	Unknown	344	327	520	x
1327	4/8/2016	LMB	Tournament	Unknown	450	436	1520	x
1328	4/8/2016	SMB	Tournament	Unknown	384	360	780	x
1329	4/8/2016	LMB	Tournament	Unknown	476	461	1690	x
1330	4/8/2016	SMB	Tournament	Unknown	406	380	1000	x
1331	4/8/2016	SMB	Tournament	Unknown	428	408	---	x
1332	4/8/2016	LMB	Tournament	Unknown	496	475	2120	x
1333	4/8/2016	LMB	Tournament	Unknown	392	375	720	x
1334	4/8/2016	SMB	Tournament	Unknown	382	362	780	x
1335	4/8/2016	LMB	Tournament	Unknown	430	412	1050	x
1336	4/8/2016	LMB	Tournament	Unknown	354	340	550	x
1337	4/8/2016	LMB	Tournament	Unknown	441	428	1300	
1338	4/9/2016	SMB	Tournament	Unknown	399	385	880	x
1339	4/9/2016	SMB	Tournament	Unknown	335	320	570	x
1340	4/4/2016	SMB	Tournament	Unknown	366	352	670	x
1341	4/4/2016	SMB	Tournament	Unknown	376	358	640	x
1342	4/4/2016	LMB	Tournament	Unknown	390	388	940	x
1343	4/4/2016	SMB	Tournament	Unknown	352	336	600	x
1344	5/9/2016	SB	Creel	Hatchery Cove	630	595	2030	x
1345	5/9/2016	SB	Creel	Hatchery Cove	390	364	510	x
1346	5/9/2016	SB	Creel	Hatchery Cove	367	341	450	x
1347	5/9/2016	SB	Creel	Hatchery Cove	428	399	640	x
1348	5/9/2016	SB	Creel	Hatchery Cove	518	476	1270	x
1349	5/9/2016	SB	Creel	Hatchery Cove	375	345	460	x
1350	5/9/2016	SB	Creel	Hatchery Cove	478	440	870	x
1351	5/9/2016	SB	Creel	Hatchery Cove	495	455	960	x
1352	6/12/2016	SB	Tournament	Unknown	522	485	1089	
1353	6/12/2016	SB	Tournament	S. Overton Area	484	460	952.5	x
1354	6/12/2016	SB	Tournament	S. Overton Area	500	458	975.2	x
1355	6/12/2016	SB	Tournament	S. Overton Area	518	479	1089	x
1356	6/12/2016	SB	Tournament	S. Overton Area	465	434	839	x
1357	6/12/2016	SB	Tournament	S. Overton Area	507	470	1134	x
1358	6/12/2016	SB	Tournament	S. Overton Area	495	460	930	x
1359	6/12/2016	SB	Tournament	S. Overton Area	504	470	1111	x
1360	6/12/2016	SB	Tournament	Overton Area	500	462	1043	x
1361	6/12/2016	SB	Tournament	Overton Area	494	455	998	x
1362	6/12/2016	SB	Tournament	Overton Area	490	450	2000	x
1363	6/12/2016	SB	Tournament	Unknown	525	488	1111	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1364	6/12/2016	SB	Tournament	Unknown	515	478	1066	x
1365	6/12/2016	SB	Tournament	Unknown	541	505	1247	x
1366	6/12/2016	SB	Tournament	Unknown	485	445	930	
1367	6/12/2016	SB	Tournament	Unknown	500	470	1021	x
1368	6/12/2016	SB	Tournament	Unknown	560	520	1293	
1369	6/12/2016	SB	Tournament	Unknown	600	553	1542	x
1370	6/12/2016	SB	Tournament	Unknown	505	463	1021	x
1371	6/12/2016	SB	Tournament	Boulder Basin	518	480	1111	
1372	6/12/2016	SB	Tournament	Boulder Basin	515	480	1111	x
1373	6/12/2016	SB	Tournament	Boulder Basin	510	470	998	x
1374	6/12/2016	SB	Tournament	Unknown	520	480	998	
1375	6/12/2016	SB	Tournament	Unknown	550	507	1111	x
1376	6/25/2016	SMB	Tournament	Unknown	430	410	1020	x
1377	6/25/2016	SMB	Tournament	Unknown	430	410	950	x
1378	6/25/2016	SMB	Tournament	Unknown	422	400	900	x
1379	6/25/2016	SMB	Tournament	Unknown	392	371	780	x
1380	6/25/2016	SMB	Tournament	Unknown	432	408	850	x
1381	6/25/2016	SMB	Tournament	Unknown	470	445	1410	x
1382	6/25/2016	SMB	Tournament	Unknown	382	362	670	x
1383	6/25/2016	SMB	Tournament	Unknown	409	390	930	x
1384	6/25/2016	SMB	Tournament	Unknown	428	408	840	x
1385	6/25/2016	SMB	Tournament	Unknown	379	358	740	x
1386	6/25/2016	SMB	Tournament	Unknown	420	399	880	x
1387	6/25/2016	SMB	Tournament	Unknown	361	345	670	x
1388	6/25/2016	SMB	Tournament	Unknown	445	425	1080	x
1389	6/25/2016	SMB	Tournament	Unknown	393	375	710	x
1390	6/25/2016	SMB	Tournament	Unknown	395	375	780	x
1391	6/25/2016	SMB	Tournament	Unknown	395	375	760	x
1392	6/25/2016	SMB	Tournament	Unknown	386	368	660	x
1393	6/25/2016	LMB	Tournament	Unknown	422	405	910	x
1394	6/25/2016	LMB	Tournament	Unknown	432	416	1040	x
1395	6/26/2016	LMB	Tournament	Unknown	415	396	900	x
1396	6/26/2016	LMB	Tournament	Unknown	500	475	1640	x
1397	6/26/2016	LMB	Tournament	Unknown	374	362	640	x
1398	6/26/2016	LMB	Tournament	Unknown	412	397	800	x
1399	6/26/2016	SMB	Tournament	Unknown	385	365	810	x
1400	6/26/2016	SMB	Tournament	Unknown	423	402	660	x
1401	6/26/2016	SMB	Tournament	Unknown	430	411	920	x
1402	6/26/2016	SMB	Tournament	Unknown	357	340	540	x
1403	6/26/2016	SMB	Tournament	Unknown	458	433	1150	x
1404	6/26/2016	SMB	Tournament	Unknown	420	402	860	x
1405	6/26/2016	SMB	Tournament	Unknown	388	370	620	x
1406	6/26/2016	SMB	Tournament	Unknown	398	378	840	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1407	6/26/2016	SMB	Tournament	Unknown	414	394	920	x
1408	6/26/2016	SMB	Tournament	Unknown	422	400	940	x
1409	6/26/2016	SMB	Tournament	Unknown	360	341	610	x
1410	6/26/2016	SMB	Tournament	Unknown	338	321	510	x
1411	9/12/2016	LMB	Tournament	Unknown	410	395	1020	x
1412	9/12/2016	LMB	Tournament	Unknown	350	339	570	x
1413	9/12/2016	LMB	Tournament	Unknown	385	369	640	x
1414	9/12/2016	SMB	Tournament	Unknown	430	406	1060	x
1415	9/12/2016	SMB	Tournament	Unknown	342	325	510	x
1416	9/12/2016	SMB	Tournament	Unknown	353	335	530	x
1417	9/12/2016	SMB	Tournament	Unknown	398	380	740	x
1418	9/12/2016	SMB	Tournament	Unknown	339	325	500	x
1419	9/12/2016	SMB	Tournament	Unknown	350	338	650	x
1420	9/12/2016	SMB	Tournament	Unknown	419	399	970	x
1421	9/12/2016	SMB	Tournament	Unknown	351	336	540	x
1422	9/12/2016	SMB	Tournament	Unknown	468	451	1380	x
1423	9/12/2016	SMB	Tournament	Unknown	340	328	490	x
1424	9/12/2016	SMB	Tournament	Unknown	330	321	360	x
1425	9/13/2016	LMB	Tournament	Unknown	480	463	1460	x
1426	9/13/2016	LMB	Tournament	Unknown	355	340	590	x
1427	9/13/2016	SMB	Tournament	Unknown	390	370	760	x
1428	9/13/2016	SMB	Tournament	Unknown	415	393	930	x
1429	9/13/2016	SMB	Tournament	Unknown	347	333	590	x
1430	9/13/2016	SMB	Tournament	Unknown	414	400	730	x
1431	9/13/2016	SMB	Tournament	Unknown	357	339	590	x
1432	9/13/2016	SMB	Tournament	Unknown	330	315	490	x
1433	9/13/2016	SMB	Tournament	Unknown	403	384	810	x
1434	9/13/2016	SMB	Tournament	Unknown	388	365	730	x
1435	9/13/2016	SMB	Tournament	Unknown	384	364	770	x
1436	9/13/2016	SMB	Tournament	Unknown	396	378	800	x
1437	9/13/2016	SMB	Tournament	Unknown	340	325	510	x
1438	9/13/2016	SMB	Tournament	Unknown	387	365	760	x
1439	9/13/2016	SMB	Tournament	Unknown	349	331	520	x
1440	9/13/2016	SMB	Tournament	Unknown	352	333	550	x
1441	9/13/2016	SMB	Tournament	Unknown	338	321	480	x
1442	9/13/2016	SMB	Tournament	Unknown	340	326	490	x
1443	9/13/2016	SMB	Tournament	Unknown	330	311	450	x
1444	9/14/2016	LMB	Tournament	Unknown	399	380	760	x
1445	9/14/2016	LMB	Tournament	Unknown	380	369	700	x
1446	9/14/2016	SMB	Tournament	Unknown	334	320	430	x
1447	9/14/2016	SMB	Tournament	Unknown	349	334	540	x
1448	9/14/2016	SMB	Tournament	Unknown	337	318	460	x
1449	9/14/2016	SMB	Tournament	Unknown	327	309	430	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1450	9/14/2016	SMB	Tournament	Unknown	327	311	390	x
1451	9/14/2016	SMB	Tournament	Unknown	379	363	610	x
1452	9/14/2016	SMB	Tournament	Unknown	424	398	950	x
1453	9/14/2016	SMB	Tournament	Unknown	374	358	650	x
1454	9/14/2016	SMB	Tournament	Unknown	349	333	570	x
1455	9/14/2016	SMB	Tournament	Unknown	337	319	460	
1456	9/14/2016	SMB	Tournament	Unknown	410	386	980	x
1457	9/14/2016	SMB	Tournament	Unknown	343	331	520	x
1458	9/14/2016	SMB	Tournament	Unknown	363	345	610	x
1459	10/4/2016	SB	Gillnetting	Anchor Cove	450	420	860	x
1460	10/4/2016	SB	Gillnetting	Anchor Cove	465	437	900	
1461	10/4/2016	SB	Gillnetting	Anchor Cove	132	116	130	x
1462	10/4/2016	SMB	Gillnetting	Anchor Cove	468	447	1690	x
1463	10/4/2016	SMB	Gillnetting	Anchor Cove	485	465	1410	
1464	10/4/2016	SB	Gillnetting	Calico Cove	473	442	950	x
1465	10/4/2016	SB	Gillnetting	Calico Cove	460	430	720	x
1466	10/4/2016	SB	Gillnetting	Echo Bay	448	423	760	
1467	10/4/2016	SB	Gillnetting	Echo Bay	463	434	680	x
1468	10/4/2016	SB	Gillnetting	Echo Bay	494	473	570	x
1469	10/4/2016	SB	Gillnetting	Echo Bay	413	384	600	x
1470	10/4/2016	SB	Gillnetting	Echo Bay	501	468	1060	x
1471	10/4/2016	SB	Gillnetting	Echo Bay	443	425	670	x
1472	10/4/2016	SB	Gillnetting	Echo Bay	403	380	610	x
1473	10/4/2016	SB	Gillnetting	Echo Bay	440	410	790	x
1474	10/4/2016	SB	Gillnetting	Echo Bay	402	379	640	x
1475	10/4/2016	SB	Gillnetting	Echo Bay	337	310	390	x
1476	10/4/2016	SB	Gillnetting	Echo Bay	373	349	480	x
1477	10/4/2016	SB	Gillnetting	Echo Bay	339	319	410	x
1478	10/4/2016	SB	Gillnetting	Echo Bay	445	419	850	x
1479	10/4/2016	SB	Gillnetting	Echo Bay	435	408	780	x
1480	10/4/2016	SB	Gillnetting	Echo Bay	405	378	620	x
1481	10/4/2016	SB	Gillnetting	Echo Bay	428	401	740	x
1482	10/4/2016	SB	Gillnetting	Echo Bay	465	436	840	x
1483	10/4/2016	SB	Gillnetting	Echo Bay	434	410	530	x
1484	10/4/2016	SB	Gillnetting	Echo Bay	383	361	550	x
1485	10/4/2016	SB	Gillnetting	Echo Bay	425	398	600	x
1486	10/4/2016	SB	Gillnetting	Echo Bay	382	359	550	x
1487	10/4/2016	SB	Gillnetting	Echo Bay	344	321	410	x
1488	10/4/2016	SB	Gillnetting	Echo Bay	162	153	50	x
1489	10/4/2016	SMB	Gillnetting	Echo Bay	358	345	580	x
1490	10/5/2016	LMB	Gillnetting	Black Point	310	300	340	
1491	10/5/2016	LMB	Gillnetting	Black Point	299	290	370	
1492	10/5/2016	LMB	Gillnetting	Black Point	275	262	260	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1493	10/5/2016	LMB	Gillnetting	Black Point	175	165	---	x
1494	10/5/2016	SB	Gillnetting	Black Point	310	304	370	
1495	10/5/2016	LMB	Gillnetting	Bluepoint Bay	374	365	810	x
1496	10/5/2016	LMB	Gillnetting	Bluepoint Bay	330	316	540	x
1497	10/5/2016	LMB	Gillnetting	Bluepoint Bay	428	415	1120	x
1498	10/5/2016	SB	Gillnetting	Bluepoint Bay	345	318	360	x
1499	10/5/2016	SB	Gillnetting	Bluepoint Bay	475	440	1010	x
1500	10/5/2016	SMB	Gillnetting	Cottonwood Cove	400	380	800	
1501	10/5/2016	SB	Gillnetting	Cottonwood Cove	455	422	560	x
1502	10/5/2016	SB	Gillnetting	Cottonwood Cove	465	428	660	x
1504	10/5/2016	SB	Gillnetting	Stewart's Bay	229	217	120	x
1505	10/6/2016	SMB	Gillnetting	Cathedral Cove	494	469	1590	
1506	10/6/2016	SB	Gillnetting	Cathedral Cove	466	432	600	x
1507	10/6/2016	SB	Gillnetting	Ramshead Cove	440	410	460	x
1508	10/6/2016	SB	Gillnetting	Ramshead Cove	435	404	640	x
1509	10/6/2016	SB	Gillnetting	Ramshead Cove	410	384	520	x
1510	10/6/2016	SB	Gillnetting	Preacher's Cove	457	429	550	x
1511	10/6/2016	SB	Gillnetting	Preacher's Cove	474	434	760	x
1512	10/6/2016	SB	Gillnetting	Preacher's Cove	410	377	630	x
1513	10/6/2016	SB	Gillnetting	Preacher's Cove	367	337	410	x
1514	10/13/2016	SMB	Gillnetting	James Bay	298	282	300	
1515	10/13/2016	LMB	Gillnetting	Sidewinder	322	310	410	
1516	10/13/2016	SMB	Gillnetting	Sidewinder	147	140	20	x
1517	10/13/2016	SB	Gillnetting	Sidewinder	485	452	720	x
1518	10/13/2016	LMB	Gillnetting	Bearing Point	312	298	380	
1519	10/13/2016	LMB	Gillnetting	Bearing Point	311	299	390	
1520	10/13/2016	SMB	Gillnetting	Bearing Point	328	324	490	x
1521	10/13/2016	SMB	Gillnetting	Bearing Point	327	316	520	x
1522	10/13/2016	BG	Gillnetting	Bearing Point	107	---	30	x
1523	10/13/2016	LMB	Gillnetting	Auxiliary Point	389	372	680	
1524	10/13/2016	SMB	Gillnetting	Auxiliary Point	234	225	150	x
1525	10/17/2016	LMB	Electroshocking	Last Chance Cove	386	---	---	
1526	10/21/2016	LMB	Gillnetting	Hideaway Cove	212	204	80	x
1527	10/21/2016	SMB	Gillnetting	Hideaway Cove	235	225	110	
1528	10/21/2016	SMB	Gillnetting	Hideaway Cove	209	201	80	x
1529	10/21/2016	SB	Gillnetting	Hideaway Cove	460	431	630	
1530	10/21/2016	SMB	Gillnetting	Callville Wash	370	356	710	x
1531	10/21/2016	SB	Gillnetting	Callville Wash	524	495	1380	
1532	10/21/2016	SB	Gillnetting	Callville Bay	404	378	560	x
1533	10/21/2016	SB	Gillnetting	Callville Bay	478	447	670	x
1534	10/25/2016	SB	Gillnetting	Pyramid Island	486	463	660	x
1535	10/25/2016	SB	Gillnetting	Pyramid Island	305	293	280	x
1536	10/25/2016	SB	Gillnetting	Pyramid Island	165	153	40	x

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith
1537	10/25/2016	SB	Gillnetting	Pyramid Island	181	170	40	x
1538	10/25/2016	SB	Gillnetting	Pyramid Island	471	436	580	x
1539	10/25/2016	SB	Gillnetting	Pyramid Island	409	380	590	x
1540	10/25/2016	LMB	Gillnetting	Saddle Cove	327	311	460	
1541	10/21/2016	SB	Gillnetting	Lovers Cove	460	431	630	x

Appendix 2. Floy tagged smallmouth bass (SMB), largemouth bass (LMB), and striped bass (SB), 2016.

Tag number	Date	Species	Capture site	TL mm	FL mm	WT g

Tag number	Date	Species	Capture site	TL mm	FL mm	WT g
40403	3/23/2016	SB	Overton Arm	477	450	905
40404	3/23/2016	SB	Overton Arm	490	456	870
5457	3/23/2016	LMB	N. of Meadows	515	412	480
5458	3/23/2016	LMB	N. of Meadows	405	394	850
5459	3/23/2016	LMB	N. of Meadows	383	375	810
5461	3/23/2016	LMB	N. of Meadows	235	215	130
5462	3/23/2016	LMB	N. of Meadows	219	208	130
5463	3/23/2016	LMB	N. of Meadows	221	212	130
5464	3/23/2016	LMB	N. of Meadows	360	342	560
5465	3/23/2016	LMB	N. of Meadows	209	196	140
5466	3/23/2016	LMB	N. of Meadows	406	382	890
5468	3/24/2016	LMB	Overton Arm	335	325	475
5469	3/24/2016	LMB	Overton Arm	375	360	670
5475	3/24/2016	SB	Overton Arm	526	485	1170
5468	3/24/2016	LMB	Meadows	335	325	475
5469	3/24/2016	LMB	Meadows	375	360	670
5475	3/24/2016	SB	Meadows	526	485	1170
5546	10/3/2016	SB	Echo Bay	433	400	780
5547	10/3/2016	SB	Echo Bay	448	423	760
7652	10/4/2016	SB	Black Point	310	304	370
5548	10/4/2016	SMB	Cottonwood Cove	400	380	800
5549	10/5/2016	SMB	Cathedral Cove	494	469	1590
5550	10/12/2016	SMB	James Bay	298	282	300
7700	10/12/2016	LMB	Sidewinder	322	310	410
7699	10/12/2016	SMB	Bearing Point	327	316	520
7698	10/12/2016	LMB	Auxiliary Point	389	372	680
7696	10/20/2016	SMB	Hideaway Cove	235	225	110
7695	10/20/2016	SB	Callville Wash	524	495	1380
7694	10/24/2016	LMB	Saddle Cove	327	311	460