NEVADA DEPARTMENT OF WILDLIFE
STATEWIDE SPORT FISHERIES MANAGEMENT

FEDERAL AID JOB PROGRESS REPORT

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2018

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, 2018 to December 31, 2018*

SUMMARY

General Sport Fishing Evaluation

In 2018, 96 days were expended conducting creel surveys on Lake Mead. A creel clerk contacted 825 anglers that caught 3,680 fish of multiple species for catch rates of 4.5 fish/angler-day and 0.96 fish/angler-hour. Anglers kept 1,331 fish for harvest rates of 1.6 fish/angler-day and 0.3 fish/angler-hour.

During the fall, NDOW, Arizona Game and Fish Department (AZGFD), and U.S. Bureau of Reclamation (USBR) cooperatively completed electroshocking and gill netting surveys. Electroshocking surveys were dominated by Bluegill *Lepomis macrochirus*, Green Sunfish *L. cyanellus*, Threadfin Shad *Dorosoma petenense*, and Gizzard Shad *D. cepedianum*. Gill-net surveys caught primarily Gizzard Shad, Channel Catfish *Ictalurus punctatus*, and Striped Bass *Morone saxatilis*.

Striped Bass Assessment

Striped Bass gill netting CPUE showed a slight decrease from 2017 results and angler interest in Striped Bass as a percentage of total angler preference was unchanged from last year at 70%. Harvested Striped Bass from creel surveys were of similar size and body condition as last year. Mean total length was 423 mm (16.7 in), mean weight was 714 g (1.6 lbs), and average condition factor (K_{FL}) was 1.12. This was slightly larger compared to results from last year, but they showed a similar average body condition. Striped Bass had a mean total length of 376 mm (14.8 in), mean weight of 580 g (1.3 lbs), and a condition factor of 1.12 K_{FL}, with 24% having a condition factor less than 1.0 K_{FL}, indicating poor condition.

Black Bass Fisheries Assessment

Gill-net surveys revealed little change in CPUE for both Largemouth Bass *Micropterus salmoides* and Smallmouth Bass *M. dolomieu* (collectively called black bass). Black bass harvest, as a percentage of the total harvest, increased slightly in 2018 to 1.9% compared to 1.4% last year. The fishery remains mostly catch-and-release with only 4.2% of the observed catch harvested. The percentage of angler preference for black bass remained stable at 27.5% of the total angling effort. Measurements taken from tournament mortalities revealed Largemouth Bass had a mean total length of 378 mm (14.9 in) and mean weight of 683 g (1.5 lb). Body

condition was slightly improved at a relative weight (W_r) of 85. Smallmouth Bass had a mean total length of 377 mm (14.8 in), mean weight of 668 g (1.5 lbs), and W_r of 79. Snorkel survey results show Smallmouth Bass were observed six times more than Largemouth Bass. There was a twofold increase in fingerling Smallmouth Bass observations compared to 2017. There was a slight increase in Largemouth Bass fingerling observations, although the current trend shows a reduction in Largemouth Bass observations compared to four years ago. This year there was also a reduction in Largemouth Bass juveniles and adult size classes, while there was little change in Smallmouth Bass juvenile and adult size classes. Smallmouth Bass catch rates while electroshocking increased to over three times the rate in 2017, while Largemouth Bass catch rates dropped to nearly half the rate in 2017.

Prey Base Studies

Threadfin Shad production was monitored during spring/summer at 30 standard transects in Overton Arm and Boulder Basin. The shad population typically exhibits a cyclical pattern with two to three years of poor production followed by a peak year in production. Both Overton Arm and Boulder Basin showed reduced shad production this year, after having a surge in production last year. Average shad production in Boulder Basin was 24 shad/3,531 ft^3 (100 m^3) and in Overton Arm peak was 91 shad/3,531 ft^3 (100 m^3). Combined average production was 58 shad/3,531 ft^3 (100 m^3), a reduction from the historical 29-year average of 71 shad/3,531 ft^3 (100 m^3).

Salmonid Fisheries Assessment

No Rainbow Trout *Oncorhynchus mykiss* were stocked in 2018 and no trout were captured in population surveys.

BACKGROUND

Lake Mead was created by the completion of 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 for providing additional forage. Initially, there was improvement in body condition, but this was short-lived. In 1963, the construction of Glen Canyon Dam upstream reduced flow conditions with the filling of Lake Powell. This also changed historic water storage patterns in Lake Mead to one having lower spring flows and higher winter flows, which cause drawdown during the black bass spawning season. Temperature fluctuations and nutrient loading also changed in Lake Mead 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 between 1969 and 1972, at which time they were found to reproduce naturally. Stocking was then

discontinued. At the time of these introductions, Threadfin Shad become an over-abundant pelagic biomass mostly unavailable to littoral fish species. After 10 years, however, Striped Bass became well established, which subsequently reduced the Threadfin Shad population. Moreover, increasing evidence indicates that Striped Bass negatively affected the salmonid fishery and contributed 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 Bass and black bass.

Since 2007, the primary strategy for managing Striped Bass has been to manipulate the structure of the lake-wide population by encouraging anglers to harvest large numbers of smaller sizes through increasing the legal possession limit. Increased harvest of 12 to 15 in (305 to 381 mm) Striped Bass, primarily one and two year old fish, would lessen the impact on YOY shad, thus making more of the current shad production available to larger Striped Bass when their distributions overlap in late summer and early fall. Ideally, this should improve the body condition in larger fish. Similar regulations are now continuous throughout lakes Powell, Mead, and Mohave, with an unlimited take of Striped Bass less than 20 in (508 mm) and a 20 fish limit on Striped Bass over 20 in. Under these regulations, there is a large number of one- and two-year-old Striped Bass available for harvest each year, though Striped Bass over 20 in 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 during creel surveys in 1999, is now an important part of the sport fishery, and is equally abundant as Largemouth Bass. 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 Lake Mead fisheries are invasive species. In 1994, Blue Tilapia *Oreochromis aureus* was first identified in Lake Mead, then, in 2007, two more aquatic nuisance species (quagga mussel and gizzard shad) made their way to Lake Mead. The impact these species will have on the fishery is unclear, however, Gizzard Shad have been found to provide additional forage for Striped Bass. Unfortunately, these shad 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

General Management 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 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.
- Monitor changes to the black bass fishery through catch data from major fishing tournaments.
- Complete weekly meter net trawls during peak threadfin shad production.
- Conduct quarterly stomach content analysis of up to 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

The creel survey program was re-designed in September 2015 to stratified random sampling where four boat landings have different sampling probabilities based on angler use. Sampling probabilities for Boulder Harbor is 0.56, Callville Bay is 0.22, Echo Bay is 0.11, and Hemenway is 0.11. The days sampled were randomly selected from Tuesday through Saturday and stratified as either morning or afternoon. In 2018, the winter sampling frequency for Echo Bay increased to 0.22, while Callville Bay was reduced to 0.11. This increased angler contacts during the upsurge in winter usage at Echo Bay from “snow birds.”

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

Black Bass Tournament Monitoring

Major Largemouth Bass fishing tournaments were monitored to evaluate weigh-in procedures, obtain tag return data, and insure a proper release procedure was adhered to that is consistent with National Park Service permit. Data on species composition and bag weights were collected. Additionally, species, length, weight, scales, and otoliths were collected from mortalities. Stomach contents were identified to determine diet.

Gill Netting Surveys

A gill-net survey was carried out in the fall and nets were set according to NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs for gillnetting warmwater species. Gill nets were of experimental design, made of multifilament, 150 ft (46 m) in length, and consisted of five 30 ft (9 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). Fish were identified to species, weighed, measured, and released back to the lake. A portion of Striped Bass, Smallmouth Bass, and Largemouth Bass were marked with Floy tags as part of an aging and growth study. Scale and otolith samples were also obtained from a portion of the catch for aging.

Electroshocking Surveys

Sampling was done in the fall, during the evening hours using a boat equipped with a Coffelt shocking apparatus and a Smith-Root VVP-15B Electrofisher voltage pulsator. 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. Stratified random sites (coves) were chosen, but selection also took into consideration visibility and clarity of water. Snorkeling sampling methods used are described in NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs. Dive transects were timed, counting all fish of a species or estimating numbers when found in large groups (e.g., Threadfin Shad schools). 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 and sampling conditions.

Shad Trawls

Weekly meter-net trawls for shad were conducted in Boulder Basin and Overton Arm at established transects. Procedures followed were in accordance with protocols established in a 1988 nutrient study, but with reduced number of sample sites. Over the years, as the lake elevation declined, some transects were moved or discontinued. 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 trawling consisted of towing a cone-shaped net with an open end of 3.3 ft (1.0 m) in diameter and 0.06 in (1.6 mm) mesh screening. The net was 19.7 ft (6.0 m) long, with a 10.0 in (25.4 cm) collection cup on the end. The net was towed approximately 65.6 ft (20 m) behind the boat and a trawl lasted for 10 min at a boat speed of 2.0 knots (approximately at 1,000-rpm engine speed). This was replicated three times to provide an average. A flow meter was attached at the mouth of the net to record water

movement through the net such that the volume of water sampled was determined. Fish were counted and abundance was 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.

FINDINGS

Creel Survey

A total of 96 days were expended conducting creel surveys on Lake Mead, contacting 825 anglers at four sites. Boulder Harbor received the most survey effort at 63% followed by Echo Bay (15%), Callville Bay (14%), and Hemenway (8%) (Table 1). Anglers caught 3,680 fish of multiple species for catch rates of 0.96 fish/angler-hr (Figure 1) and 4.5 fish/angler-d. Excellent catch rates were observed May through December, from 0.77 to 1.45 fish/hr. Reduced catch rates were observed from January through April at 0.52 to 0.53 fish/hr. Of the fish caught, 1,331 were harvested and resulted in harvest rates of 0.35 fish/angler-hr and 1.6 fish/angler-d.

TABLE 1. Fishing docks (marinas) and number of days surveyed by month during the 2018 Lake Mead creel survey.

Month	Dock (Marina)				
	Hemenway	Boulder Harbor	Callville Bay	Echo Bay	Total days
January	0	6	1	1	8
February	1	5	1	1	8
March	0	6	2	1	9
April	0	5	2	1	8
May	1	6	1	0	8
June	0	6	2	1	9
July	1	5	1	2	9
August	0	3	1	3	7
September	1	5	1	1	8
October	1	5	0	1	7
November	2	5	1	0	8
December	1	4	0	2	7
Total days	8	61	13	14	96
Percent	8	63	14	15	100

Since 2002, angler catch rates have exceeded the upper target of 0.75 fish/hr (Figure 2) for a Warmwater General Fishery Concept. Even during slow winter months over the past three years, angler success rates were above the minimum target catch rate of 0.25 fish/hr (Figure 1). Catch rates continue to exceed the target of 1.0 to 2.0 fish/angler-d (NDOW) since 1991, with some of the highest angler catch rates occurring since 2002 (Figure 3).

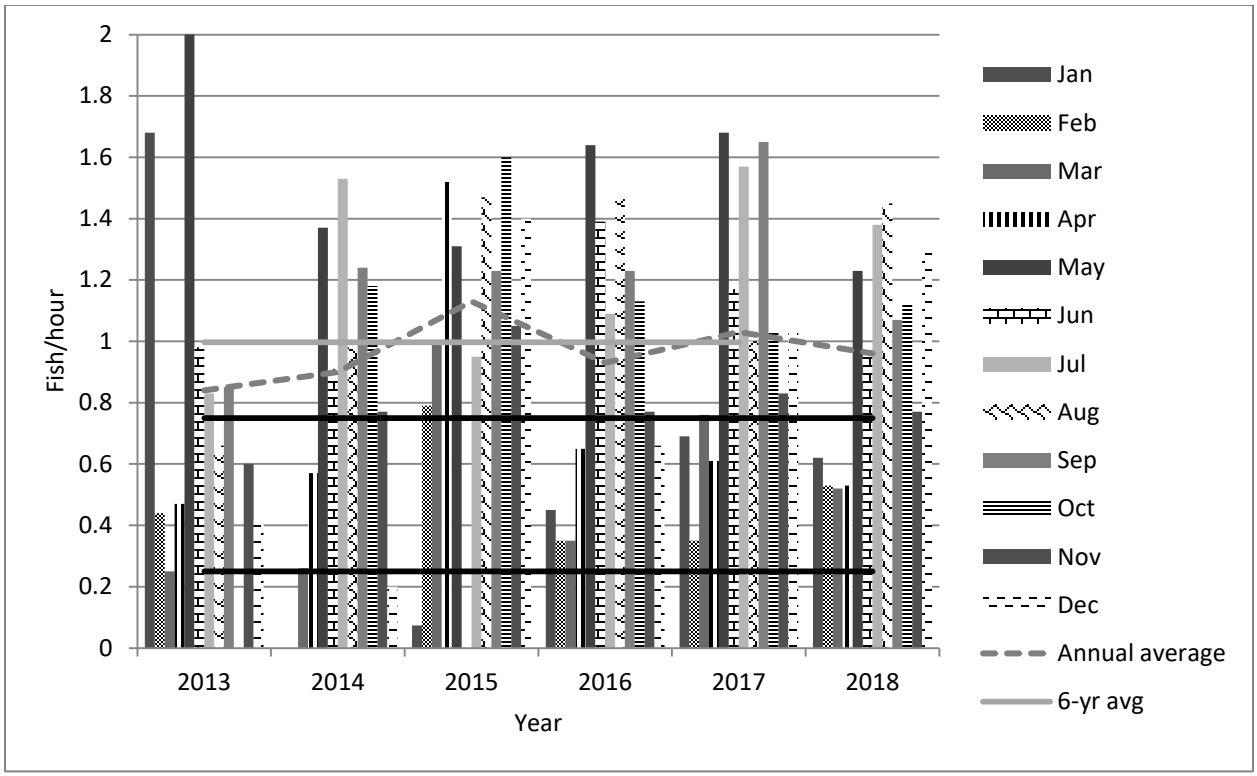

FIGURE 1. Lake Mead angler catch rates (fish/angler hour) by month from contact creel surveys, 2013-2018.

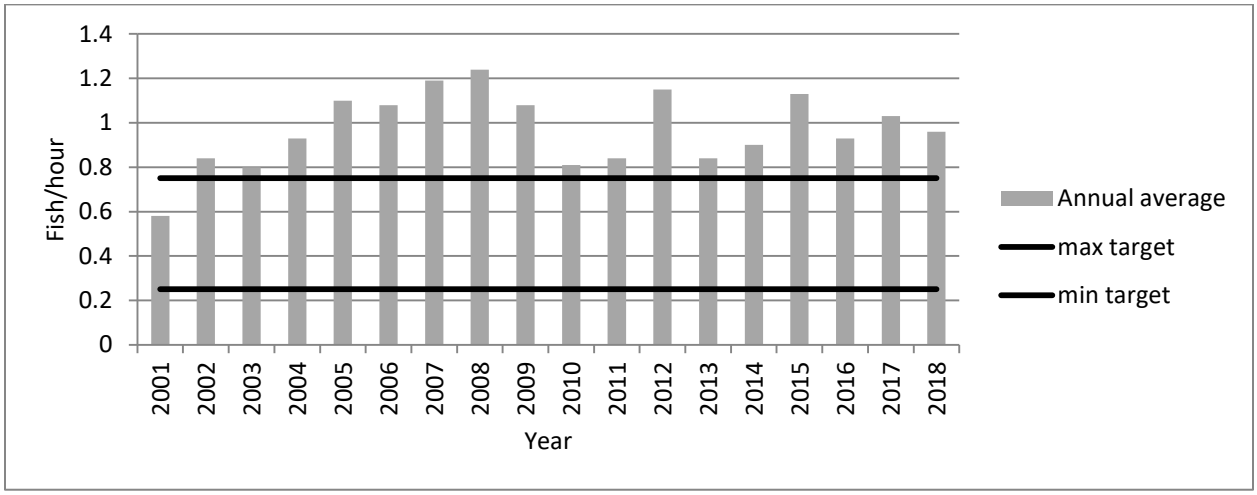

FIGURE 2. Mean catch rates (fish/angler hour) at Lake Mead from contact creel surveys, 2001-2018.

Species composition of harvested fish was led by Striped Bass at 93%, followed by Channel Catfish at 2.9%, Black Crappie at 2.2%, and black bass at 1.9% (Table 2). Angling effort (i.e., angler preference) for Striped Bass as a percentage of the total angling effort showed little change at 69.9% from 2017 at 70.4%. Black bass were the second most sought after at 27.5%, then Black Crappie at 1.2%, Channel Catfish at 0.2%, and indiscriminate at 1% (Table 3). From a sample size of 279 harvested fish,

Striped Bass had a mean total length of 423 mm (16.7 in) and a mean weight of 714 g (1.6 lb) for an average condition factor of 1.12 K_{FL}. Fourteen percent were in poor condition. Striped Bass body condition was variable throughout the year with the largest percentage of Striped Bass in poor condition during late spring and summer (Table 4).

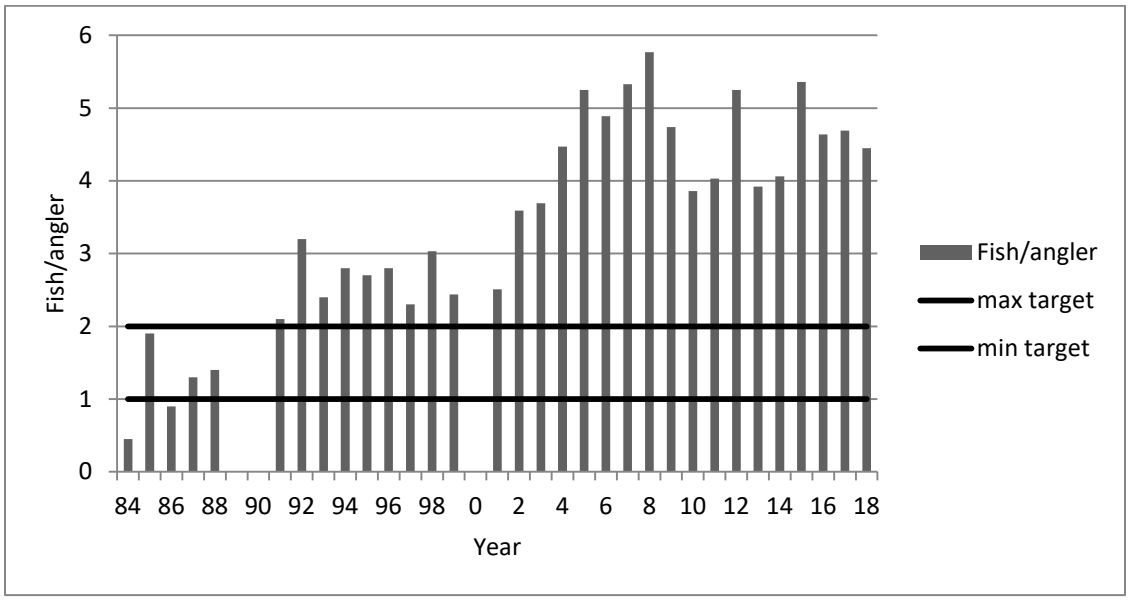

FIGURE 3. Lake Mead average angler catch rates (fish/angler day) by year from contact creel surveys, 1984-2018.

TABLE 2. Composition of harvest by species (% of total harvest) from contact creel surveys on Lake Mead, 2008-2018.

Species	Year										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Black bass	0.3	0.7	0.4	1.0	0.6	3.5	1.7	0.8	2.2	1.4	1.9
Bluegill	0.1	0	0	0.8	0.5	0.3	0	0	0	0.4	0
Black Crappie	0	0	0	0	0	0.2	0	0.5	0.3	0.1	2.2
Channel Catfish	3.5	3.0	5.9	7.7	3.5	4.6	2.2	2.8	2.6	1.5	2.9
Rainbow Trout	2.2	7.3	12.0	3.1	0	0	0	0	0	0	0
Striped Bass	94.0	88.9	81.6	87.4	95.2	91.4	95.6	95.8	94.8	96.7	93.0

TABLE 3. Lake Mead angler effort by species or preference (% of total angler use) from contact creel surveys, 2008-2018.

Species	Year										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Black Bass	5.4	8.0	5.1	8.7	11.2	14.8	21.0	15.0	25.6	27.0	27.5
Bluegill	0	0	0	0	0	0	0	0	0	0.5	0
Black Crappie	0	0	0	0	0	0	0	0.5	0	0.3	1.2
Channel Catfish	0.7	1.1	1.0	1.8	0.8	1.8	1.7	2.4	1.7	0.3	0.2
Rainbow Trout	5.9	7.0	11.1	3.9	0	0	0	0	0	0	0
Striped Bass	85.1	75.2	75.8	78.7	84.8	80.2	66.0	76.7	68.8	70.4	69.9
Multiple or any	2.8	8.7	7.0	6.6	3.0	2.9	9.6	4.8	3.9	1.0	1.0

TABLE 4. Striped Bass mean total lengths, weights, and condition factor (K_{FL}) from 2018 monthly creel survey samples at Lake Mead.

Month	*n*	Average total length		Average weight		K_{FL}	K_{FL} %<1.0
		in	mm	lb	g		
January	23	17.9	453	1.9	873	1.15	4.3
March	22	18.9	481	2.2	981	1.08	22.7
April	18	17.0	431	1.7	757	1.11	11.1
May	16	16.2	411	1.4	628	1.08	6.3
June	20	17.4	442	1.7	753	1.04	20.0
July	47	16.5	420	1.4	653	1.07	25.5
August	14	17.8	451	1.7	786	1.03	21.4
September	31	15.8	402	1.4	624	1.15	16.1
October	52	15.2	385	1.3	585	1.18	3.8
November	16	17.6	447	1.9	848	1.15	18.8
December	20	16.1	410	1.5	690	1.20	10.0
Average		16.7	423	1.6	714	1.12	14.3
Total	279						

Percent of black bass harvest increased slightly this year to 1.9% compared to 1.4% of the total harvest in 2017 (Table 2). Anglers in Lake Mead primarily practice catch-and-release, showing a 95.8% release rate. Preference black bass anglers as a percentage of all anglers remained steady at 27.5% (Table 3).

Channel Catfish was the second most harvested fish on Lake Mead in 2018 at 2.9% of the total harvest (Table 2). This rate was nearly double the 1.5% observed last year and is consistent with the current trend of less than 10% of the harvest since 2000. Channel Catfish is greatly underutilized with angler preference dropping to 0.2% from total angling effort (Table 3). Two Bluegill were reported and were caught from lower Overton Arm area. Black Crappie interest was on the rise with species preference increasing to 1.2% of the angling effort. Black Crappie also made up 2.2% of the harvest with 23 caught in upper Overton Arm, north of Bighorn Island and six from lower Overton Arm, south of Bighorn Island. Most (*n*=27) Black Crappie were caught in December and two were caught in April.

In 2018, the percentage of out-of-state anglers increased to 23% of anglers surveyed. Nevada anglers made up 77%, California 3%, Arizona 7%, and anglers from other states or countries made up 13% of angler use on Lake Mead. The percentage of California and Arizona anglers combined increased to 10%, and anglers from other areas increased to 13% (Table 5).

TABLE 5. Angler origin by state of residence (% of total angler use) from contact creel surveys on Lake Mead, 2008-2018.

State	Year										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Nevada	75.5	86.0	88.6	84.8	87.0	77.6	72.7	76.5	82.7	81.8	76.8
California	3.4	2.1	1.1	2.3	1.4	1.4	2.2	5.5	2.6	5.0	2.9
Arizona	1.4	0.6	0.1	0.2	0.6	1.8	3.9	2.3	1.5	3.4	7.0
Other	19.5	11.3	10.2	12.7	11.0	19.2	21.2	15.8	13.3	9.8	13.2

The Mail-in Angler Questionnaire Survey is another source of data 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 2017. Angler use at Lake Mead was highest in the 1980s and 1990s, with over 40,000 anglers/yr. According to questionnaire results, angler use on Lake Mead has been on a steady decline since 2000 with only occasional upswings (Figure 4). Angler use in 2017 increased by 5,684 anglers over use in 2016. They caught 162,000 fish (Figure 4) for a catch rate of 2.2 fish/d, down from 3.5 fish/d reported in 2016 (Figure 5). This rate is below the 20-year average of 3.1 fish/angler and close to the maximum target rate of 2.0 fish/angler, as defined by a Fishery Management Concepts for a Warmwater General Fishery.

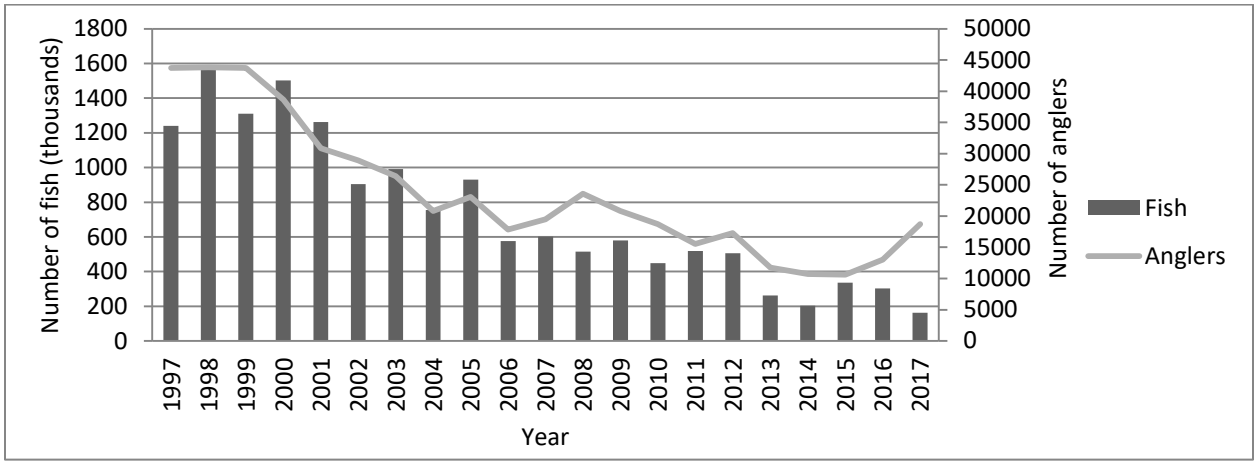

FIGURE 4. Expanded number of anglers and fish caught from the 10% angler questionnaire data for Lake Mead, 1997-2017.

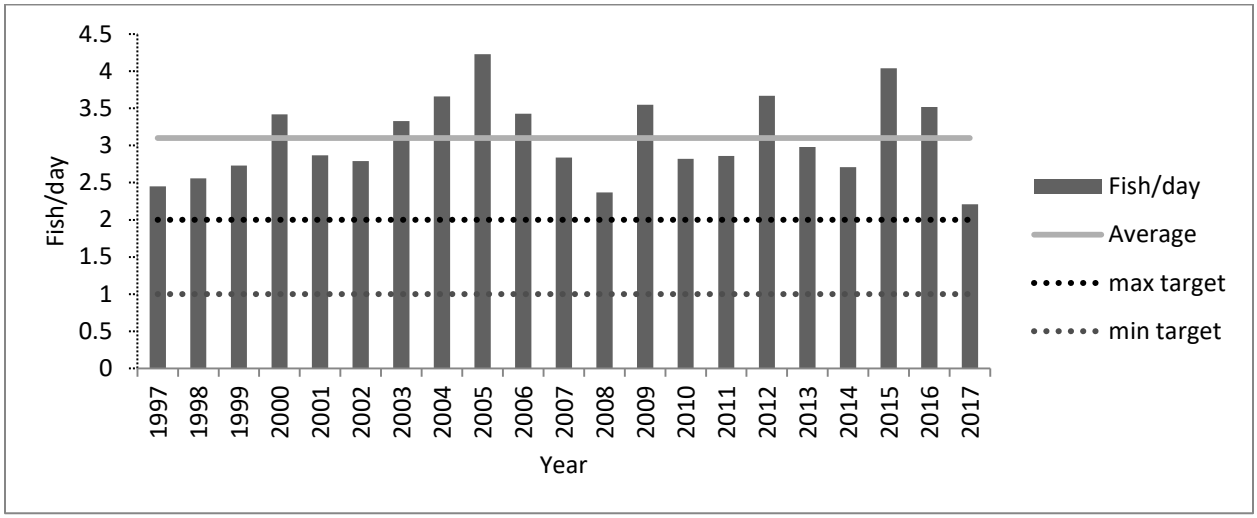

FIGURE 5. Expanded number of fish/day data from the 10% angler questionnaire data for Lake Mead, 1997-2017.

Black Bass Tournament Monitoring

Winter black bass fishing tournaments typically have little to no mortality. With no mortalities, very little biological data is obtained. Larger tournaments having greater than 100 anglers, and those held during the warmer months, have a tendency for increased mortality. Because of this, monitoring was reduced to only larger tournaments. In 2018, one black bass tournament, the Western Outdoor News (WON) U.S. Open, was attended. This was a large tournament held October 15 through 17 with 448 participants occupying 224 boats. This tournament was previously held in September and often had high mortality; however, since it has been held in October, the mortality rate has been reduced.

The tournament produced 1,899 fish over two days. Broken down by species, anglers caught 873 Largemouth Bass (46%) and 1,026 Smallmouth Bass (54%) and mortality was very low at 0.8%. By species, Largemouth Bass mortality was 0.3% (three fish) and Smallmouth Bass was 1.2% (12 fish). Individual mortalities were weighed and measured, with Largemouth Bass having a mean total length of 378 mm (14.9 in) and a mean weight of 683 g (1.5 lbs). Smallmouth Bass had a mean total length of 377 mm (14.8 in) and a mean weight of 668 g (1.5 lbs). Largemouth Bass relative weight (W_r) was 85 and the Smallmouth Bass W_r was 79 (Table 6). No tagged fish were brought to weigh-in.

TABLE 6. Summary of Lake Mead tournament-caught mortality samples with number (*n*), length in inches (in) and millimeters (mm), weight in pounds (lb) and grams (g), and condition expressed as relative weight (W_r), 2018.

Species	*n*	Mean total length mm (in)	Total length range mm (in)	Mean weight g (lbs)	Weight range g (lbs)	W_r
Largemouth Bass	3	378 (14.9)	363-393 (14.3-15.5)	683 (1.5)	630-730 (1.4-1.6)	85
Smallmouth Bass	12	377 (14.8)	328-473 (12.9-18.6)	668 (1.5)	410-1250 (0.9-2.8)	79

Stomach contents were analysis from tournament mortalities. Largemouth Bass and Smallmouth Bass ate mostly crayfish at 67% and 50% occurrence, respectively. A similar percentage of stomachs were empty for both species (Table 7). At one of the live-release boats, a Largemouth Bass was observed expelling a 177 mm (7 in) tilapia from its stomach. All Largemouth Bass were females, while Smallmouth Bass were comprised of eight males and four females (Table 7). Results show that crayfish is important in both diets and there is substantial overlap at this time of year.

TABLE 7. Summary of stomach contents from tournament-caught mortalities at Lake Mead, 2018.

Species	Stomach contents	Sex m/f
Largemouth Bass (*n*=3)	67% crayfish /33% empty	0/3
Smallmouth Bass (*n*=12)	50% crayfish / 36% empty / 7% fish mass / 7% plastic lure	8/4

Water quality was monitored at bump tanks and at live-release boats to ensure there were satisfactory temperature and dissolved oxygen (DO). On the first weigh-in day, the bump tank temperatures were 17 to 18°C and within 5°C of the lake surface

temperature of 20°C. Bump tanks were aerated and had DO levels of 10 mg/L and over 100% saturation. On the second day of weigh-in, the same water was used and the temperatures were the same and DO was between 7 and 9 mg/L with saturation levels between 75% and 95%. On both days, live-release boats showed adequate DO and temperatures ranged between 22 to 24°C, within 5°C of the lake's surface temperature. This tournament was well managed, having minimal fish mortality.

Summer Snorkel Surveys

Snorkel surveys were completed from August 1 through 17, 2018 at 10 ten randomly selected coves. Ten of the coves were located in Boulder Basin and two were located in Overton Arm. Two divers snorkeled at eight coves and one diver snorkeled at two coves for a total of 480 min. The average sampling time was 26.7 min/cove. Divers counted 201 black bass of different ages, of which 27 were Largemouth Bass and 174 were Smallmouth Bass (Table 8). Overall, Smallmouth Bass were observed over six times more than Largemouth Bass, and were more abundant than Largemouth Bass among all age-classes (Table 8; Figure 6).

TABLE 8. Largemouth and Smallmouth Bass observation numbers (*n*) and rates (fish/30 min) from 2018 Lake Mead snorkel surveys.

Species	Age-class	*n*	fish/30 min
Largemouth Bass	Fingerling	18	2.1
	Juvenile	5	0.3
	Adult	4	0.2
	All age-classes	27	1.7
Smallmouth Bass	Fingerling	140	7.8
	Juvenile	21	1.2
	Adult	13	0.7
	All age-classes	174	10.9
All black bass		201	12.6

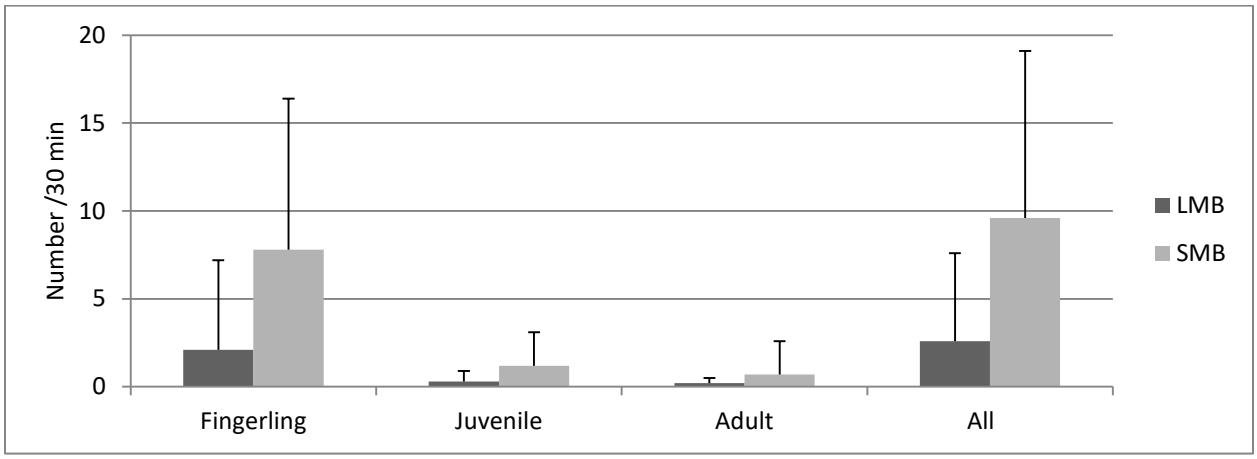

FIGURE 6. Count data from black bass snorkel surveys with error bars of 1 standard deviation, Lake Mead, 2018.

Compared to 2017, fingerling Largemouth Bass observations were similar at 2.1 fish/30 min. Fingerling Smallmouth Bass were over twice as abundant in 2018 at 7.8 fish/30 min compared to 3.2 fish/30 min in 2017 (Figure 7). Both juvenile Largemouth Bass and Smallmouth Bass numbers dropped from that of last year (Figure 8). In addition, Largemouth Bass observations showed a larger drop than Smallmouth Bass, from 1.73 fish/30 min to 0.3 fish/30 min compared to 1.6 fish/30 min to 1.2 fish/30 min, respectively. Adult Largemouth Bass observations also dropped from last year, from 0.94 to 0.20 fish/30 min. In contrast, adult Smallmouth Bass observations almost doubled from 0.42 last year to 0.70 fish/30 min this year (Figure 9).

Habitat variables of vegetation and substrate varied little from last year. Vegetation cover averaged 28.6% this year compared to 25% last year. The sites sampled this year had a slightly higher percentage of boulder/cobble (41% compared to 30%) and sand silt (30% compared to 20%) than last year. The average water temperature was 84°F this year compared to 87°F last year. In both 2017 and 2018, visibility averaged 9 ft. The lake elevation continues to decline due to drought in the upper Colorado River Basin, with the elevation in August at 1,077 ft. From July 2013 to July 2014, there was a 23 ft drop in lake elevation. After this time, Largemouth Bass numbers declined while Smallmouth Bass numbers held steady (Figures 7 through 9). Lake elevation declines and the abundance of Smallmouth Bass may be playing a role in the decrease in Largemouth Bass numbers.

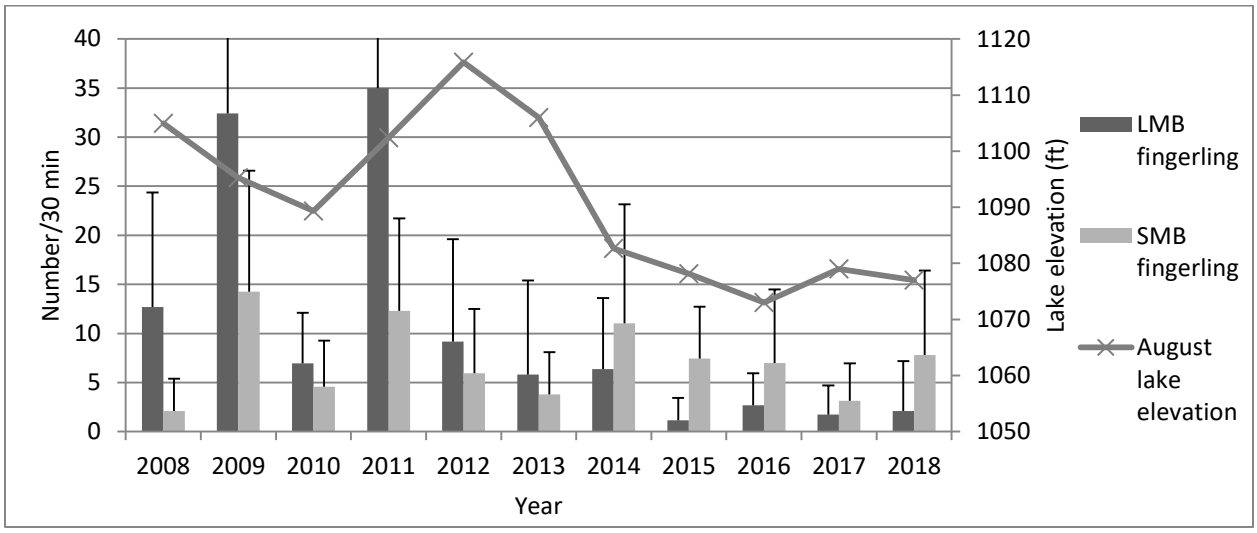

FIGURE 7. Lake elevations and fingerling black bass count rates from snorkel surveys at Lake Mead, 2008-2018.

Electroshocking Surveys

The electroshocking survey was conducted from October 17 to November 13 in conjunction with the gill-net survey. Twelve electroshocking sites were sampled (four sites were sampled by NDOW and the rest by AZGFD) (Figure 10). The reduced number of sites sampled was due to boat problems. The survey occurred over 171 min to yield 950 fish consisting of 12 species at a catch rate of 83.3 fish/15 min of effort.

Bluegill (*n*=381) was the most abundant species, making up 40% of the catch and having a CPUE of 33.4 fish/15 min. Mean total length was 73 mm (2.9 in) and the ranged was from 35 to 184 mm (1.4 to 7.2 in). The mean weight was 9.0 g (0.02 lbs), with a range from 1.0 to 124 g (0.04 to 0.27 lbs). Green Sunfish followed, making up 33% of the catch and having a CPUE of 27.1 fish/15 min. Its mean total length was 73 mm (2.9 in), ranging from 42 to 148 mm (1.7 to 5.8 in). The mean weight was 6.0 g (0.01 lbs) and range was 1.0 to 56 g (0.002 to 0.12 lbs). Threadfin Shad and Gizzard Shad were the third and fourth most abundant species, with a CPUE of 7.1 and 6.1 fish/15 min, respectively (Table 9). They were not weighed or measured.

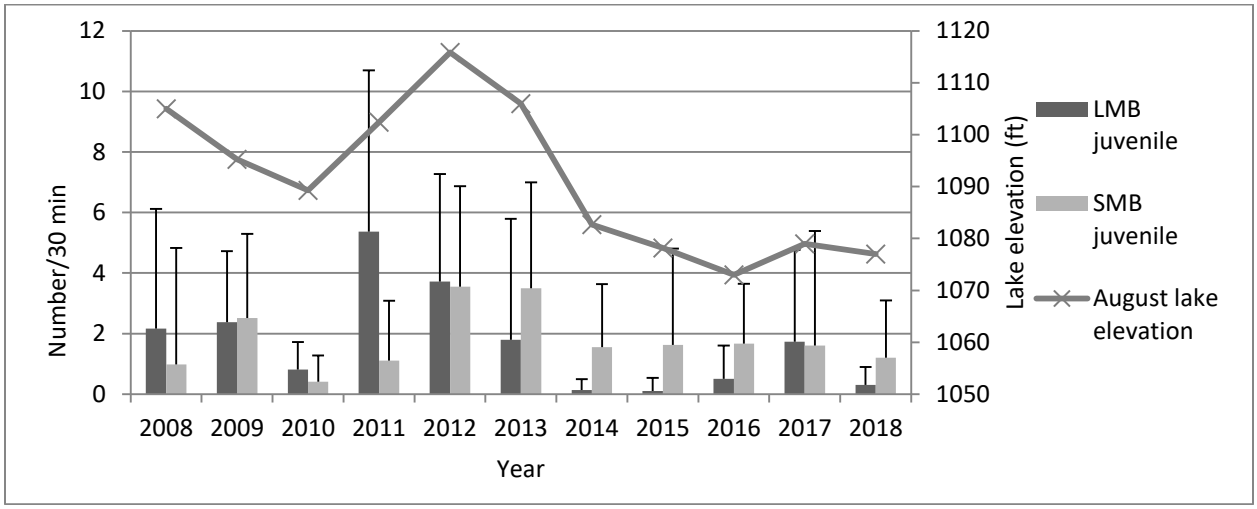

FIGURE 8. Lake elevations and juvenile black bass count rates from snorkel surveys at Lake Mead, 2008-2018.

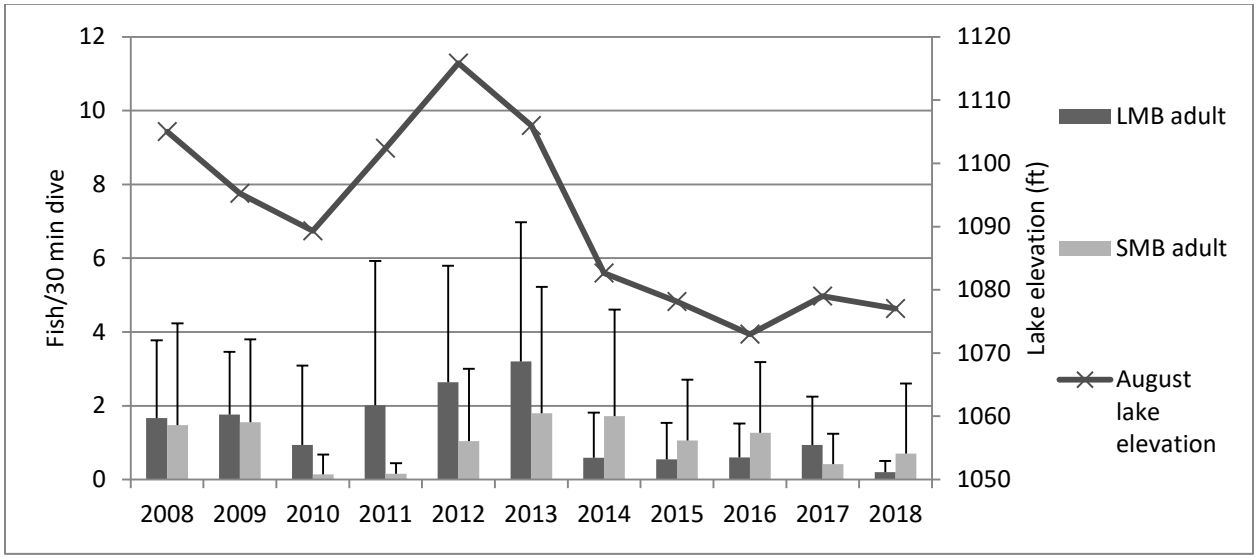

FIGURE 9. Lake elevations and adult black bass count rates from snorkel surveys at Lake Mead, 2008-2018.

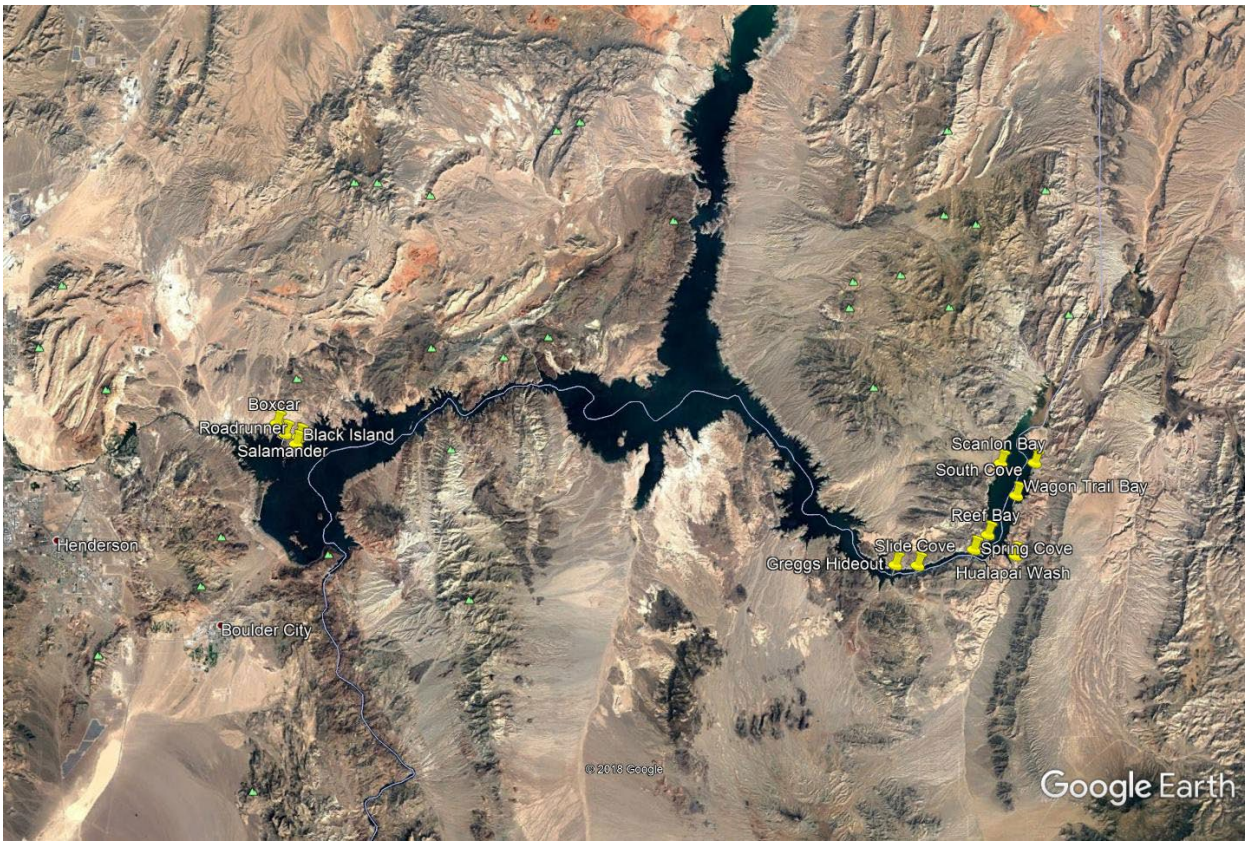

FIGURE 10. Satellite image of Lake Mead showing electroshocking sites for 2018. Google Earth, accessed 12/4/2018.

Abundance of Smallmouth Bass outnumbered Largemouth Bass 2:1, with a CPUE of 5.4 and 2.5, respectively (Table 9; Figure 11). Smallmouth Bass had a mean total length of 110 mm (4.3 in) and ranged from 60 to 180 mm (2.4 to 7.1 in) TL. The mean weight was 19 g (0.04 lbs), with weights ranging from 2.0 to 68 g (0.004 to 0.15 lbs). Largemouth Bass were larger, with a mean total length of 196 mm (7.7 in) and a range from 52 to 495 mm (2.0 to 19.4 in). The mean weight was 229 g (0.5 lbs) and ranging from 3.0 to 1,584 g (0.01 to 3.5 lbs) (Table 9). The CPUE of other species was distinctly lower. Only one Striped Bass was caught at South Cove for a CPUE of 0.88 fish/15 min (Table 9, Figure 11). This fish was 197 mm (7.8 in) TL and weighed 85 g (0.2 lb). Other species include Common Carp *Cyprinus carpio*, Channel Catfish, Blue Tilapia, Bullhead catfish *Ameiurus* sp., and Western Mosquitofish *Gambusia affinis* (Table 9).

The large increase in Smallmouth Bass CPUE this year indicates a strong year-class in 2018, while the reduction in Largemouth Bass CPUE probably indicates a poor year class in 2018 (Table 10). These results are similar to snorkel survey results, where Smallmouth Bass numbers were much greater than the Largemouth Bass numbers. Bluegill presence was high for the second consecutive year electroshocking, suggesting plentiful forage for Largemouth Bass and other littoral predators.

TABLE 9. Summary of catch data by species from the 2018 Lake Mead fall electroshocking survey.

Species	*n*	CPUE (fish/15 min)	Comp (% of catch)	Average total length (in)		Average weight (lb)	
				mm (in)	Range mm (in)	g (lbs)	Range g (lbs)
Black Crappie	0	0	0	---	---	---	---
Blue Tilapia	5	0.44	0.5	154 (6.4)	119-170 (4.7-6.7)	78 (0.17)	29-104 (0.06-0.23)
Bluegill	381	33.42	40.0	73 (2.9)	35-184 (1.4-7.2)	9 (0.02)	1-124 (0.002-0.27)
Bullhead	1	0.09	0.1	240 (9.4)	---	185 (0.41)	---
Common Carp	7	0.61	0.7	644 (25.4)	579-700 (22.8-27.6)	3,660 (8.1)	2,902-4,481 (6.40-9.88)
Channel Catfish	4	0.35	0.4	216 (8.5)	61-443 (2.4-17.4)	228 (0.50)	3-714 (0.01-1.57)
Gizzard Shad	69	6.05	7.3	---	---	---	---
Green Sunfish	309	27.11	32.5	73 (2.9)	42-148 (1.7-5.8)	6 (0.01)	1-56 (0.002-0.12)
Largemouth Bass	28	2.46	3.0	196 (7.7)	52-495 (2.0-19.5)	229 (0.50)	3-1,584 (0.01-3.49)
Mosquitofish	2	0.18	0.2	---	---	---	---
Smallmouth Bass	62	5.44	6.5	110 (4.3)	60-180 (2.4-7.1)	19 (0.04)	2-68 (0.004-0.15)
Striped Bass	1	0.88	0.1	197 (7.8)	---	85 (0.19)	---
Threadfin Shad	81	7.11	8.5	---	---	---	---
Totals	950	83.3	100				

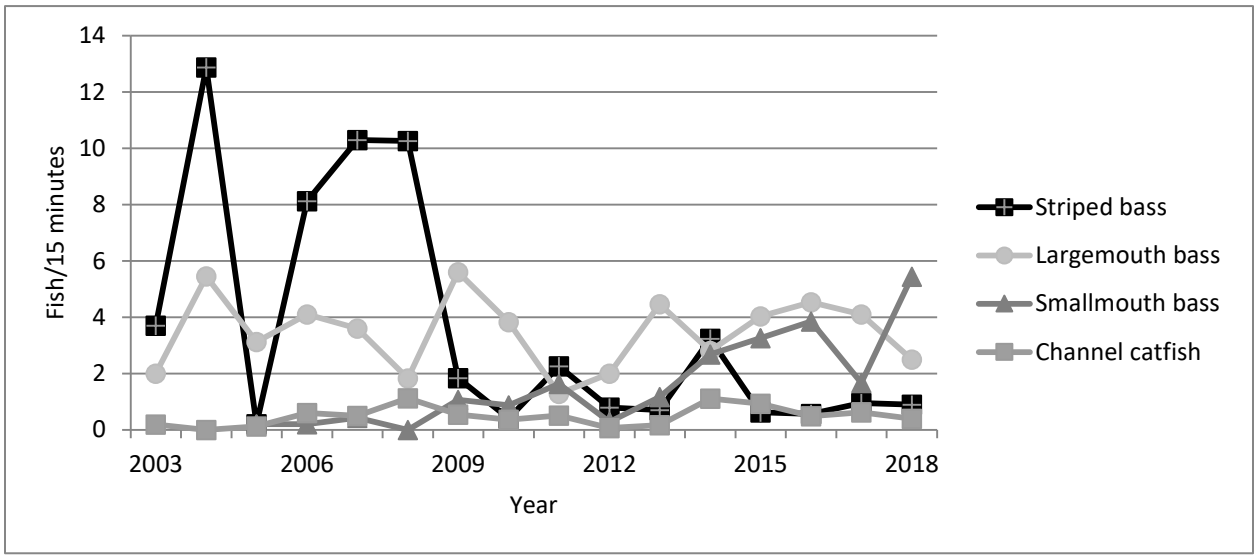

FIGURE 11. Striped Bass, Largemouth Bass, Smallmouth Bass, and Channel Catfish CPUE (fish/15 min) from fall electroshocking surveys on Lake Mead, 2003-2018.

TABLE 10. Catch rates (fish/15 min) of all species captured during electroshocking surveys on Lake Mead, 2013-2018.

Species	Year					
	2013	2014	2015	2016	2017	2018
Black Crappie	0.06	0.08	0	0.49	0	0
Blue Tilapia	0.32	0.65	1.84	1.17	0.7	0.44
Bluegill Sunfish	23.44	13.84	11.7	11.3	37.5	33.4
Bullhead Catfish	0.09	0.03	0.8	0.08	0.08	0.09
Common Carp	1.91	1.43	1.01	1.19	2.2	0.61
Channel Catfish	0.18	1.11	0.93	0.49	0.6	0.35
Gizzard Shad	2.64	2.73	4.56	2.68	4.9	6.05
Green Sunfish	13.78	32.70	24.64	21.1	18.5	27.11
Largemouth Bass	4.47	2.81	4.04	4.53	4.1	2.46
Rainbow Trout	0	0.03	0	0	0	0
Red Shiner	0.15	0.38	0.36	0.51	0.04	0
Smallmouth Bass	1.18	2.68	3.26	3.85	1.7	5.44
Striped Bass	0.71	3.24	0.62	0.57	1.0	0.88
Threadfin Shad	3.53	6.14	2.44	2.3	1.3	7.11
Mosquitofish	0.06	0	0	0	0	0.18
Totals	52.5	67.8	55.5	50.3	72.5	83.3

Gill Netting Survey

The annual fall gill-net survey was conducted from October 2 to November 5. A list of 100 randomized coves stratified by basin was identified by AZGFD with 25 coves selected per basin. Boulder Basin and Overton Arm sites are typically sampled by NDOW, Gregg Basin by AZGFD, and Virgin Basin by USBR (Figure 12). Data from all basins was combined for 100 nets set for an average of 18.3 hrs each and totaling 152 net-nights of effort (NDOW's allocation was to set 50 nets). Netting captured 2,291 fish for a catch rate of 15.24 fish/net-night (Table 11). The most numerous fish captured was Gizzard Shad at 70% of the total catch, followed by Channel Catfish (7%), Striped Bass (6%), Smallmouth Bass (5%), Common Carp (5%), and Largemouth Bass (4%) (Table 11). A few Black Crappie continue to be captured with nine caught in the upper Overton Arm and four Gregg Basin. The native Razorback Sucker *Xyrauchen texanus* was also caught in small numbers in the Overton Arm (*n*=4).

Striped Bass were the most abundant sport fish caught at a CPUE of 0.84 fish/net-night. However, the catch rate continues to decrease, by 0.40 fish/net-night compared to last year (Table 13 and Figure 14). Their abundance varied by basin, with Overton Arm the highest at 1.39 fish/net-night, followed by Boulder Basin at 0.80 fish/net-night, Gregg Basin at 0.77 fish/net-night, and Virgin Basin at 0.35 fish/net-night (Table 14).

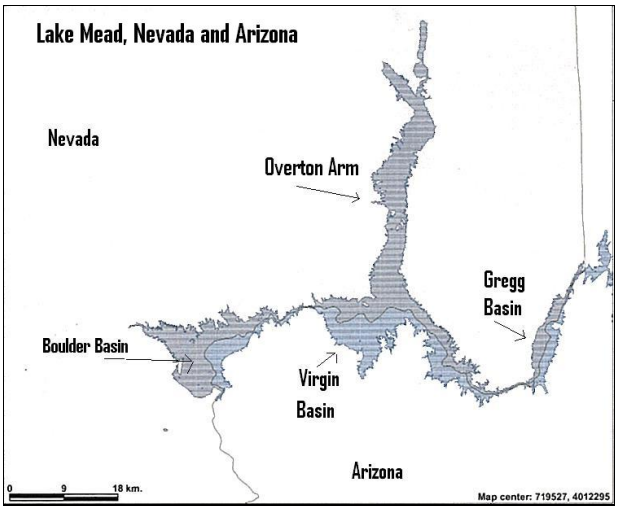

FIGURE 12. Map of Lake Mead showing the four main areas of the lake.

TABLE 11. Summary of catch data from the 2018 fall Lake Mead gill-net survey.

Species	*n*	Fish/net-night	Composition (% of catch)	Average total length		Average weight		Percent biomass
				mm (in)	Range mm (in)	g (lbs)	Range g (lbs)	
Black Crappie	13	0.09	0.6	205 (8.1)	140-328 (5.5-12.9)	165 (0.4)	20-590 (0.04-1.30)	0.13
Blue Tilapia	32	0.21	1.4	229 (9.0)	170-419 (6.7-16.5)	334 (0.7)	80-2,045 (0.18-4.5)	0.65
Bluegill	8	0.05	0.4	91 (3.6)	70.131 (2.8-5.2)	16 (0.04)	2-50 (0.004-0.11)	0.01
Bullhead	2	0.01	0.1	295 (11.6)	295-295 (295)	285 (0.63)	240-330 (0.53-0.73)	0.03
Common Carp	111	0.74	4.9	527 (20.7)	235-724 (9.3-28.5)	2,071 (4.6)	170-5,010 (0.37-11.05)	13.9
Channel Catfish	160	1.06	7.0	412 (16.2)	190-727 (7.5-28.6)	623 (1.4)	40-4,070 (0.09-8.97)	6.02
Gizzard Shad	1,590	10.58	69.4	422 (16.6)	95-503 (3.7-19.8)	724 (1.6)	2-1,230 (0.004-2.71)	69.6
Green Sunfish	21	0.14	1.0	142 (5.6)	113-225 (4.4-8.9)	62 (0.1)	20-230 (0.04-0.51)	0.08
Largemouth Bass	95	0.63	4.0	279 (11.0)	106-555 (4.2-21.9)	389 (0.9)	12-2,320 (0.03-5.11)	1.59
Razorback Sucker	4	0.03	0.2	593 (23.3)	585-600 (23.0-23.6)	2,375 (5.2)	2,210-2,480 (4.87-5.47)	0.57
Smallmouth Bass	112	0.75	4.9	315 (12.4)	158-490 (6.2-19.3)	451 (1.0)	40-1,635 (0.09-3.60)	3.05
Striped bass	126	0.84	5.5	376 (14.8)	165-720 (6.5-28.3)	580 (1.3)	80-2,045 (0.18-4.51)	4.35
Threadfin Shad	16	0.11	0.7	110 (4.3)	100-141 (3.9-5.6)	14 (0.03)	9-30 (0.02-0.07)	0.01
Totals	2,291	15.24	100					100.0

Striped bass ranged from 165 to 720 mm (6.5 to 28.3 in), with a mean of 376 mm (14.8 in). Weights ranged from 30 to 3,420 g (0.1 to 7.5 lbs), with a mean of 580 g (1.3 lbs) (Table 11). Their body condition was similar to last year and consistent with results from the creel survey (Table 4). The average condition factor was 1.12 K_{FL} with 24% of the sample in poor condition having a K_{FL} below 1.0. Gregg Basin and Overton Arm showed the highest percentage of striped bass in poor condition at 37% and 28%, respectively. Relative weight (W_r) averaged 74.6, with those in Gregg Basin having the lowest W_r (Table 12). Compared to 2017, Striped Bass increased in size by 12.7 mm (0.5 in) to 376 mm (14.8 in) (Figure 13) and had a mean weight of 580 g (1.3 lbs).

TABLE 12. Average condition (W_r and Fulton's K_{FL}) by basin of capture during 2018 gill-net 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	91	87	86	85	1.25	4
Overton Arm	83	79	78	70	1.07	28
Virgin Basin	90	83	81	76	1.17	14
Gregg Basin	90	86	81	67	1.02	37
Overall average	88	85	81	75	1.12	24

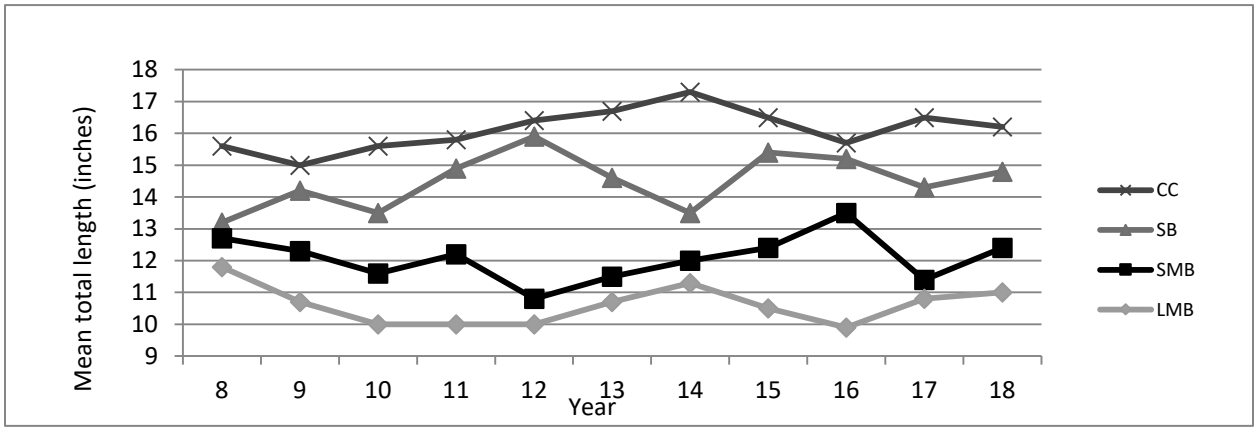

FIGURE 13. Mean total length for Channel Catfish (CC), Striped Bass (SB), Smallmouth Bass (SMB), and Largemouth Bass (LMB) captured during fall gill netting, 2008-2018.

Channel Catfish CPUE increased to 1.06 fish/net-night, compared to 0.64 fish/net-night last year (Table 11, Table 13). The mean total length in 2018 decreased slightly to 412 mm (16.2 in) (Figure 13). Channel Catfish body condition was good with an average W_r of 81, a small decrease from 2017. Condition varied across basins with Boulder Basin showing the best W_r of 86 and Overton Arm showing the lowest W_r of 78 (Table 12). Channel Catfish were most abundant in the Overton Arm with a CPUE of 2.02 fish/net-night (Table 14) and could be the reason for its decreased W_r. All other basins had at least a CPUE of 0.84 fish/net-night (Table 14).

TABLE 13. Average CPUE (fish/net-night) for each species captured during fall gill-net surveys on Lake Mead, 2008-2018.

Species	Year										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Black Crappie	0.02	0.13	0.01	0.08	0	0.1	0.04	0.08	0.08	0.05	0.09
Blue Tilapia	0.25	0.83	0.20	0.32	0.55	0.34	0.22	0.13	0.26	0.27	0.21
Bluegill	0.06	0.09	0.02	0.04	0.10	0.06	0.04	0.03	0.06	0.04	0.05
Bullhead	0	0.01	0.40	0.21	0.06	0.06	0.04	0.05	0.02	0.007	0.01
Carp	1.76	1.30	1.42	0.98	1.64	0.95	1.13	1.02	1.08	0.49	0.74
Channel Catfish	0.82	1.11	1.37	1.20	0.75	0.70	0.98	1.24	0.92	0.64	1.06
Flannelmouth Sucker	0	0	0.01	0	0.04	0.06	0	0	0	0.007	0
Gizzard Shad	0.73	5.17	11.25	8.29	7.03	9.57	9.24	8.81	8.44	10.97	10.58
Green Sunfish	0.05	0.06	0.17	0.05	0.13	0.07	0.05	0.06	0.09	0.09	0.14
Largemouth Bass	0.43	0.60	0.76	1.05	1.07	0.97	0.57	0.71	0.52	0.60	0.63
Northern Walleye	0	0	0	0	0	0	0.01	0	0.007	0	0
Rainbow Trout	0	0	0	0	0	0	0	0	0	0	0
Razorback Sucker	0.02	0.03	0.04	0.01	0.03	0.02	0.06	0.01	0.04	0.007	0.03
Smallmouth Bass	0.28	0.29	0.80	0.60	0.59	0.67	0.89	0.72	0.40	0.75	0.75
Striped Bass	1.69	1.65	1.90	1.48	1.38	1.58	1.25	1.23	1.5	1.24	0.84
Threadfin Shad	0.78	0.98	1.51	0.43	0.33	0.39	0.23	0.12	0.12	0.36	0.11
Total	6.89	12.24	19.50	14.75	13.72	15.50	14.75	14.20	13.54	15.52	15.24

TABLE 14. Sport fish and gizzard shad CPUE (fish/net-night) by basin from the fall 2018 gill-net survey on Lake Mead.

Species	Basin			
	Boulder	Overton Arm	Virgin	Gregg
Largemouth Bass	0.42	0.74	0.62	0.77
Smallmouth Bass	1.19	0.37	0.69	0.77
Striped Bass	0.80	1.39	0.35	0.77
Channel Catfish	0.66	2.02	0.84	0.71
Total CPUE (sport fish only)	3.07	4.52	2.50	3.00
Total CPUE (fish/net-night)(all fish)	12.16	22.90	10.00	15.80
Gizzard Shad	7.75	16.60	6.80	11.11

Largemouth Bass CPUE was unchanged from last year at 0.63 fish/net-night (Table 13, Figure 14) and the mean size increased slightly to 279 mm TL (11 in) (Figure 13). The overall average Largemouth Bass condition increased slightly with a W_r of 88 (Table 12). This year, Largemouth Bass body condition was good throughout the lake, although fish in Overton Arm showed a slightly lower W_r than the rest of the lake at 83 (Table 12). Smallmouth Bass CPUE was also unchanged from last year with a fish/net-night of 0.75 (Table 11; Table 13) and their size increased by 25 mm (1 in) for a mean of 315 mm TL (12.4 in) (Table 11, Figure 13). The average Smallmouth Bass W_r was 85, a slight decrease from 88 found last year. Body condition was good except for in the Overton Arm where W_r was 79 (Table 12).

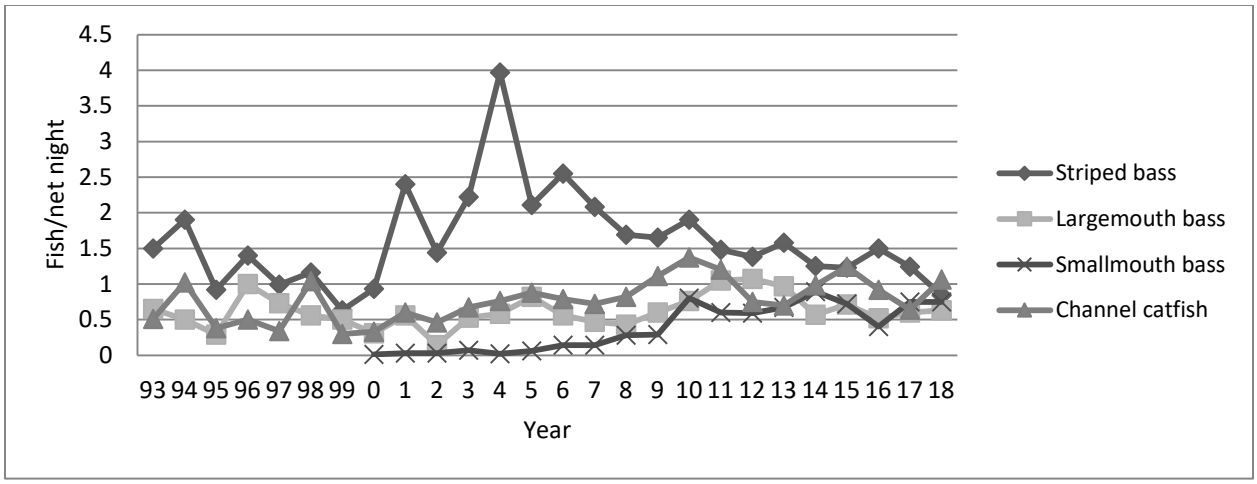

FIGURE 14. CPUE (fish/net-night) for Striped Bass, Largemouth Bass, Smallmouth Bass, and Channel Catfish from fall gill-net surveys on Lake Mead, 1993-2018.

Black bass varied in abundance by basin, with Gregg Basin showing the highest for Largemouth Bass at 0.77 fish/net-night, followed by Overton Arm at 0.74 fish/net-night, and Boulder Basin showing the lowest at 0.42 fish/net-night (Table 14). Smallmouth Bass abundance was greatest in Boulder Basin with a CPUE of 1.19 fish/net-night, and the lowest in Overton Arm at 0.37 fish/net-night. Of the four basins, Overton Arm had the highest overall CPUE for all species at 22.9 fish/net-night and the highest sport fish abundance of 4.5 fish/net-night (Table 14).

Gizzard Shad are well established in Lake Mead, reaching maximum CPUE of 11.25 fish/net-night during surveys in 2010 (Table 13; Figure 15). They have since maintained a relatively high abundance and continue to be the most numerous fish caught in gill-net surveys. In 2018, the CPUE was 10.58 fish/net-night (Table 11; Figure 15). This year, measuring and weighing Gizzard Shad was reduced to 30 fish/basin, after which the fish were only counted. From a subsample of 214 fish (14% of the catch), mean total length was 422 mm (16.6 in) and mean weight was 724 g (1.6 lbs). Gizzard Shad abundance was highest in Overton Arm with a CPUE of 16.6 fish/net-night and lowest in Virgin Basin at 6.80 fish/net-night (Table 14).

Other species including Common Carp, Blue Tilapia, Threadfin Shad, Bluegill, and Black Crappie were captured during gill netting. Common Carp CPUE was below 1.0 fish/net-night for the second year following a May 2017 spearfishing tournament that removed 1,603 carp from the lake (Figure 16). Blue Tilapia continued to be caught throughout the lake, though they have never achieved high abundance likely due to cool winter temperatures or predation. This year, tilapia was captured in Boulder Basin (*n*=16), Overton Arm (*n*=9), and Gregg Basin (*n*=7). Their overall catch rate was low at 0.21 fish/net night (Table 11 and Figure 16), with little change from last year, and made up 1.4% of the gill-net catch. Their measured an average of 229 mm TL (9.0 in) and ranged between 170 and 419 mm (6.7 and 16.5 in). Their mean weight was 334 g (0.7 lbs) and ranged between 80 and 2,045 g (0.18 and 4.5 lbs) (Table 11).

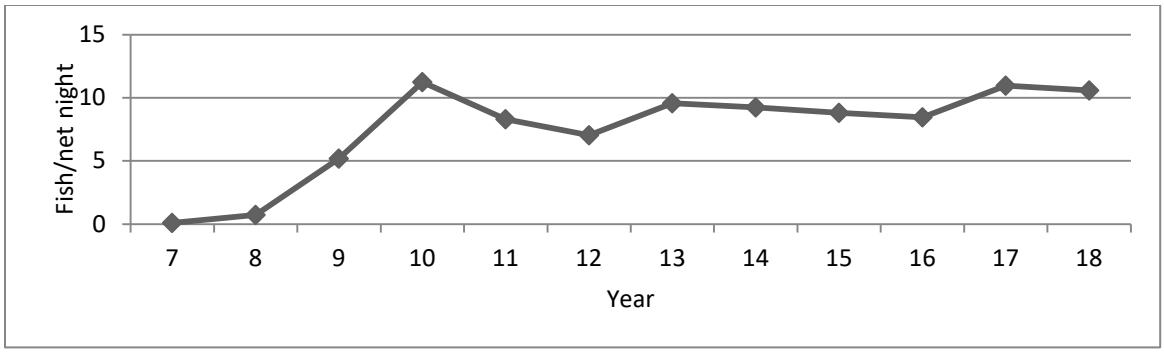

FIGURE 15. Gizzard Shad CPUE (fish/net-night) from fall gill-net surveys on Lake Mead, 2007-2018.

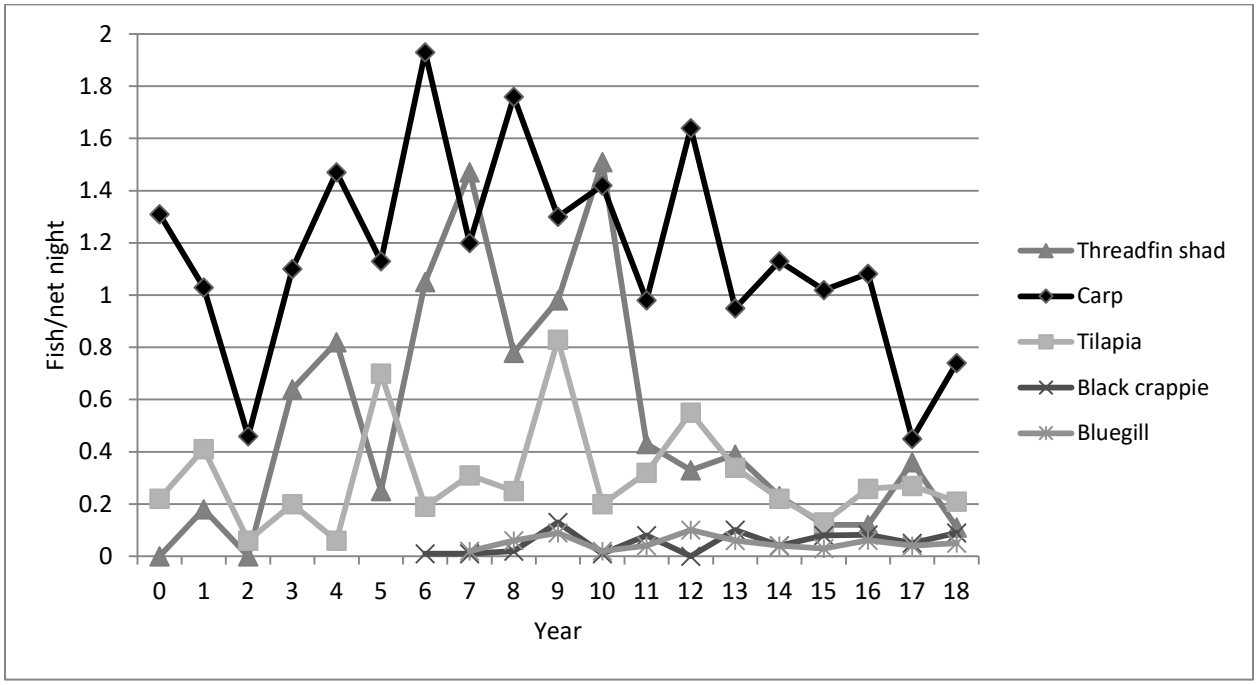

FIGURE 16. CPUE (fish/net-night) for Threadfin Shad, Common Carp, Blue Tilapia, Black Crappie, and Bluegill from fall gill-net surveys on Lake Mead, 2000-2018.

Threadfin Shad abundance was low this year based on fall gill netting results. Fifteen Threadfin Shad were captured in Gregg Basin and one in Boulder Basin showing an overall CPUE of 0.11 fish/net-night. Since 2011, Threadfin Shad abundance has been found lower than usual. This was around the same time that Gizzard Shad abundance peaked. Since 2010, Gizzard Shad has dominated the fishery, which possibly affects the Threadfin Shad fishery. Gizzard Shad spawn earlier in the year than Threadfin Shad and, due to their abundance and reproductive success, likely out-compete Threadfin Shad for habitat and food resources.

Black Crappie is typically captured in Overton Arm and Gregg Basin at a low abundance. However, since 2009, its abundance has shown small increases in gill netting CPUE (Figure 17). This fishery has been historically popular until the introduction of Striped Bass, which depleted its population. This year, 13 Black Crappie

were captured in Overton Arm (*n*=9) and Greggs Basin (*n*=4) for a CPUE of 0.09 fish/net-night. Their mean total length was 205 mm (8.1 in) and ranged between 140 and 328 mm (5.5-12.9 in). The mean weight was 165 g (0.4 lbs) and ranged from 20 to 590 g (0.04 to 1.30 lbs) (Table 11). Gill-net survey results show Black Crappie increasing, but CPUE is still low. Survey results, however, do not seem to adequately depict Black Crappie abundance, since fishing for them has become popular in winter and success appears to indicate it is more abundant. A winter/spring survey in Overton Arm may better represent Black Crappie abundance.

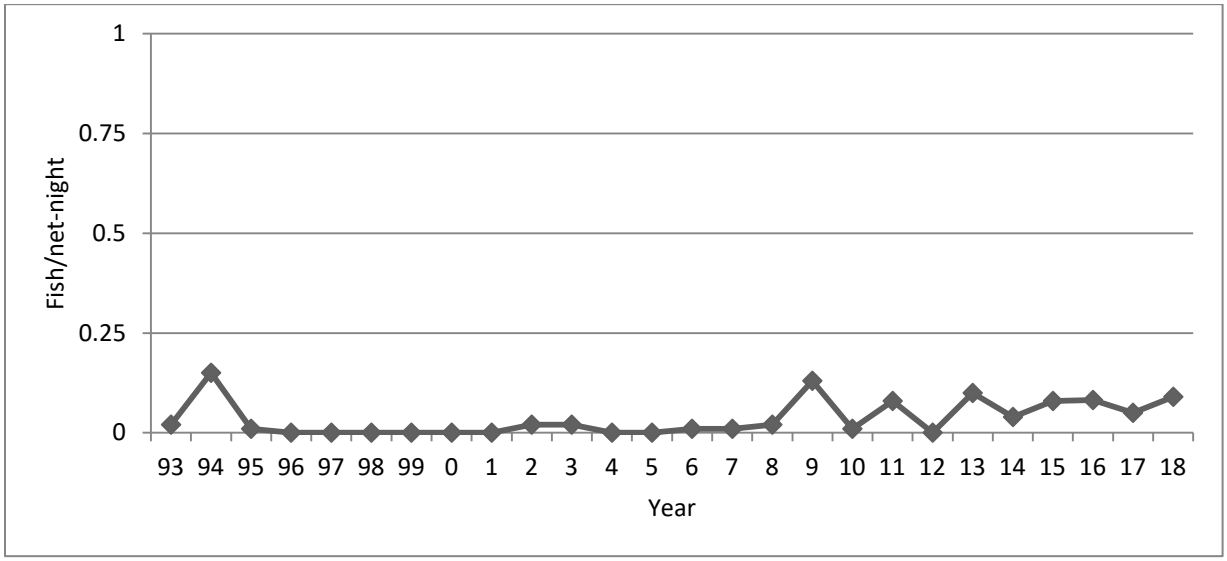

FIGURE 17. Black Crappie CPUE (fish/net-night) from fall gill-net surveys on Lake Mead, 1993-2018.

In addition to catching sport fish in the fall gill-net survey, four native Razorback Suckers were captured in the Overton Arm for a CPUE of 0.03 fish/net-night. All fish were similar in size ranging from 585 to 600 mm (23.0 to 23.6 in) TL with a mean of 593 mm TL (23.3 in). Weights ranged from 2,210 to 2,480 g (4.87 to 5.47 lbs) with a mean weight of 2,375 g (5.2 lbs) (Table 11). Two of the fish were first-time captured, wild fish and were tagged with 134 kHz PIT tags in addition to collecting fin clips for genetic analysis. The other two fish were recaptures. According to the Razorback Sucker database maintained by Marsh and Associates LLC, one recaptured fish was last caught in 2013. In over the 5 yrs and 8 mo since its capture, the fish grew 42 mm (1.7 in) and gained 530 g (1.17 lbs). The recapture location was the same as its original capture site. The other recapture was last caught 3 yrs and 7 mo ago and had grown 25 mm (0.98 in) and gained 656 g (1.4 lb) (Table 15). This fish was caught approximately 4-mi SW of its original capture site.

Prey Base Studies

Threadfin Shad production was monitored through 30 transects from April 25 through July 24 in the Overton Arm and Boulder Basin using a meter trawl net. The 2018 lake-wide larval shad production estimate (peak values) was 57 shad/3,531 ft^3

(100 m^3), and was below the 29-year average of 71 shad/3,531 ft^3 [100 m^3]) (Figure 18). Both Overton Arm and Boulder Basin exhibited reduced shad production at 91 shad/3,531 ft^3 (100 m^3) and 24 shad/3,531 ft^3 (100 m^3), respectively (Figure 18 and Table 16). The drop in shad comes after the surge in production seen last year. This pattern was somewhat predictable and consistent with Lake Mead's 3-year boom and bust cycle for Threadfin Shad.

TABLE 15. Capture history of Razorback Sucker caught in the 2018 Lake Mead fall gill net survey.

PIT tag number	Capture dates	TL mm	Weight (g)	Capture location (Agency)
3DD.003BC89C54*	10/9/2018	600	2,480	Lime Cove, Overton Arm (NDOW)
3DD.003BC89C61*	10/9/2018	600	2,210	Kline Hole, Overton Arm (NDOW)
3DD.003BC89EB2	11/1/2018	585	2,420	Stewart's Bay, Overton Arm (NDOW)
	3/31/2015	560	1,764	The Meadows, Overton Arm (BIO-WEST)
3D9.1C2D26865F	11/5/2018	586	2,390	The Meadows, Overton Arm (NDOW)
	2/21/2013	544	1,860	The Meadows, Overton Arm (BIO-WEST)

*new capture, PIT tagged and fin clipped for genetics study

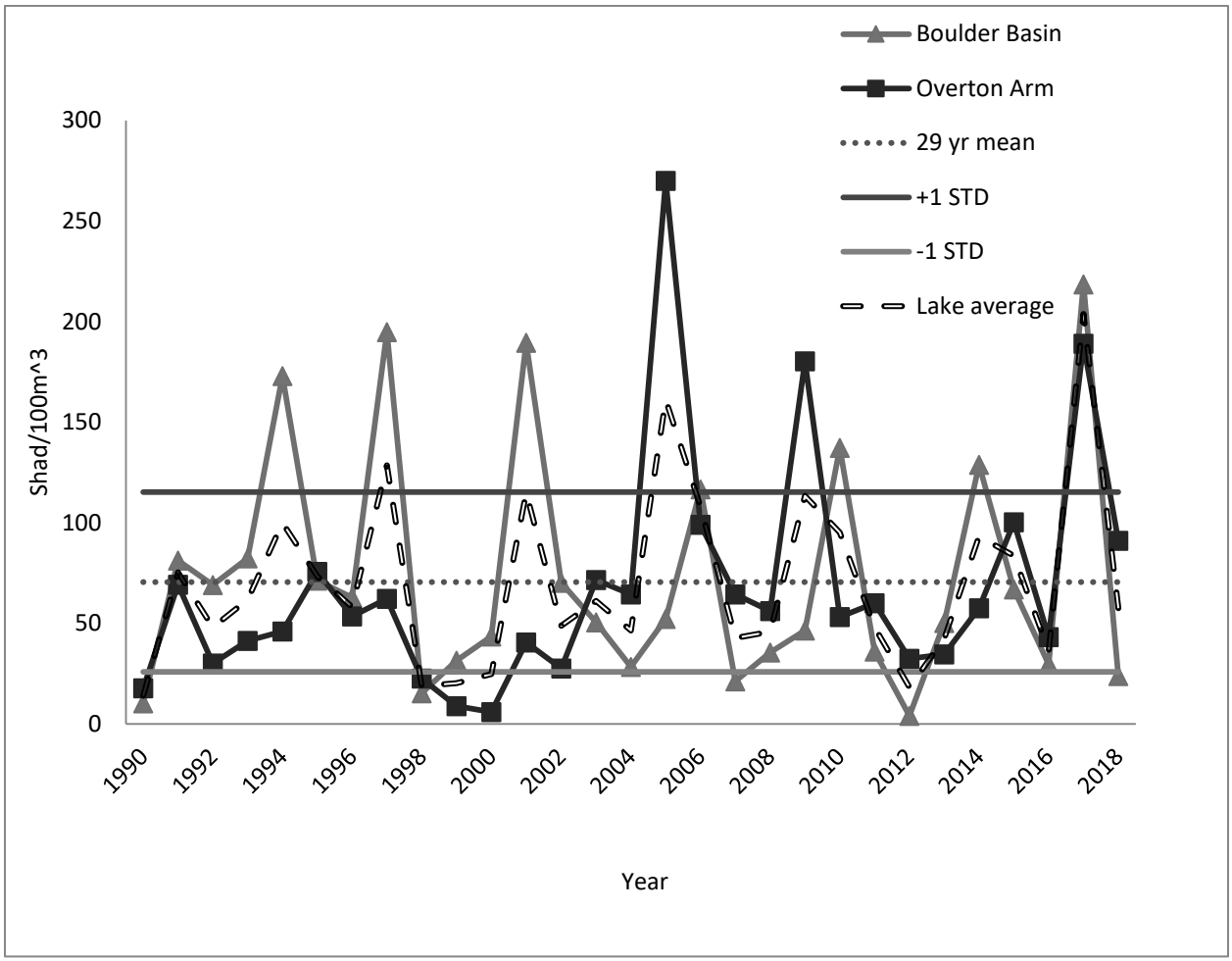

FIGURE 18. Shad densities from trawl surveys during peak production periods, 1990-2018.

TABLE 16. Lake Mead average peak shad production from trawl surveys, 2008-2018. 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
2017	143	134	245	235	189	Dry	314	305	37	219	204
2018	129	158	31	46	91	Dry	14	23	35	24	57
11-year average											76

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

Striped Bass Fisheries Assessment

The mean total length of angler harvested Striped Bass was similar to last year, with a mean total length of 423 mm (16.7 in) and mean weight of 714 g (1.6 lbs). Of the 279 Striped Bass sampled, the average body condition was 1.12 K_{FL} and 14.3% were less than 1.0 K_{FL} (a value considered to represent poor condition) (Table 4).

Angling preference for Striped Bass was the same as last year at 70% of the total observed preference (Table 3). Harvest rates decreased from 0.59 fish/hr in 2017 to 0.32 fish/hr in 2018. Catch and release fishing is becoming more popular with Striped Bass anglers showing 58% of the observed catch released back to the lake (Figure 19). The reason for the increase in throwbacks is unknown. The number of fish harvested per day decreased to 2.4 for successful Striped Bass preference anglers (compared to 3.4 fish/day in 2017). This decrease is due to a shift in anglers releasing more fish and harvesting less. The overall catch rate for Striped Bass preference anglers was 1.4 fish/hr and 5.2 fish/d. May through December was the best time to catch fish, with angler catch rates generally over 1.0 fish/hr and over 5.0 fish/d. January through April showed the lowest catch rates (Figure 20).

The fall gill-net survey caught 126 Striped Bass with a mean total length of 376 mm (14.8 in) and a mean weight of 580 g (1.3 lb) (Table 11). The average Striped Bass total length was 12.7 mm (0.5 in) longer than last year (Figure 13), and the weight was slightly more. The average condition factor was 1.12 K_{FL} (Table 12), similar to last year but with a smaller percentage of fish in poor condition.

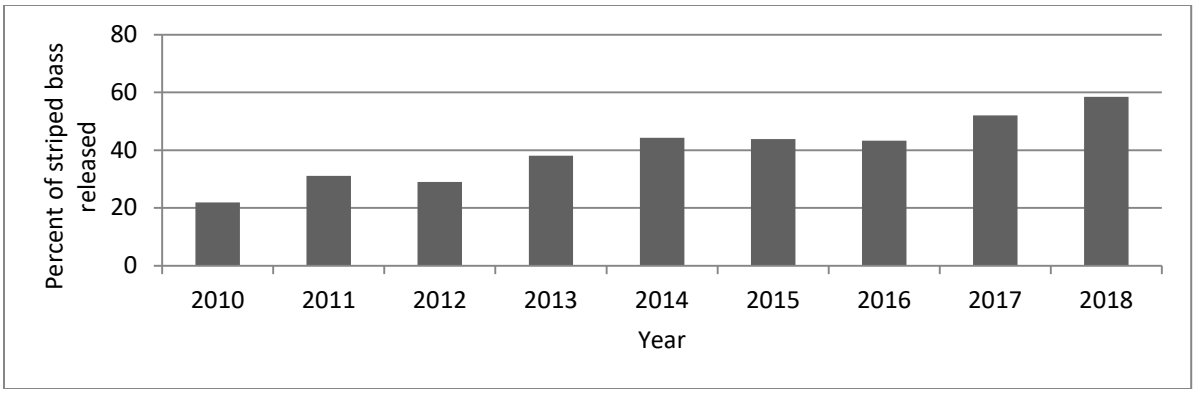

FIGURE 19. Percentage of Striped Bass released from data collected during creel surveys at Lake Mead, 2010-2018.

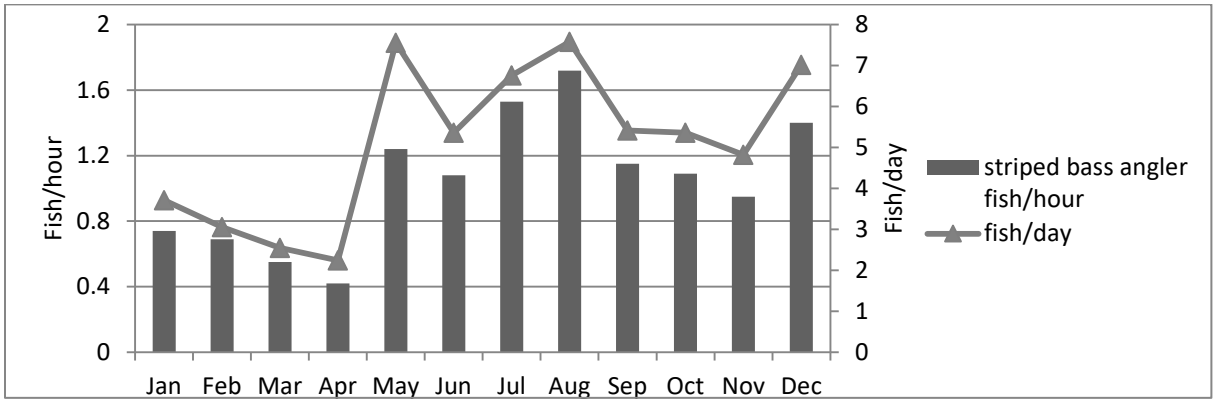

FIGURE 20. Striped Bass preference angler catch rates from the 2018 Lake Mead creel surveys.

Striped Bass CPUE during gill netting has been on a steady decline. It decreased from 1.2 fish/net-night last year to 0.84 fish/net-night this year (Table 13 and Figure 21). This was below the 26-year mean of 1.61 fish/net-night and was less than ±1 standard deviation of the mean (Figure 21). Proportional stock density (PSD, using equation 1) shows the population continues to be comprised mostly of small fish with only 5% of stock size (≥13 in [330 mm]) and greater sized Striped Bass being over 20 in (508 mm) (Figure 22). The length frequency distribution also shows this trend with only 6% of the sample greater than 20 in (508 mm) (Figure 23). The largest portion of harvest-sized fish was between 405 and 475 mm (15.9 and 18.7 in). One large Striped Bass was caught at Fire Cove in the Overton Arm and weighed in at 3,420 g (7.5 lbs) and measured 720 mm (28.3 in) TL. There was also a good show of young fish in the sample, an indication of successful spawning and recruitment (Figure 23).

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

(Equation 1)

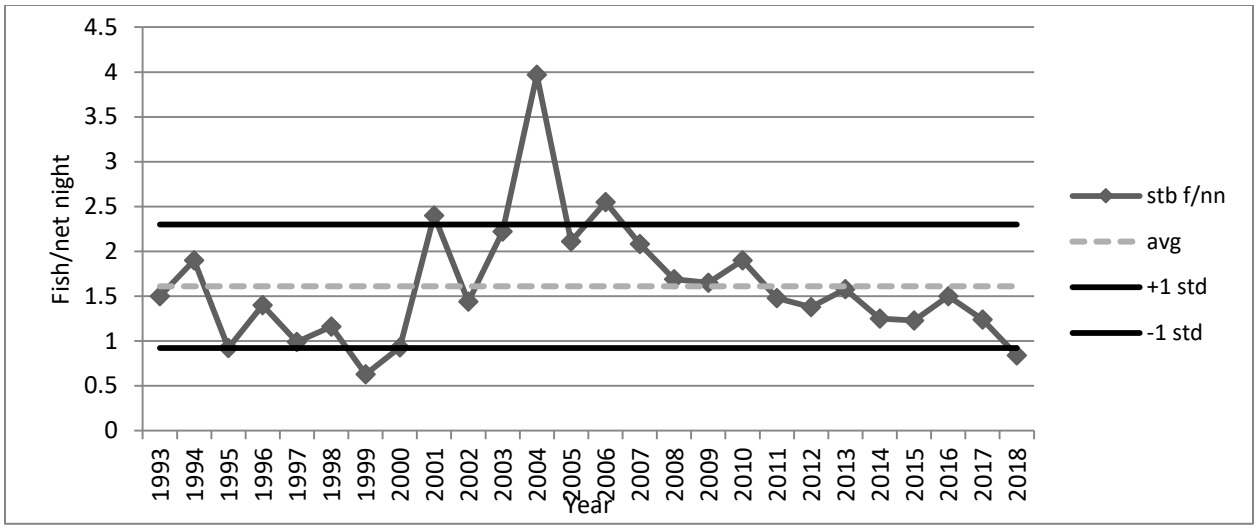

FIGURE 21. Striped Bass CPUE (fish/net-night) from the fall gill-net surveys, 1993-2018, with mean and 1 standard deviation.

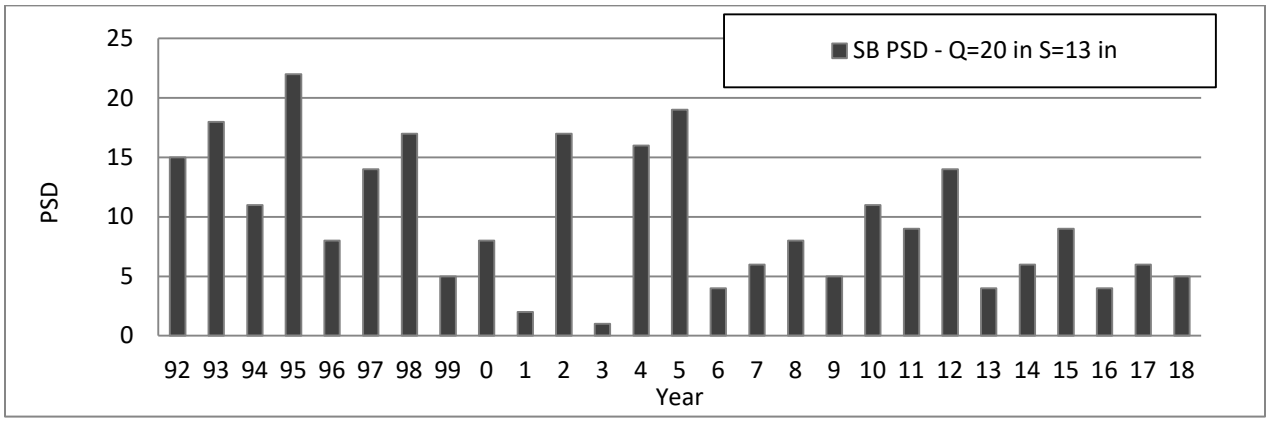

FIGURE 22. Striped Bass proportional stock density (PSD) from Lake Mead gill-net surveys, 1992-2018.

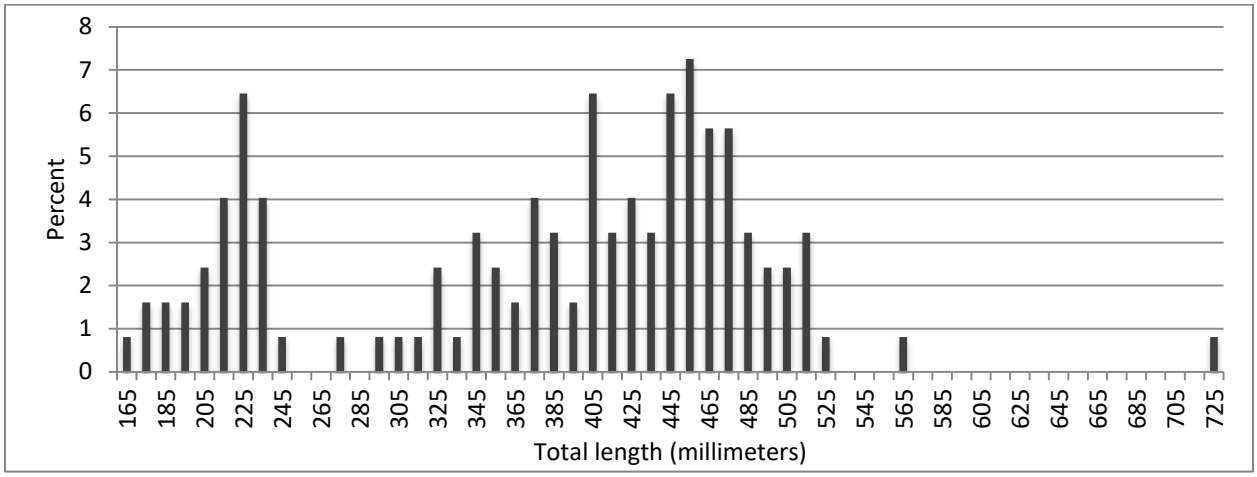

FIGURE 23. Striped Bass length frequency distribution from the 2018 fall gill-net survey on Lake Mead.

Striped Bass Stomach Content and Body Condition Analysis from Tournament Caught Fish

In addition to NDOW surveys, the Nevada Striper Club has volunteered data from tournaments held at Lake Mead 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 (March, June, September, and December). Data from the first 50 fish per tournament is collected, unless fewer fish are brought to the weigh-in or tournament members opt out to provide data. During the weigh-in, anglers place plastic tags on their four fish with their name and fish number. After the fish is weighed on tournament scales, the fish is measured by NDOW, information is recorded to match fish number with length and weight information, and then the fish is placed in a cooler of ice. After data from 50 fish is obtained, fish are taken to the cleaner where stomach contents are examined and recorded. Stomach contents are calculated as percentage of occurrence. Body condition is calculated using Fulton's K_{FL}. Scale samples and otoliths were obtained from 23 fish during June and September tournaments for use in the Striped Bass Aging Study (Appendix 1).

During tournaments in 2018, 208 fish were sampled and mean total length was 479 mm (18.9 in) and mean weight was 993 g (2.2 lbs). The average condition factor was 1.06, with 18% in poor condition and having a K_{FL}<1.0, a value that indicates a poor body condition. By season, the largest fish were caught in March, showing a mean total length of 497 mm (19.6 in) and a mean weight of 1,225 g (2.7 lbs). Body conditions were also the best in March averaging 1.19 K_{FL} (Table 17). The largest fish was caught in March, measuring 667 mm (26.3 in) TL and weighing 3,787 g (8.35 lbs). It was a female in excellent condition (K_{FL}=1.57) that consumed Gizzard and Threadfin Shad. The overall catch averaged 7.6 mm (0.3 in) longer and 91 g (0.2 lbs) heavier than last year's catch. Striped Bass were in satisfactory condition much of the year, except for September when 48% was in poor condition. By December, Striped Bass condition improved and 92% of the sample was in good condition.

Stomach contents reflect access to and availability of food resources. During most of the year, the main food items of striped bass were shad and other species of fish. In June, anchovy were found in 18% of the stomachs and crayfish in 2%. Small amounts of crayfish were seen in September and December as well (Table 17). Unlike last year, no quagga mussel or New Zealand mud snails were observed in stomachs, indicating striped bass likely had greater access to preferred food items. The reduced amount of shad and fish mass and the large amount of empty stomachs found in December (Table 17) were likely due to fish being caught at in deep water and expelling contents when brought to the surface.

Black Bass Fisheries Assessment

Summer snorkel surveys showed a higher abundance of Smallmouth Bass compared to Largemouth Bass in all age-classes. Fingerling Largemouth Bass observations were similar to last year at 2.1 fish/30 min dive, juvenile Largemouth Bass

observations dropped from last year to 0.3 fish/30 min and adult observations dropped from 0.94 to 0.20 fish/30 min. Overall, Largemouth Bass observations in 2018 dropped to 2.6 fish/30 min from 4.7 fish/30 min observed in 2017. Smallmouth Bass fingerling observations increased twofold in 2018 to 7.8 fish/30 min (Figure 7), while juveniles showed a small drop to 1.2 fish/30 min in 2018 from 1.6 fish/30 min in 2017 (Figure 8). Adult Smallmouth Bass also showed an increase in observations from 0.42 fish/30 min in 2017 to 0.70 in 2018 (Figure 9). Over the past four years, observations of Largemouth Bass in all age-classes have dropped. This coincided with a drop in lake elevation of 23 ft from July 2013 to July 2014. Increased Smallmouth Bass abundance possibly played a role in the reduction of Largemouth Bass numbers.

TABLE 17. Summary of stomach contents, total length, weight, and condition of tournament-caught Striped Bass samples from Lake Mead, 2018.

		% of food item by occurrence						Length, weight, and condition			
Date	*n*	Shad	Fish mass	Crayfish	Anchovy	Quagga mussel or clams	Empty	Mean length (mm)	Mean weight (g)	Mean condition K_{FL}	% below K_{FL} 1.0
3/11/2018	53	15	38	0	0	0	47	497	1,225	1.19	6
6/17/2018	44	26	18	2	18	0	36	450	815	1.07	14
9/16/2018	52	50	26	2	0	0	37	488	949	1.01	48
12/16/2018	59	13	15	4	0	0	68	479	984	1.11	8
Average								479	993	1.06	18
Total	208										

The electroshocking survey targeted shallow, littoral habitats, and typically caught small or YOY species. This year, Smallmouth Bass outnumbered Largemouth Bass 2:1, with a CPUE of 5.4 fish/15 min. This was opposite of last year, where Largemouth Bass CPUE was greater than that of Smallmouth Bass. These results support snorkel survey findings for fingerling bass. Fall gill netting showed no change in CPUE for both Largemouth Bass and Smallmouth Bass. Smallmouth Bass were still more abundant with a CPUE of 0.75 fish/net-night compared to 0.63 for Largemouth Bass. The Largemouth Bass CPUE was close to the 26-year mean of 0.62 fish/net-night (Figure 24) and Smallmouth Bass CPUE was well above the 11-year mean of 0.61 fish/net-night (Figure 25).

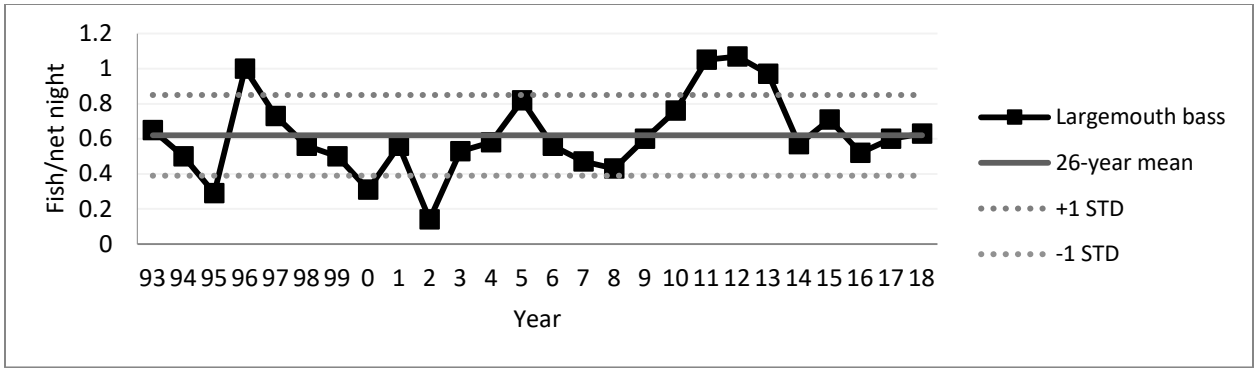

FIGURE 24. Largemouth Bass CPUE (fish/net-night) from fall gill-net surveys on Lake Mead, 1993-2018.

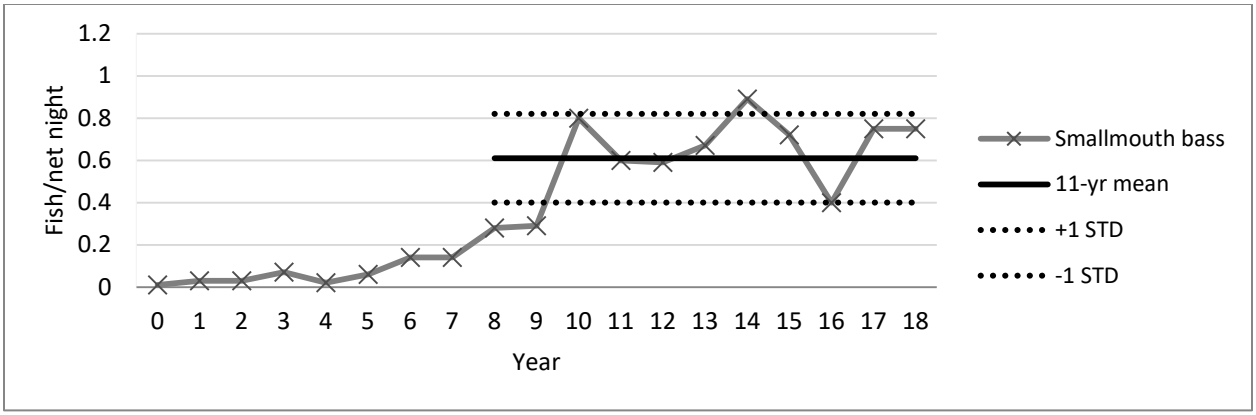

FIGURE 25. Smallmouth Bass CPUE (fish/net-night) from fall gill-net surveys on Lake Mead, 2000-2018.

From the lake-wide fall gill-net survey, the age structure of Largemouth Bass was made up of mostly fish less than 330 mm (13 in) TL (Figure 26). Two 5.0 lb fish measuring 550 and 555 mm (21.9 and 21.7 in) TL were caught, one at Ebony Cove and one at Plane Crash Island. PSD for this fishery showed an increase in the percentage of quality (≥12 in, 305 mm) and memorable length fish (≥20 in, 510 mm) using equation 2 (Figure 27). This was an improvement over last year as there was no memorable length fish. Largemouth Bass were also in good condition (W_r=88), and was similar to last year (W_r=87).

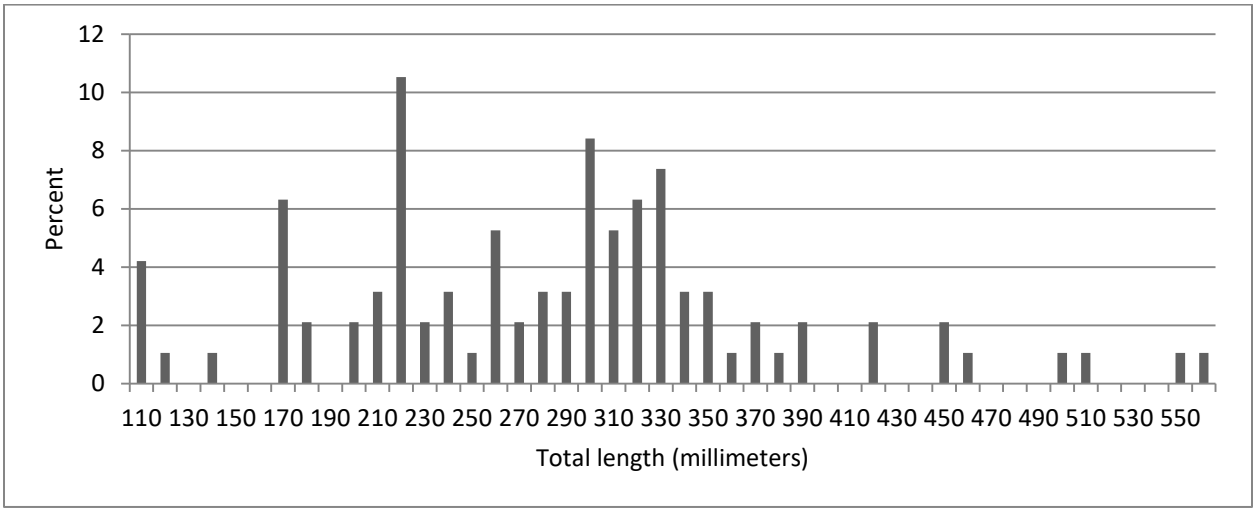

FIGURE 26. Largemouth Bass length frequency distribution from fish captured during the, 2018 Lake Mead gill-net survey.

From the fall gill-net survey, the size structure of Smallmouth Bass was comprised mostly of those 11 to 14 in (290 to 350 mm) TL (Figure 28). PSD (using equation 3) showed 81% of the sample was of quality length (≥11 in, 280 mm), 27% of preferred length (14 in, 350 mm) or greater, and 7% of memorable length (17 in, 432 mm) or greater (Figure 29). Results show an increase in quality, preferred, and memorable-sized fish. Two trophy-sized Smallmouth Bass were captured at East Point

and Miner's Cove, weighing 1,635 g (3.6 lbs) and 1,385 g (3.1 lbs), respectively. Smallmouth Bass averaged a W_r of 85, showing good body condition.

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)

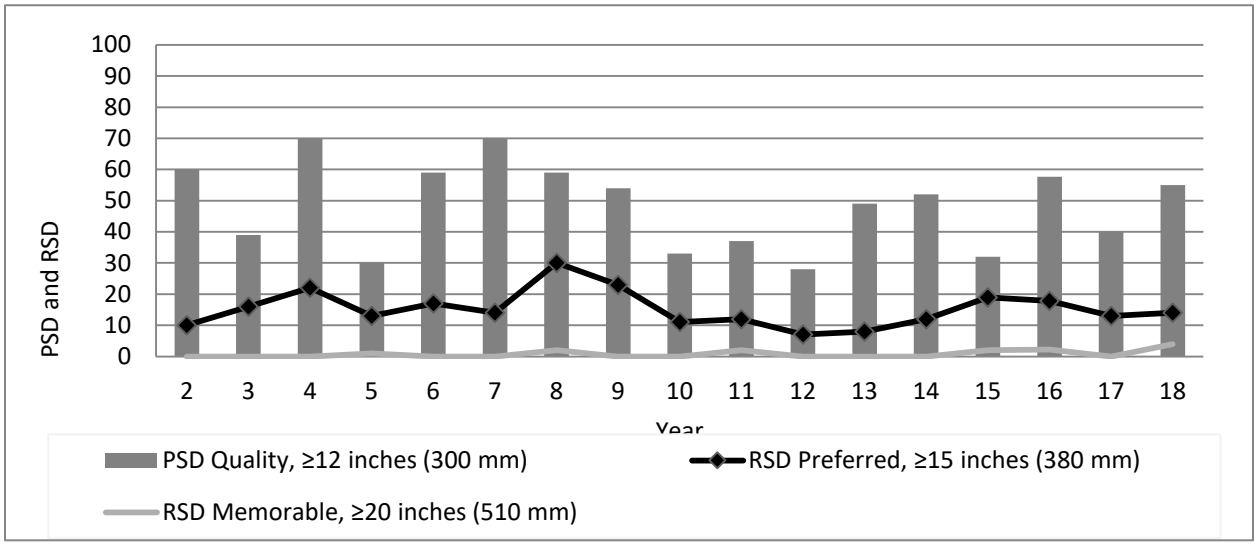

FIGURE 27. Largemouth Bass proportional stock density (PSD) and relative stock density (RSD) from fall gill-net surveys on Lake Mead, 2002-2018.

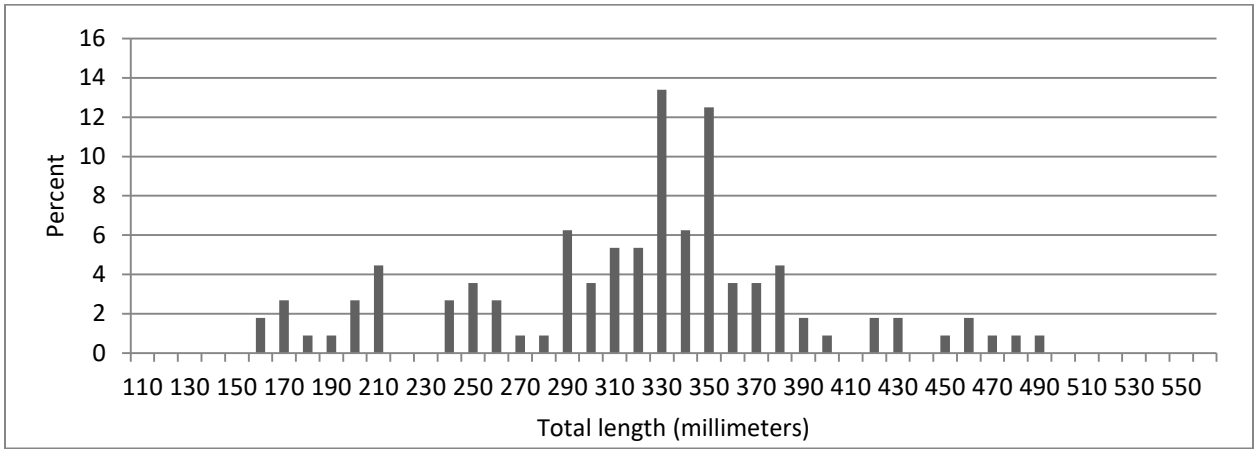

FIGURE 28. Smallmouth Bass length frequency distribution from fish captured during the 2018 Lake Mead gill-net survey.

Smallmouth Bass proportional stock densities given by the following equations:

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

$$\text{Smallmouth Bass RSD preferred length} = \frac{number\ of\ fish \geq 14\ in\ (35\ cm)}{number\ of\ fish\ \geq 7\ in\ (18\ cm)} \times 100$$

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

Equation adapted from Anderson and Neumann 1996 (3)

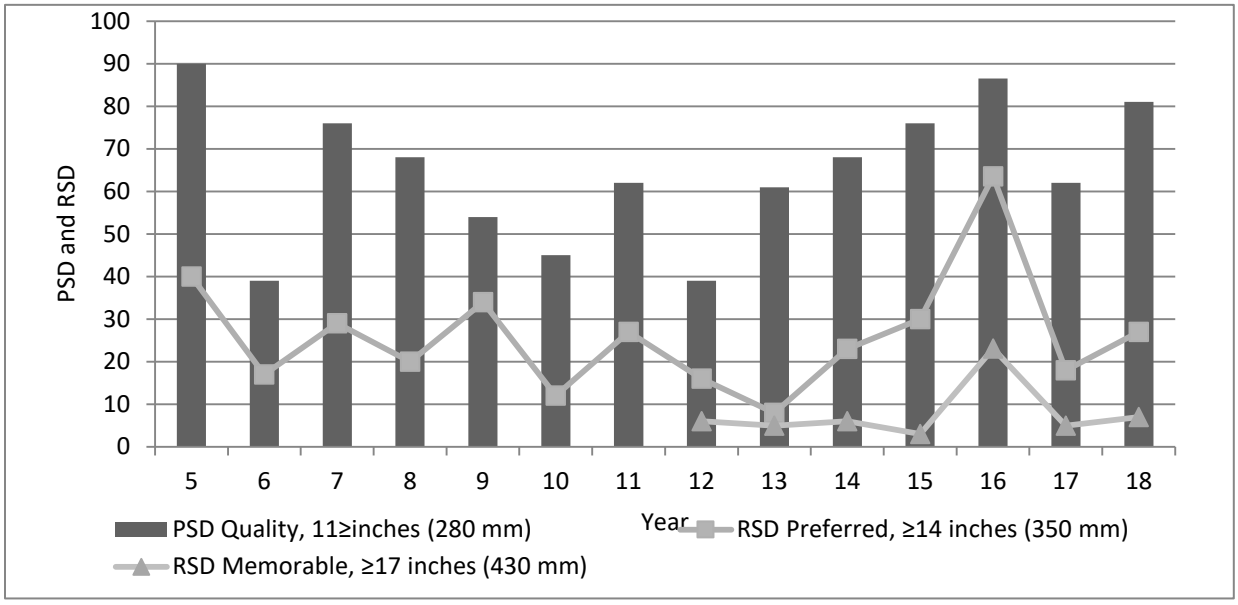

FIGURE 29. Smallmouth Bass proportional stock density (PSD) and relative stock density (RSD) from fall gill-net surveys on Lake Mead, 2005-2018.

Smallmouth Bass continue to be brought in large numbers to tournament weigh-ins. This year, Smallmouth Bass made up 54% of the weigh-in in U.S. Open in October. Samples taken from tournament mortalities found Largemouth Bass measured 378 mm (14.9 in) TL, had a mean weight of 683 g (1.5 lbs), and had an average W_r of 85. Smallmouth Bass had a mean total length of 377 mm (14.8 in), a mean weight of 668 g (1.5 lbs), and an average W_r of 79 (Table 6). Despite a decline in recreational angler use on Lake Mead, bass tournament use has been steady. The National Park Service permitted 48 bass tournaments in 2018, with 39 held on the Nevada side of the lake and nine on the Arizona side. Three of the Nevada tournaments were permitted for 100 or more anglers. The busiest months for bass tournaments were April and June with six and seven tournaments per month, respectively.

Channel Catfish

Channel Catfish CPUE during gill netting was 1.06 fish/net-night, compared to 0.64 fish/net-night last year, an increase of 0.42 fish/net-night (Table 11, Table 13). They were most abundant in Overton Arm at 2.02 fish/net-night. Their body condition was good with an average W_r of 81, a small decline from 2017m, and the mean total length declined slightly to 412 mm (16.2 in) (Figure 13). After four years of high PSD values near 70, the PSD dropped to 58 (Equation 4 and Figure 30). This is still higher than observed in 2006 through 2010 (Figure 30) and shows there is a large abundance of quality-sized catfish. The size distribution of Channel Catfish from this year's survey shows a large percentage of fish from 14 to 20 in (356 to 508 mm) (Figure 31). Two memorable-sized channel catfish were caught, one from Horsepower Cove measuring 727 mm (28.6 in) and weighing 4,020 g (8.9 lbs), and the other from Rogers Bay measuring 710 mm (28 in) and weighing 4,070 g (9.0 lbs). From creel surveys, angler preference and harvest of Channel Catfish remained low, with angling effort at 0.2% of the total effort and the lowest it has been in 10+ years (Table 3). Harvest was 2.9% of the total harvest (Table 2). Channel Catfish were the most abundant sport fish caught in the gill-net survey, outnumbering Striped Bass. Unfortunately, this fishery is under-utilized, despite the large amount of quality-sized fish available. Angler preference remains low, and nearly half of the catch is thrown back.

Channel Catfish proportional stock densities given by the following equations:

$$\text{Channel Catfish PSD quality length} = \frac{number\ of\ fish \geq 16\ in\ (41\ cm)}{number\ of\ fish\ \geq 11\ in\ (28\ cm)} \times 100$$

$$\text{Channel Catfish RSD preferred length} = \frac{number\ of\ fish \geq 24\ in\ (61\ cm)}{number\ of\ fish\ \geq 11\ in\ (18\ cm)} \times 100$$

Equation adapted from Anderson and Neumann 1996 (4)

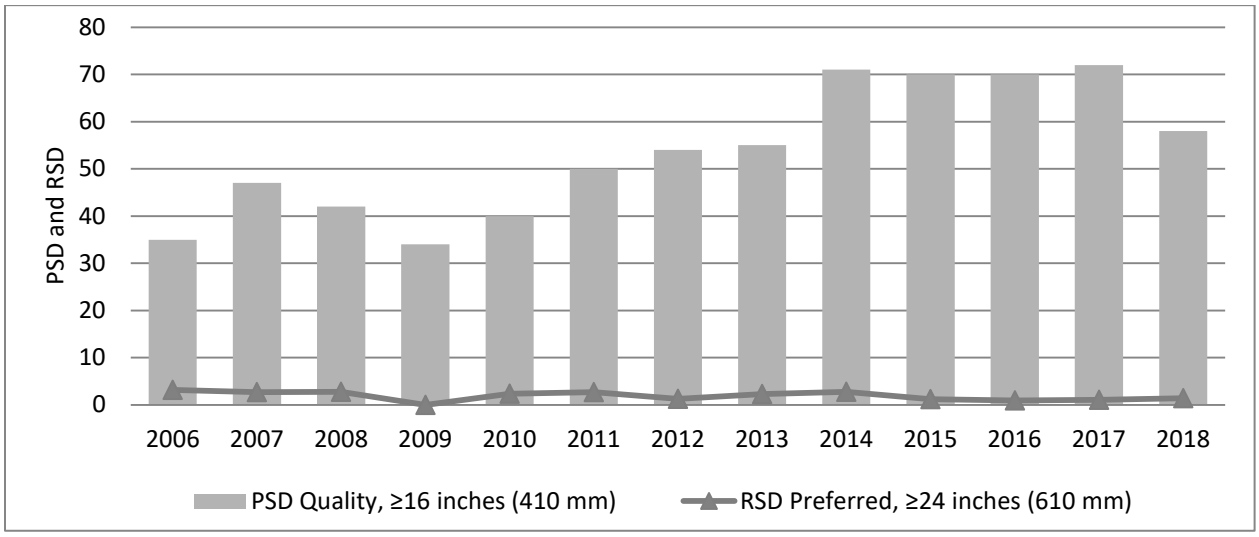

FIGURE 30. Channel Catfish proportional stock density (PSD) and relative stock density (RSD) from fall gill-net surveys on Lake Mead, 2006-2018.

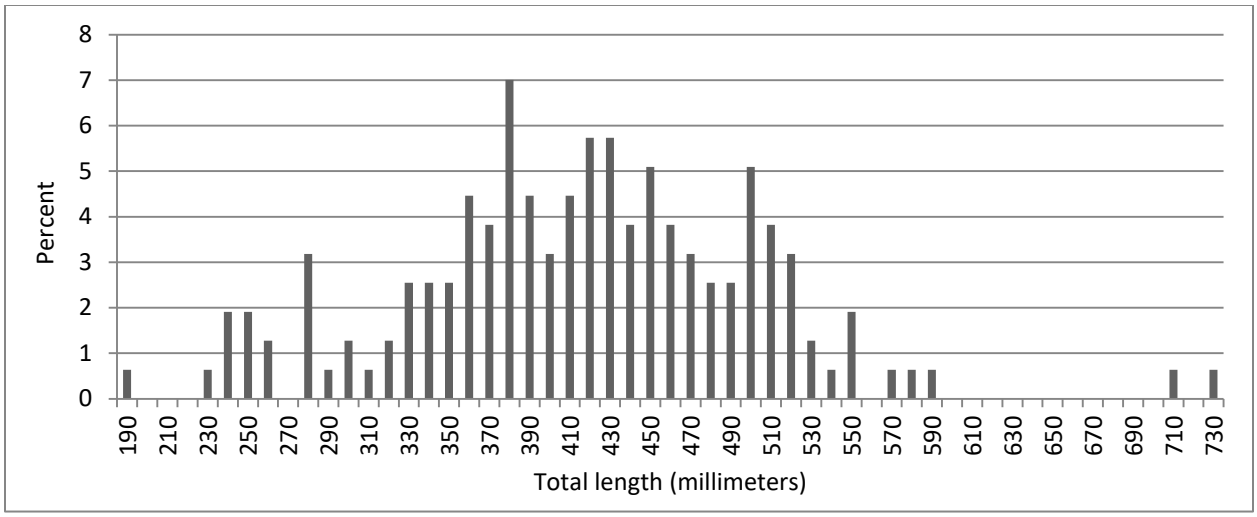

FIGURE 31. Channel Catfish length frequency distribution from the fall gill-net survey on Lake Mead, 2018.

Salmonid Fisheries Assessment

No trout were stocked and no trout species were captured during 2018 surveys in Lake Mead.

Lake Mead Fisheries Habitat Enhancement Study

Aquatic vegetation is important as protective cover for young fish, for providing aquatic invertebrates with a substrate, and as a place for adult bass to congregate and feed. With Lake Mead's fluctuating elevation, aquatic vegetation is limited. When the lake rises, shorelines flood and provide inundated tamarisk and other vegetation that benefit fish. However, these times are short lived and conditions soon return to an environment devoid of cover.

Artificial habitat has been used successfully in reservoirs to increase cover and attract fish for many years. 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, however, is to identify habitat structures that can be deployed in Lake Mead, to 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, habitat structures need to be moveable. This project takes place at Bass Cove in Lake Mohave (a surrogate study area for Lake Mead) under the current Lake Mohave Fisheries Enhancement Study. Upon successful demonstration of moving artificial habitat structures and their effectiveness in attracting fish, habitat structures will be proposed to the National Park Service for use in Lake Mead.

Approaches:

- Evaluate angler use and success at habitat locations through data collected in the general management creel survey program and opportunistic creel surveys at habitat sites.
- Evaluate effectiveness of habitat structures through hook and line sampling, and SCUBA.
- Develop strategy to move artificial habitat structures while they are submerged.

Habitat Assessment

During the first year of the study, potential habitat sites were located at Lake Mead, and from 2014 to 2017, 6 PVC cube structures (Figure 32; Figure 33), 122 reclaimed PVC siding (Fishiding) structures (Figure 34), and 4 catfish condos (Figure 35) were placed in Bass Cove (NDOW[b]). This year, no additional structures were added. The installed habitat was assessed through a spring gill-net survey, a spring electroshocking survey, a fall SCUBA dive survey, a fall trammel-net survey, a creel survey, underwater video survey, and a hook-and-line survey.

FIGURE 32. Three-cube PVC habitat structure.

FIGURE 33. Four-cube PVC habitat structure.

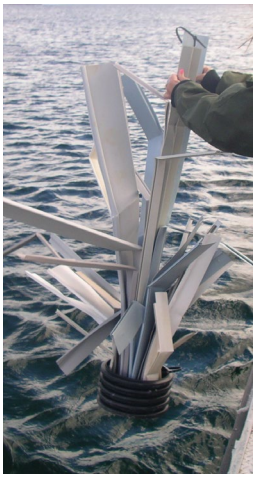

FIGURE 34. Reclaimed PVC (Fishiding) artificial habitat structure.

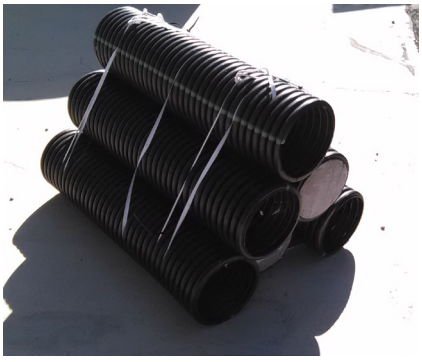

FIGURE 35. Catfish condo habitat structure.

Gill-Net Survey

The spring gill-net survey was part of the Lake Mohave General Sport Fish Management program and details can be found in the Federal Aid Job Progress Report F-20-54 for Lake Mohave (NDOW[c]). The gill-net survey was conducted between April 10 and May 10 and was a multi-agency effort with AZGFD and USBR. Sites were randomly selected by AZGFD and nets were set according to NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs for gillnetting warmwater species. Multifilament experimental gill nets were 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 no deeper than 40 ft (12 m). Fish were identified to species, weighed, measured, and released back to the lake. Gill and trammel nets are effective at catching larger body, catchable-sized fish, but they are much less effective at catching small bodied fish.

Fifty-one nets were set for one night, totaling 51 net-nights of effort. A net-night of effort defined as one net set overnight. NDOWs portion of the effort was 16 nets, and out of the 50 sites (total), seven nets were set at habitat sites. To assess the effectiveness of artificial habitats, the number of fish caught was compared to the lake-wide average and to non-habitat sites. The lake-wide CPUE was 6.27 fish/net-night, and non-habitat CPUE was 5.27 fish/net-night. By comparison, artificial habitat coves (i.e., Bass, Carp, Box, and Solicitor) showed a CPUE of 26.0, 11.0, 12.0, and 11.0 fish/net-night, respectively (Table 18). The southernmost habitat coves (i.e., Arrowhead, Shoshone, and Princess) showed much lower CPUE rates of 2.0, 4.0, and 4.0 fish/net-night, respectively.

TABLE 18. Spring gill-net survey summary, Lake Mohave, 2018.

Site	Number of fish	All fish CPUE	Number of sport fish	Sport fish CPUE	Number of black bass	Black bass CPUE
Lake-wide	320	6.27	194	3.80	44	0.86
Non-habitat coves	232	5.27	127	2.89	36	0.82
Habitat coves						
Bass Cove	28	28	26	26	1	1
Carp Cove	17	17	11	11	1	1
Box Cove	18	18	12	12	1	1
Solicitor Cove	15	15	11	11	4	4
Arrowhead Cove	2	2	0	0	0	0
Shoshone Cove	4	4	3	3	3	3
Princess Cove	4	4	2	2	0	0
Habitat cove averages				9.29		1.43

The lake-wide CPUE for sport fish only was 3.80 fish/net-night and for non-habitat coves was 2.89 fish/net-night. By comparison, habitat coves ranged from 0 to 26 sport fish/net-night (Table 18), with the northernmost habitat sites (i.e., Bass, Box, Carp, and Solicitor) having higher catch rates. Higher catch rates at artificial habitat sites were mostly attributed to large numbers of Channel Catfish (Table 19). From 120 Channel Catfish captured lake-wide, 54 (45%) were captured at habitat coves, with Bass Cove having the most (*n*=25). Black bass was caught from 1.0 to 4.0 black

bass/net-night in habitat coves compared to lake-wide and non-habitat cove averages of 0.86 and 0.82 fish/net-night, respectively (Table 18). Black bass CPUE from all habitat coves averaged 1.43 fish/net-night, with Solicitor and Shoshone coves showing the highest catch rate of 4.0 and 3.0 black bass/net-night, respectively.

TABLE 19. Number of sport fish by habitat site from the spring gill-net survey, Lake Mohave, 2018.

Site	Largemouth Bass	Smallmouth Bass	Striped Bass	Channel Catfish
Bass Cove	0	1	1	25
Carp Cove	0	1	0	10
Box Cove	1	0	1	11
Solicitor Cove	3	1	1	6
Arrowhead Cove	0	0	0	0
Shoshone Cove	3	0	0	0
Princess Cove	0	0	0	2
Total	7	3	3	54

Artificial habitat coves just north of Cottonwood Basin were found to attract more fish than non-habitat coves. Habitat Coves near Katherine Landing were not as successful, yet Shoshone Cove had one of the highest black bass catch rates within a habitat cove. Habitat coves near Cottonwood Basin attracted a large number of Channel Catfish, with Bass Cove generating the most. This particular region of the lake may be more suitable for catfish and catfish condos and Fishiding structures in Bass Cove may attract even more catfish.

Electroshocking Survey

Electroshocking surveys were carried out in the spring as part of the Lake Mohave General Fisheries Management program (NDOW[c]). Thirteen sites were surveyed and six coves had artificial habitat. NDOW sampled 10 sites. To assess the effectiveness of artificial habitat, sites were compared to the lake-wide average and to non-habitat sites. A Clark aluminum boat equipped with a Coffelt shocking boom and a Smith-Root VVP-15B Control Box was used according to methods described in NDOW's Sport Fish Sampling Guidelines for Lakes, Ponds, and Reservoirs. Fish were identified to species, measured, weighed, and released back to the lake. Each site was sampled for 900 s of "on" pedal time. Electroshocking surveys are effective for catching fish along the shoreline and are less effective at depths greater than 5.0 ft. Habitat structures were typically found at depths of 15 to 30 ft.

The spring survey yielded 330 fish for a lake-wide CPUE of 25.4 fish/15 min. When analyzing sport fish, the lake-wide CPUE was 8.5 fish/15 min (Table 20). Bass Cove was below (habitat site) the lake-wide average CPUE for all fish at 20 fish/15 min; however, for sport fish, Bass Cove was above the lake-wide/non-habitat cove CPUE at 19 fish/15 min. This was due to the 17 channel catfish captured at Bass Cove (Table 21). Box and Shoshone coves were slightly above the lake-wide average for all fish at 27 and 26 fish/15 min, respectively. All other habitat coves were below the lake-wide/non-habitat cove CPUE for all fish. Concerning sport fish, Box Cove was slightly

higher than the lake-wide/non-habitat cove average with a CPUE of 9.0 fish/15min (Table 20). When combining all habitat coves and comparing the average sport fish CPUE of 8.5 fish/15 min to the lake-wide/non-habitat cove CPUE, there was no difference (Table 20).

TABLE 20. Spring electroshocking survey summary, Lake Mohave, 2018.

Site	# fish	All fish CPUE	# sport fish	sport fish CPUE
Lake-wide (13 sites)	330	25.4	111	8.5
Non-habitat coves only	216	30.9	60	8.6
Habitat coves				
Bass Cove	20	20	19	19
Box Cove	27	27	9	9
Carp Cove	8	8	2	2
Solicitor	18	18	8	8
Prospect	15	15	6	6
Shoshone	26	26	7	7
All habitat coves	114	19	51	8.5

TABLE 21. Sport fish counts from the spring electroshocking survey, Lake Mohave, 2018.

Site	Largemouth Bass	Smallmouth Bass	Striped Bass	Channel Catfish	Total sport fish
Lake-wide (13 sites)	25	43	5	38	111
Non-habitat coves only	11	26	4	18	59
Habitat coves					
Bass Cove	0	2	0	17	19
Box Cove	1	8	1	0	10
Carp Cove	0	1	0	1	2
Solicitor	5	1	0	2	8
Prospect	5	1	0	0	6
Shoshone	3	4	0	0	7
All habitat coves	14	17	1	20	32

Bass Cove attracted Channel Catfish more than any other cove in the survey. The 17 catfish were adults ranging from 426 to 614 mm (16.8 to 24.2 in) TL and 1,120 to 2,545 g (2.5 to 5.6 lbs). There were not many black bass at Bass Cove, though there were two Smallmouth Bass measuring 162 and 179 mm (6.4 and 5.5 in) TL. Other habitat coves were more successful in attracting black bass such as Box, Solicitor, Prospect, and Shoshone coves, with six or more (Table 21).

Fall Trammel-Netting Survey

Four trammel nets 150 ft (45.7 m) length X 1.5 in (3.8 cm) mesh were set the afternoon of November 19 at Bass Cove (habitat site) and Painted Canyon Cove (non-habitat site) to assess and compare fish abundance. Trammel nets were used instead of gill nets due to the potential of Razorback Sucker to inhabit the area and to avoid injury. Two nets were set at Bass Cove with one net set perpendicular to the northern shoreline, closest to the habitat, and the other placed on the western shoreline near

habitat. At Painted Canyon Cove, two nets were set, one at the northern shoreline and the other placed at the western shoreline (Figure 36). The nets were placed overnight and pulled the next morning between 0845 and 1100 hrs. Fish were identified to species, measured, weighed, and returned to the lake. Abundance was calculated as number of fish/net-night, with a net-night defined as one net set overnight for 12 hours. Bass Cove had 2.81 net-nights of effort and Painted Canyon Cove had 3.13 net-nights.

FIGURE 36. Satellite image of the Bass and Painted Canyon coves netting sites and their proximity to the Cottonwood Cove Marina at Lake Mohave, Clark County, NV. Google Earth, accessed 12/10/2018.

Bass Cove

At Bass Cove, nets caught 25 fish consisting of five species, the most numerous being 11 Largemouth Bass for a CPUE of 3.9 fish/net-night. Common Carp was the next most numerous with seven fish for a CPUE of 2.5 fish/net-night followed by Bullhead, Channel Catfish, and Smallmouth Bass. Largemouth Bass was the predominant sport fish. Only one each of Smallmouth Bass and Channel Catfish were caught and no Striped Bass were captured this year. The sport fish CPUE (13 fish) was 4.6 fish/net-night (Table 22).

Largemouth Bass ranged from 287 to 461 mm (11.3 to 18.1 in), with a mean total length of 360 mm (14.0 in) (Table 22). The distribution of lengths made up two groups, with half of the fish measuring between 287 and 319 mm (11.3 and 12.6 in) TL and the

other half measuring between 400 and 461 mm (15.7 and 18.1 in) TL (Figure 37). Largemouth Bass weighed between 320 and 1,750 g (0.7 and 3.9 lbs), with a mean weight of 839 g (1.8 lbs). The only Smallmouth Bass was a large 502 mm (19.8 in) TL and weighed 2,070 g (4.6 lbs) (Figure 38). One Channel Catfish was caught and measured 442 mm (17 in) TL and weighed 700 g (1.5 lbs) (Table 22).

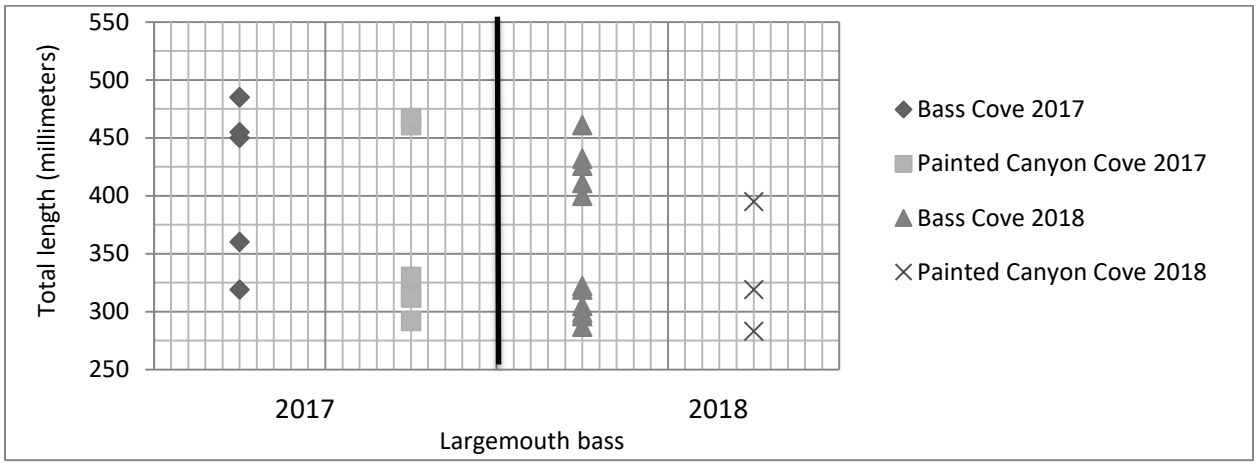

FIGURE 37. Comparison of Largemouth Bass size distributions from Bass Cove and Painted Canyon Cove trammel netting, Lake Mohave, Clark County, NV, 11/20/2018.

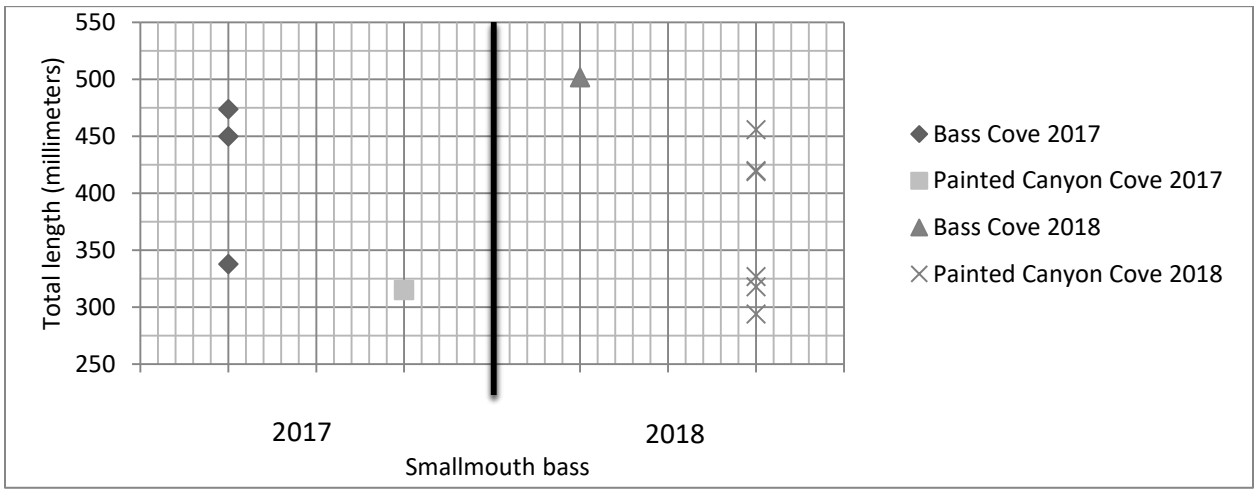

FIGURE 38. Comparison of Smallmouth Bass size distributions from Bass Cove and Painted Canyon Cove trammel netting, Lake Mohave, Clark County, NV, 11/20/2018.

Painted Canyon Cove

Trammel netting yielded 22 fish consisting of eight species for a CPUE of 7.04 fish/net-night. The most numerous species was Smallmouth Bass, with six caught for a CPUE of 1.92 fish/net-night. The next most abundant fishes were Largemouth Bass, Channel Catfish, Common Carp, and Gizzard Shad, with three of each being caught for a CPUE of 0.96 fish/net-night for each. One Bullhead and one Razorback Sucker were also captured (Table 22). The sport fish CPUE was 3.8 fish/net-night.

TABLE 22. Bass Cove fall trammel net catch summary at Lake Mohave, 2018.

Species	*n*	CPUE (fish/net-night)	Comp (% of catch)	Mean total length		Mean weight	
				mm (in)	Range mm (in)	g (lbs)	Range g (lbs)
Bluegill	0	---	---	---	---	---	---
Bullhead	5	1.8	20	283 (11.1)	254-318 (10-12.5)	318 (0.7)	220-420 (0.5-0.9)
Common Carp	7	2.5	28	317 (12.5)	259-376 (10.2-14.8)	441 (1.0)	230-690 (0.5-1.5)
Channel Catfish	1	0.4	4	442 (17.4)	---	700 (1.5)	---
Gizzard Shad	0	0	---	---	---	---	---
Largemouth Bass	11	3.9	44	360 (14.2)	287-461 (11.3-18.1)	839 (1.8)	320-1,750 (0.7-3.9)
Razorback Sucker	0	---	---	---	---	---	---
Smallmouth Bass	1	0.4	4	502 (19.8)	---	2,070 (4.6)	---
Striped bass	0	---	---	---	---	---	---
Totals	25	8.9	100				

Largemouth Bass ranged from 283 to 395 mm (11.1 to 15.6 in), with a mean total length of 332 mm (13 in), and from 320 to 1,750 g (0.7 to 3.9 lbs), with a mean weight of 597 g (1.3 lbs) (Table 23). Overall, Largemouth Bass caught in Painted Canyon Cove were smaller than those caught in Bass Cove (Figure 37). Painted Canyon Cove also had more Smallmouth Bass than Bass Cove, which showed variable sizes ranging from 294 to 456 mm (11.6-18.0 in) and a mean of 372 mm (14.6 in) TL (Table 23; Figure 38). Weights ranged from 350 to 1,330 g (0.8 to 2.9 lbs), with a mean of 822 g (1.8 lbs) (Table 23). Channel Catfish were also more abundant and larger in Painted Canyon Cove than in Bass Cove. The three Channel Catfish ranged from 440 to 604 mm (17.3-23.8 in) TL, with a mean of 520 mm (20.5 in) TL. Weights were heavier than the Channel Catfish caught in Bass Cove and ranged from 730 to 2,150 g (1.6 to 4.7 lbs), with a mean of 1,483 g (3.3 lbs) (Table 23).

One Razorback Sucker was captured in Painted Canyon Cove measuring 559 mm (22 in) TL and weighing 2,000 g (4.4 lbs). It was scanned and found to be a recapture originally reared at Willow Beach National Fish Hatchery, released in 2010 in Lake Mohave, recaptured by USBR in 2011 below Hoover Dam, before being recaptured in this survey (Table 24) (information based on the native fish database managed by Marsh and Associates). The fish had grown 134 mm (5.3 in) and traveled some 40 mi since its initial release nearly eight years ago.

When comparing fish abundance between the two sites, Bass Cove showed a slightly higher sport fish CPUE of 4.6 fish/net-night compared to Painted Canyon Cove at 3.8 fish/net-night. The fish assemblage was also different. Painted Canyon Cove had more Smallmouth Bass and Bass Cove had more Largemouth Bass (Figure 39). Additionally, Largemouth Bass at Bass Cove were larger, and while there was only one Smallmouth Bass caught at Bass Cove, it too was larger.

TABLE 23. Painted Canyon Cove fall trammel net catch summary, Lake Mohave, 2018.

Species	*n*	CPUE (fish/net-night)	Comp (% of catch)	Mean total length		Mean weight	
				mm (in)	Range mm (in)	g (lbs)	Range g (lbs)
Bluegill	2	0.64	9	251 (9.9)	207-294 (8.1-11.6)	250 (0.6)	150-350 (0.3-0.8)
Bullhead	1	0.32	4	300 (11.8)	---	380 (0.8)	---
Common Carp	3	0.96	14	438 (17.2)	320-590 (12.6-23.2)	1,393 (3.1)	430-2,850 (0.9-6.3)
Channel Catfish	3	0.96	14	520 (20.5)	440-604 (17.3-23.8)	1,483 (3.3)	730-2,150 (1.6-4.7)
Gizzard Shad	3	0.96	14	273 (10.7)	262-283 (10.3-11.1)	190 (0.4)	150-230 (0.3-0.5)
Largemouth Bass	3	0.96	14	332 (13.1)	283-395 (11.1-15.6)	597 (1.3)	320-1,020 (0.7-2.2)
Razorback Sucker	1	0.32	4	55 (22.0)	---	2,000 (4.4)	---
Smallmouth Bass	6	1.92	27	372 (14.6)	294-456 (11.6-18.0)	822 (1.8)	350-1,330 (0.8-2.9)
Striped Bass	0	---	---	---	---	---	---
Totals	22	7.04	100				

TABLE 24. Razorback Sucker capture history of fish captured at Painted Canyon Cove, November 21, 2018.

PIT tag number	Capture date	Location	Collector	Total length (mm)	Weight (g)
3D9.1C2D7452E8	11/21/2018	Painted Canyon Cove	NDOW	559	2000
	9/15/2011	Below Hoover Dam	USBR	495	1485
	1/7/2010	Repatriate release Willow Beach NFH	USBR	425	-

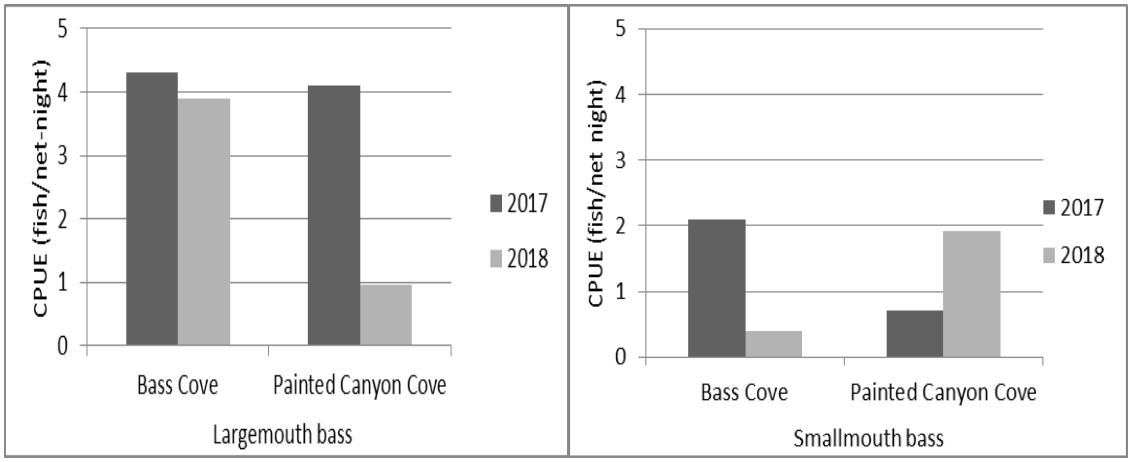

FIGURE 39. Comparison of Smallmouth Bass and Largemouth Bass CPUE at Bass Cove and Painted Canyon Cove, Clark County, NV, 2017 and 2018.

Comparing 2018 with 2017, Largemouth Bass CPUE at Bass Cove was nearly the same as last year, while the CPUE at Painted Canyon Cove dropped from that of last year (Figure 39). For Smallmouth Bass, the CPUE dropped in Bass Cove, yet increased in Painted Canyon Cove. These results indicate Bass Cove tends to hold mostly Largemouth Bass during the fall, but not necessarily Smallmouth Bass. Largemouth Bass also tend to be bigger in Bass Cove.

This year, trammel-netting results showed a similar trend to last year with larger fish found in habitat coves. It is possible that larger bass prefer the habitat structures and tend to drive off smaller bass into less desirable areas. This year there were fewer Smallmouth Bass at Bass Cove. There was also a large amount of natural vegetation at the Bass Cove site, much more than the Painted Canyon Cove site. The large amount of vegetation was likely more suitable to Largemouth Bass needs and was possibly why fewer Smallmouth Bass were found at Bass Cove this year. The survey this year was conducted in November; however, it was conducted in December last year. Consequently, the vegetation at Bass Cove may have died off by December making conditions better for Smallmouth Bass.

Creel Surveys

A total of six days of contact creel surveys were conducted at Cottonwood Cove (NDOW[c]) and no opportunistic creel surveys were carried. Anglers were asked where they fished, if they were aware of coves containing artificial habitat, and if they have ever fished these areas. They were also asked the amount of effort, species desired, fishing meth, bait used, and state of origin.

Out of 27 anglers, none reported fishing in habitat coves, though 33.3% were aware of the habitat project and 14.8% have previously fished at habitat coves. This year, the creel surveys did not collect enough information to assess angler success at Bass Cove or the other habitat sites.

Hook-and-Line Sampling

Due to difficulties in contacting anglers fishing habitat coves, hook-and-line sampling was used to help assess fishing success at Bass Cove. Bass Cove was sampled on two occasions, along with fishing a non-habitat cove (Table 25). No fish were caught during 75 min of angling. Sampling in the summer may have been more successful; however, no sampling was done in summer due to other obligations.

TABLE 25. Summary of hook-and-line sampling, 2018.

Date	Location	Minutes	Catch
1/30/2018	Bass Cove	20	0
	Painted Canyon Cove	10	0
	Arizona Cove	15	0
4/23/2018	Bass Cove	15	0
	North Basin Light Cove	15	0
Total		75	

Video Sampling

A GoPro™ Hero 4 was used to video habitat and non-habitat coves to assess fish attraction to structures and distribution at different times of the year. The boat was positioned as close to the habitat as possible and the camera was lowered on a rope. Black bass were observed at Bass Cove at each sampling date, yet the numbers were low (Table 26). In March and April, the non-habitat Coves showed more black bass than Bass Cove. On a brief visit to Box Cove (adjacent to Bass Cove) in April, a school of black bass fry was observed on a pallet/brush structure, indicating successful spawning in the area. Using a GoPro™ to monitor fish abundance/distribution does not necessarily allow for accurate results. As the camera moves around, and fish move in and out of frame, some fish may be counted more than once or may be missed. It seems to work better in examining presence/absence of fish.

TABLE 26. Summary of video sampling of habitat (H) coves and non-habitat coves, 2018.

Date	Location	Video minutes	Total fish	Fish/min	Species
1/30/2018	Bass Cove (H)	41.25	2	0.05	2 black bass
	Painted Canyon Cove	9.83	0	0	None
	Arizona Cove	18.13	0	0	None
3/23/2018	Bass Cove (H)	27.5	2	0.07	1 black bass; 1 unidentified fish
	Tequila Cove	24	14	0.58	5 black bass; 5 catfish; 3 unidentified fish
4/23/2018	Bass Cove (H)	40.92	2	0.05	1 adult black bass; 1 yearling black bass
	Box Cove (H)	4.2	150	35.7	150 larval black bass
	N. Basin Light Cove	28.72	29	1.0	25 bluegill, 3 adult black bass; 1 carp
Total		194.55			

SCUBA Survey

A SCUBA survey was carried out on August 28, 2018 to assess the fish community occupying habitat structures at Bass Cove and neighboring Solicitor Cove. Two divers performed timed fish counts, a stopwatch was used to time only the observation time at each structure and not the time spent swimming between structures. Structures were identified as PVC, reclaimed siding (Fishiding), brush bundle, or catfish condo. The maximum dive depth at Bass Cove was 30 ft (9.1 m) and the average dive depth was 17 ft (5.2 m). The maximum dive depth at Solicitor Cove was 31 ft (9.5 m) and the average dive depth was 21 ft (6.4 m). The water temperature at both sites was 82°F (27.8°C).

Bass Cove

Seven Largemouth Bass, three Smallmouth Bass, and eight sunfish were found around PVC cube structures (Table 27) at a rate of 3.3 bass/dive-min, and 2.7

sunfish/dive min (Table 28). Four juvenile Smallmouth Bass were observed on the Fishiding structures at a rate of 2.0 bass/dive-min. No Channel Catfish were seen around catfish condos or other structures. The PVC structures attracted more fish than any other structure types. Fingerling black bass and sunfish were more attracted to PVC structure and Smallmouth Bass juveniles were more attracted to Fishiding structures (Table 27).

TABLE 27. Bass Cove SCUBA survey observations by structure type and species (Largemouth Bass [LMB], Smallmouth Bass [SMB], sunfish [Bluegill or Green Sunfish], and Channel Catfish) at Lake Mohave, 2018.

Structure type	Survey time	LMB fingerling	LMB juvenile	LMB adult	SMB fingerling	SMB juvenile	SMB adult	Sunfish	Channel Catfish
Fishiding	2 min	0	0	0	0	4	0	0	0
Catfish condos	30 sec	0	0	0	0	0	0	0	0
PVC	3 min	6	1	0	3	0	0	8	0
Totals	5.5 min	6	1	0	3	3	0	8	0

TABLE 28. SCUBA survey fish observation rates by cove, structure type, and species (Black Bass [bass], sunfish [Bluegill or Green Sunfish], and Channel Catfish [CC]) at Lake Mohave, 2018.

Site	Structure type	Survey minutes	Bass/min (Bass/structure)	Sunfish/min (sunfish/structure)	CC/min (CC/structure)
Bass Cove	PVC	3	3.3 (3.3)	2.7 (2.7)	0 (0)
	Fishiding	2	2 (4)	0 (0)	0 (0)
	Catfish condo	0.5	0	0	0
Solicitor Cove	PVC	6.75	7 (5.4)	2.7 (3)	0.4 (0.4)
	Brush	10.15	2.9 (3.2)	10.1 (11.4)	0 (0)

An important observation was the large amount of thick, natural vegetation on the bottom between habitat structures. A few Bluegill were observed in this vegetation, but visibility was somewhat poor and there could have been more. Natural vegetation and cover may be preferred by some species over the artificial habitat structures, which may account for low numbers of fish observed during this dive. In addition, at the end of the dive when approaching the shoreline, a school of approximately 50 Striped Bass fingerlings was observed over a substrate of sand and cobble. While no Striped Bass was observed near habitat structures, the presence of structures in this cove may have an influence on the fish assemblage in the entire cove.

Solicitor Cove

The Solicitor Cove SCUBA survey was conducted on the northern side of the cove for 16.9 survey minutes. There were 86 black bass observations on PVC and brush bundle structures, as well as 121 sunfish and three Channel Catfish (Table 29).

The PVC structures attracted the most black bass with an observation rate of 7.0 bass/min (5.4 bass/structure) while the brush bundles showed 2.9 bass/min (3.2 bass/structure). The brush bundles attracted more sunfish at 10.1 fish/min (11.4 sunfish/structure), compared to the 2.7 fish/min (3.0 sunfish/structure) on PVC structures (Table 28).

TABLE 29. Solicitor Cove SCUBA survey observations by structure type and species (Largemouth Bass [LMB], Smallmouth Bass [SMB], sunfish [Bluegill or Green Sunfish], and Channel Catfish).

Structure type	Survey time	LMB fingerling	LMB juvenile	LMB adult	SMB fingerling	SMB juvenile	SMB adult	Sunfish	Channel Catfish
PVC	6.75 min	19	0	0	24	4	0	18	3
Brush	10.15 min	14	0	1	13	0	1	103	0
Totals	16.9 min	33	0	1	37	4	1	121	3

Fish counts on the habitat structures at both coves seemed low for this time of the year. The large amount of low-lying natural vegetation in Bass Cove may have been preferred over artificial structures. Black bass counts on PVC cube structures were higher at Solicitor Cove than at Bass Cove. The addition of natural brush to the PVC cube structures at Solicitor Cove may be the reason for higher black bass counts, as older PVC structures at Solicitor Cove lacking brush had few fish associated with them. Sunfish numbers on PVC structures were similar between the two coves at 2.7 sunfish/min. The brush bundles were by far more effective at attracting sunfish than PVC structures, with an observation rate of 10.1 sunfish/min. No adult black bass were observed at Bass Cove, though there were juveniles on Fishiding structures, and only two adults were seen at Solicitor Cove. A high water temperature (82°F) may have influenced the number of bass observed. It is expected that larger black bass will seek cooler water in summer.

During the summer of 2018, staff completed a Search and Recovery dive training in preparation for moving habitat structures. During the August SCUBA survey, staff practiced using lift bags to recover an anchor near a PVC structure at Bass Cove. Since the project was successful, lift bags will be used to move PVC structures and other habitat structure types next year.

Lake Mead Smallmouth Bass Age and Growth Study

Smallmouth Bass were first documented in Lake Mead in 1999 by showing up in small numbers in tournament catches. They were captured in gill-net surveys for the first time in 2000. The initial catches were limited to Overton Arm, and it is unknown how Smallmouth Bass came to Lake Mead, as they were not purposely stocked. By 2010, their abundance equaled that of Largemouth Bass and they were found throughout the lake. They are now commonly found in fisheries surveys and tournament catches, and have become an important sport fish for Lake Mead anglers. Currently, little is known about Smallmouth Bass growth rates in Lake Mead. The purpose of this study is to develop a length at age table using analysis of hard body

parts (e.g., scales and otoliths) and back calculation of past growth to understand growth rates in Lake Mead.

Approaches:

- Obtain scale samples from Smallmouth Bass captured from trammel netting, gill netting, electroshocking, and bass tournaments during the fall. Otoliths will be collected from mortalities.
- Collect samples over a three-year period with a record of date, location, GPS coordinates, length, and weight data for each fish.
- During general management activities, mark Smallmouth Bass with Floy tags to observe growth from recaptured fish and to validate back calculated growth during scale analysis. When fish are tagged, scales will be collected along with date, length, weight, location, and GPS coordinates.
- Analyze and age scales using a microscope with camera, or by using a microprojector or microfiche projector.
- Develop an age at length table and an analysis of Smallmouth Bass population age structure.

PROCEDURES

Over a three-year period, 300 scale samples and 244 otoliths from Small Mouth Bass were collected from gill netting, trammel netting, and tournament-caught mortalities in Lake Mead (Table 30 and Appendix 1). Scales were removed from the left side of the fish just behind the pectoral fin using a scraping motion with a knife. Scales and otoliths were placed into labeled scale envelopes. For scale preparation, the scales were cleaned by placing in warm water and then rubbing debris off with a paper towel. The cleaned scales were then mounted between glass microscope slides with either five or six scales per slide. The slides were labeled with sample number, species, and date fish was collected. The fish length data was kept separate from the scales to avoid any influence it may have in aging. Initially in 2015 and 2016, many scale samples were obtained without accompanying otoliths, and after aging attempts, it was found that an otolith was needed in most cases to help in accurately aging fish. In 2017, most scale samples were taken from mortalities so that otoliths could also be used in this study.

TABLE 30. Number of Smallmouth Bass scales and otoliths collected by year and by survey type, 2015-17.

Survey type	2015		2016		2017	
	Scales	Otoliths	Scales	Otoliths	Scales	Otoliths
Gill-net	23	9	13	8	10	8
Tournaments	104	80	81	77	63	62
Trammel netting	0	0	6	0	0	0
Total	127	89	100	85	73	70

Otoliths were viewed in both whole and sectioned forms. Whole otoliths were cleaned, placed concave side up in a petri dish filled with water, placed on a black background base, and viewed on a zoom stereo dissecting microscope with reflected

light as described in Miller 1966. Additionally, sectioned otoliths were prepared by breaking the otolith in half dorsoventrally at the focus. The broken ends were sanded using a variable speed drill using a 13 cm sanding disk (Maceina 1988) having 320 grit sandpaper. The smoothed end was cemented to a microscope slide and was then the top of the otolith was sanded down to approximately 1.0 mm. The sectioned otolith was examined under a dissecting microscope with immersion oil to clarify the annuli.

Scales were photographed at 10X using a 3-megapixel camera, and measurements were taken using calibrated measuring software that accompanied the camera and microscope (AmScope Model SH-2T-C2-3MT). Regenerated scales and scales that were difficult to read were not used. Back calculation of annular growth was achieved by using the direct proportion method (Devries and Frie 1996). Prior to aging scales, whole and sectioned otoliths were aged to help with accurate aging of scales.

In addition to collecting scale and otolith samples for aging, Smallmouth Bass were Floy-tagged to obtain observed growth data. Floy tags were given to 41 Smallmouth Bass from 2015 to 2018 (Appendix 2). Only five of these fish were caught and reported after their initial release. They had only been tagged 28 days or less before they were captured, so little to no growth was observed. Therefore, this portion of this study did not provide any useful growth information.

RESULTS

A total of 199 scales and otoliths were used in the final aging. These fish ranged in total length from 158 to 495 mm (6.2 to 19.5 in). The youngest was age 2 and the oldest fish was age 8 (Table 31). No age 1 fish were found, however, the back calculated length of 86 mm for age 1 fish is consistent with the electroshocking catch data for young Smallmouth Bass averaging 110 mm and ranging in size from 60 to 180 mm TL. These results are comparable to the aging of Smallmouth Bass on Lake Powell and other North American waters (Table 32), with Lake Mead Smallmouth Bass being slightly large at ages 3 and older.

TABLE 31. Mean estimated back calculated lengths for Smallmouth Bass scales collected 2015-2017.

Year class	*n*	Back calculated total lengths (mm) at annulus							
		1	2	3	4	5	6	7	8
2015	1	105	153						
2013	10	94	183	247	297				
2012	42	92	194	274	325	360			
2011	50	85	180	264	313	345	357		
2010	54	76	162	254	310	350	380	411	
2009	29	86	175	246	299	340	368	370	
2008	12	80	147	228	288	329	365	389	421
2007	1	66	175	269	334	358	383	400	416
Mean		86	171	255	309	347	371	393	419

TABLE 32. Mean estimated back calculated total lengths of Smallmouth Bass from multiple reservoirs.

	Length (mm) at annulus								
	1	2	3	4	5	6	7	8	9
Lake Mead 2015-2017	85	176	258	311	348	370	386	420	
Various locations[a]	94	170	234	279	323	358	381	404	429
Lake Powell 2013-2015[b]	118	174	216	256					

[a]Coble (1975) mean estimated back calculated total lengths from smallmouth bass from throughout North America.
[b]UDNR

Overlaying the back calculated lengths at age over the length frequency data from the fall gill-net survey, the population age structure becomes apparent with the majority of the current population age 4 through 6 (Figure 40). The aging of Smallmouth Bass fills a knowledge gap regarding the Lake Mead fishery and will help identify year-class strength, help in fishery forecasts, as well as detect problems in the fishery such as if we see changes in growth rates. With this information, we can now have a better estimate of age distribution in the Smallmouth Bass population.

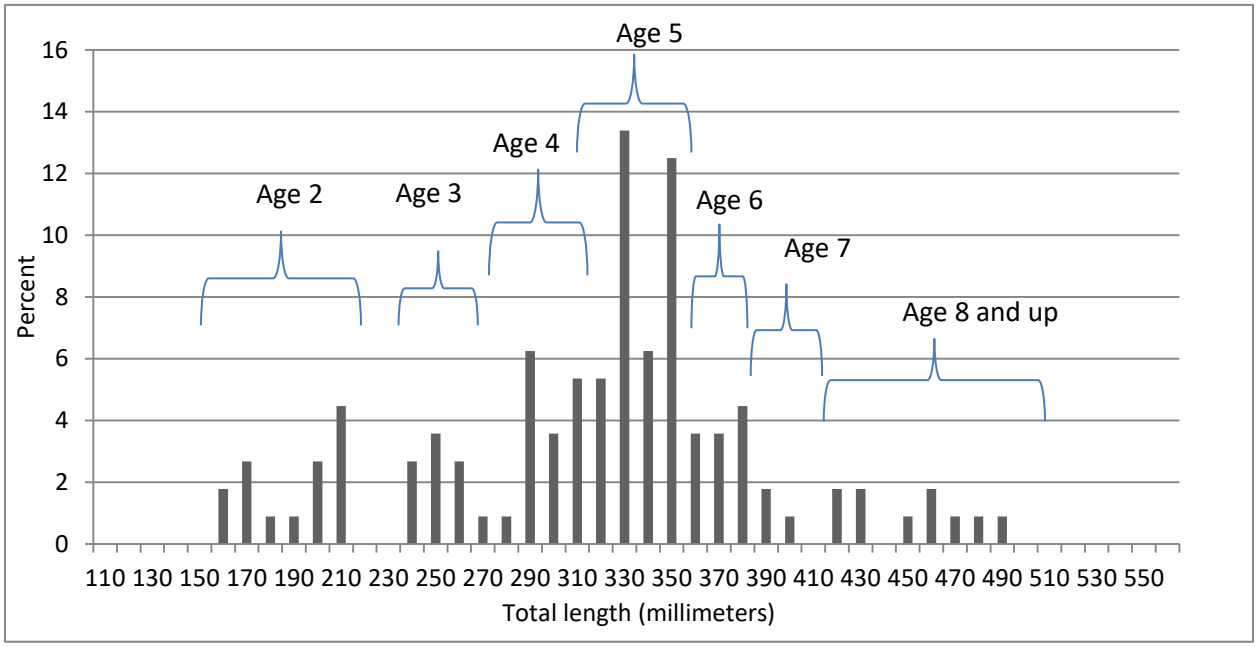

FIGURE 40. Smallmouth Bass length frequency distribution, 2018 Lake Mead gill-net survey.

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. 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 growth rates with that prior to the invasion of quagga mussel and Gizzard

Shad by estimating age from collected scales. Largemouth Bass scale analysis can be compared to historically published growth rates from Lake Mead (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 caught during netting surveys will be Floy tagged, so that growth can be observed when fish are recaptured.

Approaches:

- Obtain scale samples from largemouth bass and striped bass captured from trammel netting, gill netting, and electroshocking surveys during the fall. Obtain otoliths in the event of Smallmouth Bass mortality during netting. Scales and otoliths may also be obtained from Largemouth Bass and Striped Bass tournament mortalities.
- During general management activities, tag Largemouth Bass and Striped Bass with Floy tags to observe growth when fish are recaptured and to validate back calculated growth rates from scale analysis. When fish are tagged, scales will be collected along with date, length, weight, location, and GPS coordinates.
- Collect samples over three-years with a record of date, location, GPS coordinates, length, and weight data for each fish.
- Store scales and otoliths in envelopes or vials and prepare for analysis.
- Analyze and age scales using a zoom stereo microscope with camera, or using a microprojector or microfiche projector. Analyze and age scales and otoliths using accepted methods.
- Develop a length at age table and analyze Largemouth Bass and Striped Bass population age structure by comparing scales collected during the 1980 or from published data.

PROCEDURES

A total of 155 scale and 72 otolith samples were obtained from Largemouth Bass (Table 33, Appendix 1) and 391 scale and 309 otolith samples were obtained from Striped Bass (Table 34; Appendix 1) from 2015 to 2018. Scales were removed from the side of the fish using a scraping motion with a knife. Scales and otoliths were placed into labeled scale envelopes. During preparation, scales were cleaned by placing in warm water and then rubbing debris off with a paper towel. The cleaned scales were then mounted between glass microscope slides with either five or six scales per slide. The slides were labeled with sample number, species, and date. Fish length data was kept separate from the scales to avoid any influence it may have in aging scales. Initially in 2015, many scale samples were obtained without accompanying otoliths, and after aging attempts, it was found that an otolith was needed in most cases to help in aging scales.

Whole otoliths were cleaned, placed concave side up in a petri dish filled with water, placed on a black background on the dissecting microscope base, and viewed with reflected light as described in Miller 1966. In addition, sectioned otoliths were prepared by breaking the otolith in half dorsoventrally at the focus. The broken ends were sanded with a variable speed drill using a sanding disk (Maceina 1988) with 320-grit sandpaper. The smoothed end was cemented to a microscope slide and the exposed end was then sanded down to approximately 1.0 mm.

In 2018, scales and otoliths were mounted on slides, though they were not aged. Age analysis along with a full report of findings will be reported in the 2019 Job Progress Report.

TABLE 33. Number of Largemouth Bass scales and otoliths collected by year and by survey type, 2015-18.

Survey type	2015		2016		2017		2018	
	LMB		LMB		LMB		LMB	
	Scales	Otoliths	Scales	Otoliths	Scales	Otoliths	Scales	Otoliths
Gillnet	33	8	13	6	12	12	23	13
Tournaments	7	1	24	23	4	4	4	3
Trammel netting	0	0	12	0	0	0	18	1
Creel	1	0	0	0	0	0	0	0
Electroshocking	0	0	4	0	0	0	0	0
Total	41	10	53	29	16	16	45	17

TABLE 34. Number of Striped Bass scales and otoliths collected by year and by survey type, 2015-18.

Survey type	2015		2016		2017		2018	
	STB		STB		STB		STB	
	Scales	Otoliths	Scales	Otoliths	Scales	Otoliths	Scales	Otoliths
Gillnet	74	53	54	50	35	35	54	52
Tournaments	17	1	24	19	9	1	23	21
Trammel netting	0	0	0	0	0	0	54	28
Creel	36	29	8	8	12	12	0	0
Electroshocking	0	0	0	0	0	0	0	0
Total	127	83	86	77	47	48	131	101

MANAGEMENT REVIEW

The approaches for the general management objective were completed. The objectives were met through contact creel surveys, tournament data collection, gill netting, electroshocking, dive surveys, shad trawls, and Striped Bass stomach content analysis. The Largemouth Bass fishery remains stable in the face of continued lake drawdowns due to long-term drought conditions. The Smallmouth Bass fishery continues to grow with abundance now greater than Largemouth Bass. The Striped Bass population is in decline; however, successful recruitment is occurring. Striped Bass body condition was satisfactory this year, despite low Threadfin Shad reproduction. Black Crappie may be benefitting from the Striped Bass decline with a

rebound in numbers. Angler interest and harvest of Black Crappie in the Overton Arm continues.

The Lake Mead Fisheries Habitat Enhancement Study approaches were completed by an assessment of the effectiveness of artificial habitat through creel surveys, netting, electroshocking, SCUBA survey, and hook-and-line sampling. Work will continue to develop ways to move habitat structures while underwater. The Smallmouth Bass age and growth study was completed, which will be useful in their management. The Largemouth Bass and Striped Bass aging study will be completed in the coming year.

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-net surveys and summer dive investigations should be continued.
- Collect black bass catch data from major tournaments to track trends in the black bass fishery.
- Continue with assigned electroshocking transects during the fall survey.
- Continue the quarterly checking Striped Bass stomach contents to detect changes in diet.
- Continue weekly shad trawl transects during the peak spawning season.
- Continue to investigate the feasibility and effectiveness of moveable underwater habitat structures for future deployment in Lake Mead.
- Study the growth rates of Largemouth Bass and Striped Bass to detect changes since the invasion of quagga mussels and Gizzard Shad.
- Consider a separate bag limit for Smallmouth Bass to increase harvest and provide increased fishing opportunity to anglers.
- Sample the black crappie population in the Overton Arm during winter and spring to assess the population.

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Appendix 1. Scale and otolith data collections of Striped Bass (SB), Largemouth Bass (LMB), and Smallmouth Bass (SMB), 2015-2018.

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1001	7/17/2015	SB	Creel	Hatchery Cove	446	417	660	N
1002	7/17/2015	SB	Creel	Hatchery Cove	490	457	1,020	Y
1003	7/17/2015	SB	Creel	Hatchery Cove	452	430	820	N
1004	7/17/2015	SB	Creel	Hatchery Cove	460	428	690	Y
1005	7/17/2015	SB	Creel	Hatchery Cove	404	383	560	N
1006	7/17/2015	SB	Creel	Hatchery Cove	526	493	1,140	N
1007	7/23/2015	LMB	Creel	The Narrows	390	375	690	N
1008	8/3/2015	SB	Creel	The Narrows	469	440	910	Y
1009	8/3/2015	SB	Creel	The Narrows	430	402	660	Y
1010	8/3/2015	SB	Creel	The Narrows	445	415	840	Y
1011	8/3/2015	SB	Creel	The Narrows	516	490	1,220	Y
1012	8/3/2015	SB	Creel	The Narrows	410	385	610	Y
1013	8/3/2015	SB	Creel	The Narrows	445	420	790	Y
1014	8/3/2015	SB	Creel	The Narrows	420	400	670	Y
1015	8/3/2015	SB	Creel	The Narrows	472	442	880	Y
1016	8/3/2015	SB	Creel	The Narrows	470	430	900	Y
1017	8/3/2015	SB	Creel	The Narrows	420	390	690	Y
1018	8/3/2015	SB	Creel	The Narrows	420	390	650	Y
1019	8/3/2015	SB	Creel	The Narrows	460	425	810	Y
1020	8/3/2015	SB	Creel	The Narrows	465	430	780	Y
1021	8/3/2015	SB	Creel	The Narrows	475	455	900	Y
1022	8/3/2015	SB	Creel	The Narrows	440	415	710	Y
1023	8/3/2015	SB	Creel	The Narrows	454	423	810	Y
1024	8/3/2015	SB	Creel	The Narrows	338	318	390	Y
1027	9/13/2015	SB	Tournament	Unknown	545	503	1,270	N
1028	9/13/2015	SB	Tournament	Unknown	498	460	953	N
1029	9/13/2015	SB	Tournament	Unknown	475	450	953	N
1030	9/13/2015	SB	Tournament	Unknown	490	450	907	N
1031	9/13/2015	SB	Tournament	Unknown	490	455	975	Y
1032	9/13/2015	SB	Tournament	Unknown	475	442	839	N
1033	9/13/2015	SB	Tournament	Hatchery Cove	524	485	1,225	N
1034	9/13/2015	SB	Tournament	Hatchery Cove	555	510	1,270	N
1035	9/13/2015	SB	Tournament	Unknown	499	465	1,111	N
1036	9/13/2015	SB	Tournament	Unknown	485	445	998	N
1037	9/13/2015	SB	Tournament	Hatchery Cove	503	467	1,202	N
1038	9/13/2015	SB	Tournament	Unknown	626	585	2,223	N
1040	9/13/2015	SB	Tournament	Unknown	558	520	1,588	N
1041	9/13/2015	SB	Tournament	Unknown	535	498	1,361	N
1042	9/13/2015	SB	Tournament	Unknown	532	495	1,338	N
1043	9/13/2015	SB	Tournament	E of Black Point	540	501	1,338	N
1044	9/14/2015	SMB	Tournament	Unknown	386	367	790	Y
1045	9/14/2015	SMB	Tournament	Unknown	400	380	910	Y
1046	9/14/2015	SMB	Tournament	Unknown	440	415	990	Y
1047	9/14/2015	SMB	Tournament	Unknown	407	385	780	Y
1048	9/14/2015	SMB	Tournament	Unknown	407	390	890	Y
1049	9/14/2015	SMB	Tournament	Unknown	400	380	750	Y
1050	9/14/2015	SMB	Tournament	Unknown	348	330	590	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1051	9/14/2015	SMB	Tournament	Unknown	352	335	590	Y
1052	9/14/2015	SMB	Tournament	Unknown	352	335	570	Y
1053	9/14/2015	SMB	Tournament	Unknown	330	310	430	Y
1054	9/14/2015	SMB	Tournament	Unknown	380	362	780	Y
1055	9/14/2015	SMB	Tournament	Unknown	400	380	870	Y
1056	9/14/2015	SMB	Tournament	Unknown	430	410	970	Y
1057	9/14/2015	SMB	Tournament	Unknown	348	332	590	Y
1058	9/14/2015	SMB	Tournament	Unknown	360	350	550	Y
1059	9/14/2015	SMB	Tournament	Unknown	353	335	580	Y
1060	9/14/2015	SMB	Tournament	Unknown	375	355	620	Y
1061	9/14/2015	SMB	Tournament	Unknown	418	398	1,000	N
1062	9/14/2015	SMB	Tournament	Unknown	417	398	960	N
1063	9/14/2015	SMB	Tournament	Unknown	387	370	700	N
1064	9/14/2015	SMB	Tournament	Unknown	406	383	790	N
1065	9/14/2015	SMB	Tournament	Unknown	400	380	790	N
1066	9/14/2015	SMB	Tournament	Unknown	463	444	1,380	N
1067	9/14/2015	LMB	Tournament	Unknown	450	432	1,150	N
1068	9/14/2015	SMB	Tournament	Unknown	452	432	1,010	N
1069	9/14/2015	LMB	Tournament	Unknown	455	435	1,330	N
1070	9/14/2015	LMB	Tournament	Unknown	403	387	980	N
1071	9/14/2015	SMB	Tournament	Unknown	358	340	560	N
1072	9/14/2015	SMB	Tournament	Unknown	435	410	1,250	N
1073	9/14/2015	SMB	Tournament	Unknown	405	385	810	N
1074	9/14/2015	LMB	Tournament	Unknown	333	318	520	N
1075	9/14/2015	SMB	Tournament	Unknown	405	385	850	N
1076	9/14/2015	SMB	Tournament	Unknown	348	330	520	N
1077	9/14/2015	SMB	Tournament	Unknown	380	358	690	N
1078	9/14/2015	SMB	Tournament	Unknown	428	408	1,130	N
1079	9/14/2015	SMB	Tournament	Unknown	375	360	680	Y
1080	9/14/2015	LMB	Tournament	Unknown	355	341	540	Y
1081	9/14/2015	SMB	Tournament	Unknown	330	300	420	Y
1082	9/14/2015	SMB	Tournament	Unknown	439	414	1,060	Y
1083	9/14/2015	SMB	Tournament	Unknown	457	435	1,220	Y
1084	9/15/2015	SMB	Tournament	Unknown	373	353	600	Y
1085	9/15/2015	SMB	Tournament	Unknown	361	341	560	Y
1086	9/15/2015	SMB	Tournament	Unknown	428	407	1,110	Y
1087	9/15/2015	SMB	Tournament	Unknown	400	384	860	Y
1088	9/15/2015	SMB	Tournament	Unknown	369	347	660	N
1089	9/15/2015	SMB	Tournament	Unknown	350	330	580	Y
1090	9/15/2015	SMB	Tournament	Unknown	370	350	610	N
1091	9/15/2015	SMB	Tournament	Unknown	361	347	530	Y
1092	9/15/2015	SMB	Tournament	Unknown	440	422	1,260	Y
1093	9/15/2015	SMB	Tournament	Unknown	355	338	560	N
1094	9/15/2015	SMB	Tournament	Unknown	395	376	690	Y
1095	9/15/2015	SMB	Tournament	Unknown	390	365	820	Y
1096	9/15/2015	SMB	Tournament	Unknown	403	380	780	Y
1097	9/15/2015	SMB	Tournament	Unknown	390	374	740	Y
1098	9/15/2015	SMB	Tournament	Unknown	392	372	780	Y
1099	9/15/2015	SMB	Tournament	Unknown	360	342	570	Y
1100	9/15/2015	SMB	Tournament	Unknown	397	377	780	N
1101	9/15/2015	SMB	Tournament	Unknown	405	389	880	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1102	9/15/2015	SMB	Tournament	Unknown	324	315	480	Y
1103	9/15/2015	SMB	Tournament	Unknown	385	365	670	Y
1104	9/15/2015	SMB	Tournament	Unknown	365	350	630	Y
1105	9/15/2015	SMB	Tournament	Unknown	360	339	540	Y
1106	9/15/2015	SMB	Tournament	Unknown	341	327	500	Y
1107	9/15/2015	SMB	Tournament	Unknown	345	328	510	Y
1108	9/15/2015	SMB	Tournament	Unknown	400	385	890	Y
1109	9/15/2015	SMB	Tournament	Unknown	378	358	700	Y
1110	9/15/2015	SMB	Tournament	Unknown	410	390	900	N
1111	9/15/2015	SMB	Tournament	Unknown	370	349	620	Y
1112	9/15/2015	SMB	Tournament	Unknown	482	459	1,490	Y
1113	9/15/2015	SMB	Tournament	Unknown	439	416	1,100	Y
1114	9/15/2015	SMB	Tournament	Unknown	365	347	660	Y
1115	9/15/2015	LMB	Tournament	Unknown	465	445	1,050	Y
1116	9/15/2015	SMB	Tournament	Unknown	330	312	440	Y
1117	9/15/2015	SMB	Tournament	Unknown	440	415	1,090	Y
1118	9/15/2015	SMB	Tournament	Unknown	402	378	710	Y
1119	9/15/2015	SMB	Tournament	Unknown	387	368	820	Y
1120	9/15/2015	SMB	Tournament	Unknown	410	395	970	Y
1121	9/15/2015	SMB	Tournament	Unknown	363	345	610	N
1122	9/15/2015	SMB	Tournament	Unknown	325	312	430	Y
1123	9/16/2015	SMB	Tournament	Unknown	393	374	900	Y
1124	9/16/2015	SMB	Tournament	Unknown	347	331	580	Y
1125	9/16/2015	SMB	Tournament	Unknown	382	365	790	Y
1126	9/16/2015	SMB	Tournament	Unknown	430	410	900	Y
1127	9/16/2015	SMB	Tournament	Unknown	395	370	790	Y
1128	9/16/2015	SMB	Tournament	Unknown	395	378	830	Y
1129	9/16/2015	SMB	Tournament	Unknown	328	312	420	Y
1130	9/16/2015	SMB	Tournament	Unknown	430	405	970	Y
1131	9/16/2015	SMB	Tournament	Unknown	362	345	570	Y
1132	9/16/2015	SMB	Tournament	Unknown	335	319	520	Y
1133	9/16/2015	SMB	Tournament	Unknown	390	367	720	Y
1134	9/16/2015	SMB	Tournament	Unknown	393	373	890	Y
1135	9/16/2015	SMB	Tournament	Unknown	338	321	510	Y
1136	9/16/2015	SMB	Tournament	Unknown	345	325	550	Y
1137	9/16/2015	SMB	Tournament	Unknown	324	306	480	Y
1138	9/16/2015	SMB	Tournament	Unknown	338	322	450	Y
1139	9/16/2015	SMB	Tournament	Unknown	331	315	430	Y
1140	9/16/2015	SMB	Tournament	Unknown	325	312	490	Y
1141	9/16/2015	SMB	Tournament	Unknown	352	332	560	Y
1142	9/16/2015	SMB	Tournament	Unknown	392	376	770	Y
1143	9/16/2015	SMB	Tournament	Unknown	411	392	880	Y
1144	9/16/2015	SMB	Tournament	Unknown	375	358	680	Y
1145	9/16/2015	SMB	Tournament	Unknown	336	320	470	Y
1146	9/23/2015	SB	Creel	Las Vegas Bay	375	346	550	Y
1147	9/23/2015	SB	Creel	Las Vegas Bay	394	370	640	Y
1148	9/23/2015	SB	Creel	Las Vegas Bay	315	294	320	Y
1149	9/23/2015	SB	Creel	Las Vegas Bay	392	365	620	Y
1150	9/23/2015	SB	Creel	Las Vegas Bay	540	500	1,220	Y
1151	9/23/2015	SB	Creel	Las Vegas Bay	398	370	600	Y
1152	9/23/2015	SB	Creel	Las Vegas Bay	299	278	290	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1153	9/23/2015	SB	Creel	Las Vegas Bay	382	352	510	Y
1154	10/2/2015	LMB	Tournament	Unknown	357	344	410	Y
1155	10/2/2015	SMB	Tournament	Unknown	388	368	700	Y
1156	10/2/2015	SMB	Tournament	Unknown	340	324	560	Y
1157	10/2/2015	SMB	Tournament	Unknown	435	417	1,060	Y
1158	10/2/2015	SMB	Tournament	Unknown	425	410	1,030	Y
1159	10/2/2015	SMB	Tournament	Unknown	420	409	1,070	Y
1160	10/2/2015	SMB	Tournament	Unknown	386	368	820	Y
1161	10/2/2015	SMB	Tournament	Unknown	359	342	560	Y
1162	10/19/2015	SB	Gill Netting	The Cliffs	494	459	1,150	N
1163	10/5/2015	SB	Gill Netting	Black Island	400	378	670	Y
1164	10/5/2015	SMB	Gill Netting	Black Island	237	228	160	Y
1165	10/5/2015	SMB	Gill Netting	Black Island	270	260	240	N
1166	10/5/2015	SMB	Gill Netting	Roadrunner	403	381	860	N
1167	10/5/2015	SMB	Gill Netting	Roadrunner	420	400	1,040	N
1168	10/5/2015	SMB	Gill Netting	Roadrunner	418	402	940	Y
1169	10/5/2015	SB	Gill Netting	Swallow Bay	390	364	520	Y
1170	10/5/2015	SB	Gill Netting	Swallow Bay	372	348	480	Y
1171	10/5/2015	SB	Gill Netting	Swallow Bay	448	422	830	Y
1172	10/5/2015	SB	Gill Netting	Swallow Bay	384	358	490	Y
1173	10/6/2015	SB	Gill Netting	Rogers Bay	374	350	520	Y
1174	10/6/2015	LMB	Gill Netting	Rogers Bay	221	210	130	Y
1175	10/6/2015	LMB	Gill Netting	Rogers Bay	200	193	100	Y
1176	10/6/2015	SB	Gill Netting	Twin Peaks	172	160	20	Y
1177	10/6/2015	LMB	Gill Netting	Calico Bay	216	209	150	N
1178	10/6/2015	SB	Gill Netting	Echo Bay	426	397	720	Y
1179	10/6/2015	SB	Gill Netting	Echo Bay	360	339	500	Y
1180	10/6/2015	SB	Gill Netting	Echo Bay	488	455	1,130	Y
1181	10/6/2015	SB	Gill Netting	Echo Bay	417	389	730	N
1182	10/6/2015	LMB	Gill Netting	Echo Bay	568	530	2,730	N
1183	10/7/2015	LMB	Gill Netting	Cathedral Cove	255	245	200	N
1184	10/7/2015	LMB	Gill Netting	Gunsight	194	186	80	Y
1185	10/7/2015	SMB	Gill Netting	Gunsight	425	405	1,060	Y
1186	10/7/2015	SB	Gill Netting	Gunsight	325	303	320	Y
1187	10/7/2015	SMB	Gill Netting	Quail Bay	213	204	130	Y
1189	10/7/2015	SMB	Gill Netting	Quail Bay	299	283	350	Y
1190	10/12/2015	SMB	Gill Netting	Battleship Rock	330	315	460	Y
1191	10/12/2015	SB	Gill Netting	Battleship Rock	214	200	60	Y
1192	10/12/2015	SB	Gill Netting	Battleship Rock	508	469	880	Y
1193	10/12/2015	SB	Gill Netting	Water Barge	338	314	430	Y
1194	10/12/2015	SMB	Gill Netting	Water Barge	291	278	330	N
1195	10/12/2015	SMB	Gill Netting	Water Barge	400	380	750	N
1196	10/12/2015	SMB	Gill Netting	Water Barge	296	280	380	Y
1197	10/12/2015	SB	Gill Netting	Lovers Cove	390	360	530	Y
1198	10/19/2015	SB	Gill Netting	The Cliffs	440	412	750	Y
1199	10/19/2015	SB	Gill Netting	The Cliffs	480	450	990	Y
1200	10/19/2015	SB	Gill Netting	The Cliffs	503	470	1,120	Y
1201	10/19/2015	SB	Gill Netting	The Cliffs	444	416	890	Y
1202	10/19/2015	SB	Gill Netting	The Cliffs	465	439	830	Y
1203	10/19/2015	SB	Gill Netting	The Cliffs	464	432	860	Y
1204	10/19/2015	LMB	Gill Netting	Horsepower	397	382	860	N

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1205	10/19/2015	SB	Gill Netting	Horsepower	523	490	1,460	Y
1206	10/19/2015	SB	Gill Netting	Horsepower	350	329	450	Y
1207	10/19/2015	SB	Gill Netting	Horsepower	548	515	1,480	Y
1208	10/19/2015	SB	Gill Netting	Horsepower	335	316	420	Y
1209	10/19/2015	SB	Gill Netting	The Cliffs	480	455	990	Y
1212	10/19/2015	SB	Gill Netting	Horsepower	341	320	420	Y
1213	10/19/2015	SB	Gill Netting	Horsepower	358	335	460	Y
1214	10/22/2015	SB	Gill Netting	Gov't Wash	325	315	300	Y
1215	10/22/2015	LMB	Gill Netting	Gov't Wash	229	220	150	N
1216	10/22/2015	SB	Gill Netting	Gov't Wash	398	371	670	Y
1217	10/22/2015	LMB	Gill Netting	Indian Canyon	296	283	340	N
1218	10/22/2015	SMB	Gill Netting	Indian Canyon	302	288	380	N
1219	10/26/2015	SB	Gill Netting	Stewarts Bay	430	405	740	N
1220	10/26/2015	SB	Gill Netting	Stewarts Bay	369	348	520	N
1221	10/26/2015	SB	Gill Netting	Stewarts Bay	207	196	104	Y
1222	10/26/2015	SB	Gill Netting	Stewarts Bay	327	310	360	Y
1223	10/26/2015	SB	Gill Netting	Stewarts Bay	343	324	440	Y
1224	10/22/2015	SB	Gill Netting	Gov't Wash	403	378	670	Y
1225	10/22/2015	SB	Gill Netting	Gov't Wash	120	112	10	N
1226	10/22/2015	SB	Gill Netting	Gov't Wash	405	376	610	Y
1227	10/22/2015	SB	Gill Netting	Gov't Wash	230	215	110	Y
1228	10/22/2015	SB	Gill Netting	Gov't Wash	376	353	540	Y
1229	10/22/2015	SB	Gill Netting	Gov't Wash	354	330	450	Y
1230	10/22/2015	SB	Gill Netting	Gov't Wash	234	218	130	Y
1231	10/22/2015	SB	Gill Netting	Gov't Wash	385	364	540	Y
1232	10/22/2015	SB	Gill Netting	Gov't Wash	405	377	650	Y
1233	10/22/2015	SB	Gill Netting	Gov't Wash	409	382	670	Y
1234	10/22/2015	SB	Gill Netting	Gov't Wash	233	217	150	Y
1235	10/22/2015	SB	Gill Netting	Gov't Wash	494	461	1,200	Y
1236	10/22/2015	SB	Gill Netting	Gov't Wash	231	221	130	Y
1237	10/22/2015	SB	Gill Netting	Gov't Wash	230	215	130	Y
1238	10/22/2015	LMB	Gill Netting	Indian Canyon	217	210	130	Y
1239	10/22/2015	LMB	Gill Netting	Indian Canyon	397	385	930	Y
1240	10/26/2015	SB	Gill Netting	Stewarts Bay	355	336	480	Y
1241	10/26/2015	SB	Gill Netting	Stewarts Bay	317	300	340	Y
1242	10/26/2015	SB	Gill Netting	Stewarts Bay	353	338	480	Y
1243	10/26/2015	SB	Gill Netting	Stewarts Bay	210	199	106	Y
1244	10/26/2015	SB	Gill Netting	Stewarts Bay	182	170	61	Y
1245	10/26/2015	LMB	Gill Netting	Stewarts Bay	205	198	100	Y
1246	10/26/2015	SB	Gill Netting	Stewarts Bay	226	212	138	Y
1247	10/26/2015	LMB	Gill Netting	Bluepoint Bay	258	250	210	N
1248	10/26/2015	LMB	Gill Netting	Bluepoint Bay	209	199	105	N
1249	10/26/2015	LMB	Gill Netting	Bluepoint Bay	226	218	145	N
1250	10/22/2015	LMB	Gill Netting	Indian Canyon	298	294	370	Y
1251	10/22/2015	SMB	Gill Netting	Indian Canyon	370	354	680	Y
1252	10/26/2015	SMB	Gill Netting	Cottonwood	400	380	770	N
1253	10/26/2015	SMB	Gill Netting	Cottonwood	155	146	44	N
1254	10/26/2015	LMB	Gill Netting	Cottonwood	254	244	230	N
1255	10/26/2015	SMB	Gill Netting	Cottonwood	200	192	103	N
1256	10/26/2015	LMB	Gill Netting	Cottonwood	234	225	170	Y
1257	10/26/2015	SMB	Gill Netting	Cottonwood	290	278	310	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1258	10/26/2015	SMB	Gill Netting	S-Cove	401	380	910	N
1259	10/26/2015	LMB	Gill Netting	S-Cove	339	325	520	N
1260	10/26/2015	SMB	Gill Netting	S-Cove	300	285	330	N
1261	10/26/2015	SMB	Gill Netting	S-Cove	300	287	380	N
1262	12/5/2015	SMB	Tournament	Unknown	375	359	640	N
1263	12/13/2015	SB	Tournament	Unknown	515	486	1,157	N
1264	12/13/2015	SB	Tournament	Unknown	570	533	1,474	N
1265	12/13/2015	SB	Tournament	Unknown	547	514	1,520	N
1266	12/13/2015	SB	Tournament	Unknown	515	486	1,338	N
1268	12/13/2015	SB	Tournament	Unknown	510	474	1,225	N
1269	12/13/2015	SB	Tournament	Unknown	512	478	1,270	N
1270	12/13/2015	SB	Tournament	Unknown	525	493	1,225	N
1271	12/13/2015	SB	Tournament	Unknown	509	477	1,089	N
1272	12/13/2015	SB	Tournament	Unknown	506	470	1,270	N
1273	12/13/2015	SB	Tournament	Unknown	515	485	1,429	N
1274	12/13/2015	SB	Tournament	Unknown	523	493	1,202	N
1276	12/13/2015	SB	Tournament	Unknown	543	510	1,497	N
1277	12/13/2015	SB	Tournament	Unknown	547	519	1,474	N
1278	12/13/2015	SB	Tournament	Unknown	520	495	1,293	N
1279	12/13/2015	SB	Tournament	Unknown	517	486	1,338	N
1280	12/13/2015	SB	Tournament	Unknown	520	495	1,293	N
1281	12/13/2015	SB	Tournament	Unknown	518	488	1,225	N
3001	10/6/2015	SMB	Gill Netting	James Bay	331	318	450	N
3002	10/5/2015	SMB	Gill Netting	James Bay	250	236	180	N
3003	10/6/2015	LMB	Gill Netting	Bearing Cove	170	150	60	N
3004	10/6/2015	LMB	Gill Netting	Hamblin Bay	450	400	1,410	N
3005	10/6/2015	LMB	Gill Netting	Hamblin Bay	400	350	690	N
3006	10/7/2015	LMB	Gill Netting	South Beach	322	309	420	N
1300	3/23/2016	SMB	Trammel net	Echo Bay	396	377	818	N
1301	3/23/2016	LMB	Trammel net	Overton Arm	301	285	248	N
1302	3/24/2016	LMB	Trammel net	The Meadows	204	198	---	N
1303	3/24/2016	LMB	Trammel net	The Meadows	204	198	96	N
1304	3/24/2016	LMB	Trammel net	The Meadows	264	251	---	N
1305	3/24/2016	LMB	Trammel net	The Meadows	208	199	---	N
1306	3/24/2016	LMB	Trammel net	The Meadows	268	256	---	N
1307	3/24/2016	LMB	Trammel net	The Meadows	251	243	194	N
1308	3/24/2016	LMB	Trammel net	The Meadows	236	228	130	N
1309	3/23/2016	LMB	Electroshocking	The Meadows	515	412	480	N
1310	3/23/2016	LMB	Electroshocking	The Meadows	209	---	140	N
1311	3/23/2016	LMB	Electroshocking	The Meadows	406	382	890	N
1312	3/24/2016	LMB	Trammel net	The Meadows	331	320	415	N
1314	3/24/2016	LMB	Trammel net	The Meadows	365	352	685	N
1315	3/24/2016	LMB	Trammel net	The Meadows	375	360	670	N
1316	3/23/2016	SMB	Trammel net	Echo Bay	231	221	142	N
1317	3/22/2016	LMB	Trammel net	Echo Bay	426	410	998	N
1318	3/22/2016	SMB	Trammel net	Echo Bay	313	296	308	N
1319	3/22/2016	SMB	Trammel net	Echo Bay	377	356	898	N
1320	3/22/2016	SMB	Trammel net	Echo Bay	295	282	320	N
1321	3/22/2016	SMB	Trammel net	Echo Bay	364	349	558	N
1322	4/3/2016	LMB	Tournament	Unknown	428	415	1,020	Y
1323	4/3/2016	SMB	Tournament	Unknown	389	370	720	N

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1324	4/8/2016	LMB	Tournament	Unknown	428	410	1,040	Y
1325	4/8/2016	SMB	Tournament	Unknown	446	425	1,090	Y
1326	4/8/2016	LMB	Tournament	Unknown	344	327	520	Y
1327	4/8/2016	LMB	Tournament	Unknown	450	436	1,520	Y
1328	4/8/2016	SMB	Tournament	Unknown	384	360	780	Y
1329	4/8/2016	LMB	Tournament	Unknown	476	461	1,690	Y
1330	4/8/2016	SMB	Tournament	Unknown	406	380	1,000	Y
1331	4/8/2016	SMB	Tournament	Unknown	428	408	---	Y
1332	4/8/2016	LMB	Tournament	Unknown	496	475	2,120	Y
1333	4/8/2016	LMB	Tournament	Unknown	392	375	720	Y
1334	4/8/2016	SMB	Tournament	Unknown	382	362	780	Y
1335	4/8/2016	LMB	Tournament	Unknown	430	412	1,050	Y
1336	4/8/2016	LMB	Tournament	Unknown	354	340	550	Y
1337	4/8/2016	LMB	Tournament	Unknown	441	428	1,300	N
1338	4/9/2016	SMB	Tournament	Unknown	399	385	880	Y
1339	4/9/2016	SMB	Tournament	Unknown	335	320	570	Y
1340	4/4/2016	SMB	Tournament	Unknown	366	352	670	Y
1341	4/4/2016	SMB	Tournament	Unknown	376	358	640	Y
1342	4/4/2016	LMB	Tournament	Unknown	390	388	940	Y
1343	4/4/2016	SMB	Tournament	Unknown	352	336	600	Y
1344	5/9/2016	SB	Creel	Hatchery Cove	630	595	2,030	Y
1345	5/9/2016	SB	Creel	Hatchery Cove	390	364	510	Y
1346	5/9/2016	SB	Creel	Hatchery Cove	367	341	450	Y
1347	5/9/2016	SB	Creel	Hatchery Cove	428	399	640	Y
1348	5/9/2016	SB	Creel	Hatchery Cove	518	476	1,270	Y
1349	5/9/2016	SB	Creel	Hatchery Cove	375	345	460	Y
1350	5/9/2016	SB	Creel	Hatchery Cove	478	440	870	Y
1351	5/9/2016	SB	Creel	Hatchery Cove	495	455	960	Y
1352	6/12/2016	SB	Tournament	Unknown	522	485	1,089	N
1353	6/12/2016	SB	Tournament	S. Overton Arm	484	460	953	Y
1354	6/12/2016	SB	Tournament	S. Overton Arm	500	458	975	Y
1355	6/12/2016	SB	Tournament	S. Overton Arm	518	479	1,089	Y
1356	6/12/2016	SB	Tournament	S. Overton Arm	465	434	839	Y
1357	6/12/2016	SB	Tournament	S. Overton Arm	507	470	1,134	Y
1358	6/12/2016	SB	Tournament	S. Overton Arm	495	460	930	Y
1359	6/12/2016	SB	Tournament	S. Overton Arm	504	470	1,111	Y
1360	6/12/2016	SB	Tournament	Overton Arm	500	462	1,043	Y
1361	6/12/2016	SB	Tournament	Overton Arm	494	455	998	Y
1362	6/12/2016	SB	Tournament	Overton Arm	490	450	2,000	Y
1363	6/12/2016	SB	Tournament	Unknown	525	488	1,111	Y
1364	6/12/2016	SB	Tournament	Unknown	515	478	1,066	Y
1365	6/12/2016	SB	Tournament	Unknown	541	505	1,247	Y
1366	6/12/2016	SB	Tournament	Unknown	485	445	930	N
1367	6/12/2016	SB	Tournament	Unknown	500	470	1,021	Y
1368	6/12/2016	SB	Tournament	Unknown	560	520	1,293	N
1369	6/12/2016	SB	Tournament	Unknown	600	553	1,542	Y
1370	6/12/2016	SB	Tournament	Unknown	505	463	1,021	Y
1371	6/12/2016	SB	Tournament	Boulder Basin	518	480	1,111	N
1372	6/12/2016	SB	Tournament	Boulder Basin	515	480	1,111	Y
1373	6/12/2016	SB	Tournament	Boulder Basin	510	470	998	Y
1374	6/12/2016	SB	Tournament	Unknown	520	480	998	N

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1375	6/12/2016	SB	Tournament	Unknown	550	507	1,111	Y
1376	6/25/2016	SMB	Tournament	Unknown	430	410	1,020	Y
1377	6/25/2016	SMB	Tournament	Unknown	430	410	950	Y
1378	6/25/2016	SMB	Tournament	Unknown	422	400	900	Y
1379	6/25/2016	SMB	Tournament	Unknown	392	371	780	Y
1380	6/25/2016	SMB	Tournament	Unknown	432	408	850	Y
1381	6/25/2016	SMB	Tournament	Unknown	470	445	1,410	Y
1382	6/25/2016	SMB	Tournament	Unknown	382	362	670	Y
1383	6/25/2016	SMB	Tournament	Unknown	409	390	930	Y
1384	6/25/2016	SMB	Tournament	Unknown	428	408	840	Y
1385	6/25/2016	SMB	Tournament	Unknown	379	358	740	Y
1386	6/25/2016	SMB	Tournament	Unknown	420	399	880	Y
1387	6/25/2016	SMB	Tournament	Unknown	361	345	670	Y
1388	6/25/2016	SMB	Tournament	Unknown	445	425	1,080	Y
1389	6/25/2016	SMB	Tournament	Unknown	393	375	710	Y
1390	6/25/2016	SMB	Tournament	Unknown	395	375	780	Y
1391	6/25/2016	SMB	Tournament	Unknown	395	375	760	Y
1392	6/25/2016	SMB	Tournament	Unknown	386	368	660	Y
1393	6/25/2016	LMB	Tournament	Unknown	422	405	910	Y
1394	6/25/2016	LMB	Tournament	Unknown	432	416	1,040	Y
1395	6/26/2016	LMB	Tournament	Unknown	415	396	900	Y
1396	6/26/2016	LMB	Tournament	Unknown	500	475	1,640	y
1397	6/26/2016	LMB	Tournament	Unknown	374	362	640	Y
1398	6/26/2016	LMB	Tournament	Unknown	412	397	800	Y
1399	6/26/2016	SMB	Tournament	Unknown	385	365	810	Y
1400	6/26/2016	SMB	Tournament	Unknown	423	402	660	Y
1401	6/26/2016	SMB	Tournament	Unknown	430	411	920	Y
1402	6/26/2016	SMB	Tournament	Unknown	357	340	540	Y
1403	6/26/2016	SMB	Tournament	Unknown	458	433	1,150	Y
1404	6/26/2016	SMB	Tournament	Unknown	420	402	860	Y
1405	6/26/2016	SMB	Tournament	Unknown	388	370	620	Y
1406	6/26/2016	SMB	Tournament	Unknown	398	378	840	Y
1407	6/26/2016	SMB	Tournament	Unknown	414	394	920	Y
1408	6/26/2016	SMB	Tournament	Unknown	422	400	940	Y
1409	6/26/2016	SMB	Tournament	Unknown	360	341	610	Y
1410	6/26/2016	SMB	Tournament	Unknown	338	321	510	Y
1411	9/12/2016	LMB	Tournament	Unknown	410	395	1,020	Y
1412	9/12/2016	LMB	Tournament	Unknown	350	339	570	Y
1413	9/12/2016	LMB	Tournament	Unknown	385	369	640	Y
1414	9/12/2016	SMB	Tournament	Unknown	430	406	1,060	Y
1415	9/12/2016	SMB	Tournament	Unknown	342	325	510	Y
1416	9/12/2016	SMB	Tournament	Unknown	353	335	530	Y
1417	9/12/2016	SMB	Tournament	Unknown	398	380	740	Y
1418	9/12/2016	SMB	Tournament	Unknown	339	325	500	Y
1419	9/12/2016	SMB	Tournament	Unknown	350	338	650	Y
1420	9/12/2016	SMB	Tournament	Unknown	419	399	970	Y
1421	9/12/2016	SMB	Tournament	Unknown	351	336	540	Y
1422	9/12/2016	SMB	Tournament	Unknown	468	451	1,380	Y
1423	9/12/2016	SMB	Tournament	Unknown	340	328	490	Y
1424	9/12/2016	SMB	Tournament	Unknown	330	321	360	Y
1425	9/13/2016	LMB	Tournament	Unknown	480	463	1,460	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1426	9/13/2016	LMB	Tournament	Unknown	355	340	590	Y
1427	9/13/2016	SMB	Tournament	Unknown	390	370	760	Y
1428	9/13/2016	SMB	Tournament	Unknown	415	393	930	Y
1429	9/13/2016	SMB	Tournament	Unknown	347	333	590	Y
1430	9/13/2016	SMB	Tournament	Unknown	414	400	730	Y
1431	9/13/2016	SMB	Tournament	Unknown	357	339	590	Y
1432	9/13/2016	SMB	Tournament	Unknown	330	315	490	Y
1433	9/13/2016	SMB	Tournament	Unknown	403	384	810	Y
1434	9/13/2016	SMB	Tournament	Unknown	388	365	730	Y
1435	9/13/2016	SMB	Tournament	Unknown	384	364	770	Y
1436	9/13/2016	SMB	Tournament	Unknown	396	378	800	Y
1437	9/13/2016	SMB	Tournament	Unknown	340	325	510	Y
1438	9/13/2016	SMB	Tournament	Unknown	387	365	760	Y
1439	9/13/2016	SMB	Tournament	Unknown	349	331	520	Y
1440	9/13/2016	SMB	Tournament	Unknown	352	333	550	Y
1441	9/13/2016	SMB	Tournament	Unknown	338	321	480	Y
1442	9/13/2016	SMB	Tournament	Unknown	340	326	490	Y
1443	9/13/2016	SMB	Tournament	Unknown	330	311	450	Y
1444	9/14/2016	LMB	Tournament	Unknown	399	380	760	Y
1445	9/14/2016	LMB	Tournament	Unknown	380	369	700	Y
1446	9/14/2016	SMB	Tournament	Unknown	334	320	430	Y
1447	9/14/2016	SMB	Tournament	Unknown	349	334	540	Y
1448	9/14/2016	SMB	Tournament	Unknown	337	318	460	Y
1449	9/14/2016	SMB	Tournament	Unknown	327	309	430	Y
1450	9/14/2016	SMB	Tournament	Unknown	327	311	390	Y
1451	9/14/2016	SMB	Tournament	Unknown	379	363	610	Y
1452	9/14/2016	SMB	Tournament	Unknown	424	398	950	Y
1453	9/14/2016	SMB	Tournament	Unknown	374	358	650	Y
1454	9/14/2016	SMB	Tournament	Unknown	349	333	570	Y
1455	9/14/2016	SMB	Tournament	Unknown	337	319	460	N
1456	9/14/2016	SMB	Tournament	Unknown	410	386	980	Y
1457	9/14/2016	SMB	Tournament	Unknown	343	331	520	Y
1458	9/14/2016	SMB	Tournament	Unknown	363	345	610	Y
1459	10/4/2016	SB	Gill Netting	Anchor Cove	450	420	860	Y
1460	10/4/2016	SB	Gill Netting	Anchor Cove	465	437	900	N
1461	10/4/2016	SB	Gill Netting	Anchor Cove	132	116	130	Y
1462	10/4/2016	SMB	Gill Netting	Anchor Cove	468	447	1,690	Y
1463	10/4/2016	SMB	Gill Netting	Anchor Cove	485	465	1,410	N
1464	10/4/2016	SB	Gill Netting	Calico Bay	473	442	950	Y
1465	10/4/2016	SB	Gill Netting	Calico Bay	460	430	720	Y
1466	10/4/2016	SB	Gill Netting	Echo Bay	448	423	760	N
1467	10/4/2016	SB	Gill Netting	Echo Bay	463	434	680	Y
1468	10/4/2016	SB	Gill Netting	Echo Bay	494	473	570	Y
1469	10/4/2016	SB	Gill Netting	Echo Bay	413	384	600	Y
1470	10/4/2016	SB	Gill Netting	Echo Bay	501	468	1,060	Y
1471	10/4/2016	SB	Gill Netting	Echo Bay	443	425	670	Y
1472	10/4/2016	SB	Gill Netting	Echo Bay	403	380	610	Y
1473	10/4/2016	SB	Gill Netting	Echo Bay	440	410	790	Y
1474	10/4/2016	SB	Gill Netting	Echo Bay	402	379	640	Y
1475	10/4/2016	SB	Gill Netting	Echo Bay	337	310	390	Y
1476	10/4/2016	SB	Gill Netting	Echo Bay	373	349	480	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1477	10/4/2016	SB	Gill Netting	Echo Bay	339	319	410	Y
1478	10/4/2016	SB	Gill Netting	Echo Bay	445	419	850	Y
1479	10/4/2016	SB	Gill Netting	Echo Bay	435	408	780	Y
1480	10/4/2016	SB	Gill Netting	Echo Bay	405	378	620	Y
1481	10/4/2016	SB	Gill Netting	Echo Bay	428	401	740	Y
1482	10/4/2016	SB	Gill Netting	Echo Bay	465	436	840	Y
1483	10/4/2016	SB	Gill Netting	Echo Bay	434	410	530	Y
1484	10/4/2016	SB	Gill Netting	Echo Bay	383	361	550	Y
1485	10/4/2016	SB	Gill Netting	Echo Bay	425	398	600	Y
1486	10/4/2016	SB	Gill Netting	Echo Bay	382	359	550	Y
1487	10/4/2016	SB	Gill Netting	Echo Bay	344	321	410	Y
1488	10/4/2016	SB	Gill Netting	Echo Bay	162	153	50	Y
1489	10/4/2016	SMB	Gill Netting	Echo Bay	358	345	580	Y
1490	10/5/2016	LMB	Gill Netting	Black Point	310	300	340	N
1491	10/5/2016	LMB	Gill Netting	Black Point	299	290	370	N
1492	10/5/2016	LMB	Gill Netting	Black Point	275	262	260	Y
1493	10/5/2016	LMB	Gill Netting	Black Point	175	165	---	Y
1494	10/5/2016	SB	Gill Netting	Black Point	310	304	370	N
1495	10/5/2016	LMB	Gill Netting	Bluepoint Bay	374	365	810	Y
1496	10/5/2016	LMB	Gill Netting	Bluepoint Bay	330	316	540	Y
1497	10/5/2016	LMB	Gill Netting	Bluepoint Bay	428	415	1,120	Y
1498	10/5/2016	SB	Gill Netting	Bluepoint Bay	345	318	360	Y
1499	10/5/2016	SB	Gill Netting	Bluepoint Bay	475	440	1,010	Y
1500	10/5/2016	SMB	Gill Netting	Cottonwood	400	380	800	N
1501	10/5/2016	SB	Gill Netting	Cottonwood	455	422	560	Y
1502	10/5/2016	SB	Gill Netting	Cottonwood	465	428	660	Y
1504	10/5/2016	SB	Gill Netting	Stewarts Bay	229	217	120	Y
1505	10/6/2016	SMB	Gill Netting	Cathedral Cove	494	469	1,590	N
1506	10/6/2016	SB	Gill Netting	Cathedral Cove	466	432	600	Y
1507	10/6/2016	SB	Gill Netting	Ramshead	440	410	460	Y
1508	10/6/2016	SB	Gill Netting	Ramshead	435	404	640	Y
1509	10/6/2016	SB	Gill Netting	Ramshead	410	384	520	Y
1510	10/6/2016	SB	Gill Netting	Preachers Cove	457	429	550	Y
1511	10/6/2016	SB	Gill Netting	Preachers Cove	474	434	760	Y
1512	10/6/2016	SB	Gill Netting	Preachers Cove	410	377	630	Y
1513	10/6/2016	SB	Gill Netting	Preachers Cove	367	337	410	Y
1514	10/13/2016	SMB	Gill Netting	James Bay	298	282	300	N
1515	10/13/2016	LMB	Gill Netting	Sidewinder	322	310	410	N
1516	10/13/2016	SMB	Gill Netting	Sidewinder	147	140	20	Y
1517	10/13/2016	SB	Gill Netting	Sidewinder	485	452	720	Y
1518	10/13/2016	LMB	Gill Netting	Bearing Point	312	298	380	N
1519	10/13/2016	LMB	Gill Netting	Bearing Point	311	299	390	N
1520	10/13/2016	SMB	Gill Netting	Bearing Point	328	324	490	Y
1521	10/13/2016	SMB	Gill Netting	Bearing Point	327	316	520	Y
1523	10/13/2016	LMB	Gill Netting	Auxiliary Point	389	372	680	N
1524	10/13/2016	SMB	Gill Netting	Auxiliary Point	234	225	150	Y
1525	10/17/2016	LMB	Electroshocking	Last Chance	386	---	---	N
1526	10/21/2016	LMB	Gill Netting	Hideaway Cove	212	204	80	Y
1527	10/21/2016	SMB	Gill Netting	Hideaway Cove	235	225	110	N
1528	10/21/2016	SMB	Gill Netting	Hideaway Cove	209	201	80	Y
1529	10/21/2016	SB	Gill Netting	Hideaway Cove	460	431	630	N

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1530	10/21/2016	SMB	Gill Netting	Callville Wash	370	356	710	y
1531	10/21/2016	SB	Gill Netting	Callville Wash	524	495	1,380	N
1532	10/21/2016	SB	Gill Netting	Callville Bay	404	378	560	Y
1533	10/21/2016	SB	Gill Netting	Callville Bay	478	447	670	Y
1534	10/25/2016	SB	Gill Netting	Pyramid Island	486	463	660	Y
1535	10/25/2016	SB	Gill Netting	Pyramid Island	305	293	280	Y
1536	10/25/2016	SB	Gill Netting	Pyramid Island	165	153	40	Y
1537	10/25/2016	SB	Gill Netting	Pyramid Island	181	170	40	Y
1538	10/25/2016	SB	Gill Netting	Pyramid Island	471	436	580	Y
1539	10/25/2016	SB	Gill Netting	Pyramid Island	409	380	590	Y
1540	10/25/2016	LMB	Gill Netting	Saddle Cove	327	311	460	N
1541	10/21/2016	SB	Gill Netting	Lovers Cove	460	431	630	Y
1600	3/12/2017	SB	Tournament	Unknown	448	420	794	N
1601	3/12/2017	SB	Tournament	Unknown	655	610	2,200	Y
1602	3/12/2017	SB	Tournament	Unknown	567	530	1,293	N
1603	3/12/2017	SB	Tournament	Unknown	450	415	612	N
1604	3/12/2017	SB	Tournament	Unknown	486	450	907	N
1605	3/12/2017	SB	Tournament	Unknown	447	415	748	N
1606	3/12/2017	SB	Tournament	Unknown	506	470	1,134	N
1607	3/12/2017	SB	Tournament	Unknown	295	272	249	N
1608	3/12/2017	SB	Tournament	Unknown	465	430	930	N
1609	4/1/2017	LMB	Tournament	Unknown	478	457	1,220	Y
1610	4/15/2017	SMB	Tournament	Unknown	427	406	1,030	Y
1611	4/15/2017	SMB	Tournament	Unknown	450	425	1,200	Y
1612	4/15/2017	SMB	Tournament	Unknown	439	419	1,120	Y
1613	9/8/2017	SMB	Tournament	Unknown	324	310	400	Y
1614	9/8/2017	SMB	Tournament	Unknown	410	390	910	Y
1615	9/8/2017	SMB	Tournament	Unknown	435	415	1,030	Y
1616	9/8/2017	SMB	Tournament	Unknown	340	325	500	Y
1617	9/8/2017	SMB	Tournament	Unknown	342	325	500	Y
1618	9/8/2017	SMB	Tournament	Unknown	440	418	1,110	Y
1619	9/8/2017	SMB	Tournament	Unknown	356	336	660	Y
1620	9/8/2017	SMB	Tournament	Unknown	392	375	780	Y
1621	9/8/2017	SMB	Tournament	Unknown	430	407	1,080	Y
1622	9/8/2017	SMB	Tournament	Unknown	354	336	600	Y
1623	9/8/2017	SMB	Tournament	Unknown	393	374	850	Y
1624	9/8/2017	LMB	Tournament	Unknown	555	530	3,070	Y
1625	9/8/2017	SMB	Tournament	Unknown	465	440	1,370	Y
1626	9/8/2017	SMB	Tournament	Unknown	405	382	850	Y
1627	9/8/2017	SMB	Tournament	Unknown	325	310	420	Y
1628	9/8/2017	SMB	Tournament	Unknown	415	395	970	Y
1629	9/8/2017	LMB	Tournament	Unknown	367	350	590	Y
1630	9/8/2017	SMB	Tournament	Unknown	357	338	580	Y
1631	9/8/2017	SMB	Tournament	Unknown	377	361	670	Y
1632	9/8/2017	SMB	Tournament	Unknown	383	360	720	Y
1633	9/8/2017	SMB	Tournament	Unknown	360	338	610	Y
1634	9/8/2017	SMB	Tournament	Unknown	417	397	960	Y
1635	9/8/2017	SMB	Tournament	Unknown	342	322	500	Y
1636	9/8/2017	SMB	Tournament	Unknown	412	387	920	Y
1637	9/8/2017	SMB	Tournament	Unknown	398	375	810	Y
1638	9/8/2017	SMB	Tournament	Unknown	364	346	640	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1639	9/8/2017	SMB	Tournament	Unknown	330	312	470	Y
1640	9/8/2017	SMB	Tournament	Unknown	346	330	490	Y
1641	9/9/2017	SMB	Tournament	Unknown	400	478	840	Y
1642	9/9/2017	SMB	Tournament	Unknown	334	315	460	Y
1643	9/9/2017	SMB	Tournament	Unknown	353	334	590	Y
1644	9/9/2017	SMB	Tournament	Unknown	405	384	980	Y
1645	9/9/2017	SMB	Tournament	Unknown	346	331	570	Y
1646	9/9/2017	SMB	Tournament	Unknown	440	423	1,200	Y
1647	9/9/2017	SMB	Tournament	Unknown	495	470	740	Y
1648	9/9/2017	SMB	Tournament	Unknown	335	320	430	Y
1649	9/9/2017	SMB	Tournament	Unknown	460	440	1,440	Y
1650	9/9/2017	SMB	Tournament	Unknown	328	311	460	Y
1651	9/9/2017	SMB	Tournament	Unknown	365	348	640	y
1652	9/9/2017	SMB	Tournament	Unknown	317	302	440	Y
1653	9/9/2017	SMB	Tournament	Unknown	402	379	840	Y
1654	9/9/2017	LMB	Tournament	Unknown	365	350	690	Y
1655	9/9/2017	SMB	Tournament	Unknown	333	315	460	Y
1656	9/9/2017	SMB	Tournament	Unknown	380	357	730	Y
1657	9/9/2017	SMB	Tournament	Unknown	355	334	520	Y
1658	9/9/2017	SMB	Tournament	Unknown	348	330	560	Y
1659	9/9/2017	SMB	Tournament	Unknown	385	365	710	Y
1660	9/9/2017	SMB	Tournament	Unknown	400	378	850	Y
1661	9/14/2017	SB	Creel	Vegas Wash	347	320	410	Y
1662	9/14/2017	SB	Creel	Vegas Wash	408	377	700	Y
1663	9/14/2017	SB	Creel	Vegas Wash	383	357	590	Y
1664	9/14/2017	SB	Creel	Vegas Wash	453	418	700	Y
1665	9/14/2017	SB	Creel	Vegas Wash	433	401	670	Y
1666	9/14/2017	SB	Creel	Vegas Wash	363	335	470	Y
1667	9/14/2017	SB	Creel	Vegas Wash	410	380	590	Y
1668	9/14/2017	SB	Creel	Vegas Wash	454	426	920	Y
1669	9/14/2017	SB	Creel	Vegas Wash	355	329	440	Y
1670	9/14/2017	SB	Creel	Vegas Wash	383	354	540	Y
1671	9/14/2017	SB	Creel	Vegas Wash	429	397	740	Y
1672	9/14/2017	SB	Creel	Vegas Wash	372	343	480	Y
1673	10/4/2017	SMB	Gill Netting	Bearing Point	249	226	170	Y
1674	10/4/2017	SMB	Gill Netting	Bearing Point	236	225	150	Y
1675	10/4/2017	SMB	Gill Netting	Bearing Point	158	149	10	Y
1676	10/4/2017	LMB	Gill Netting	Auxiliary	310	295	800	Y
1677	10/11/2017	SMB	Gill Netting	Azure Cove	251	243	200	Y
1678	10/11/2017	SB	Gill Netting	Azure Cove	431	397	650	Y
1679	10/11/2017	SB	Gill Netting	Preachers Cove	351	322	400	Y
1680	10/11/2017	SB	Gill Netting	Ramshead	448	416	740	Y
1681	10/11/2017	SB	Gill Netting	Ramshead	346	321	360	Y
1682	10/11/2017	SMB	Gill Netting	Ramshead	235	225	140	Y
1683	10/12/2017	SB	Gill Netting	Anchor Cove	469	444	720	Y
1684	10/12/2017	SB	Gill Netting	Anchor Cove	456	422	680	Y
1685	10/12/2017	LMB	Gill Netting	Anchor Cove	164	157	60	Y
1686	10/12/2017	LMB	Gill Netting	Anchor Cove	310	302	380	Y
1687	10/12/2017	LMB	Gill Netting	Anchor Cove	165	154	60	Y
1688	10/12/2017	SMB	Gill Netting	Anchor Cove	182	175	80	Y
1689	10/12/2017	SB	Gill Netting	Calico Bay	328	307	300	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1690	10/12/2017	LMB	Gill Netting	Calico Bay	246	236	160	Y
1691	10/12/2017	LMB	Gill Netting	Calico Bay	222	215	120	Y
1692	10/12/147	LMB	Gill Netting	Calico Bay	216	200	100	Y
1693	10/12/2017	SB	Gill Netting	Rogers Bay	463	427	580	Y
1694	10/12/2017	SB	Gill Netting	Rogers Bay	326	309	380	Y
1695	10/12/2017	SB	Gill Netting	Whale Rock	216	203	90	Y
1696	10/12/2017	SB	Gill Netting	Whale Rock	477	441	930	Y
1697	10/12/2017	LMB	Gill Netting	Whale Rock	211	203	100	Y
1698	10/12/2017	SB	Gill Netting	Whale Rock	226	209	100	Y
1699	10/12/2017	SB	Gill Netting	Whale Rock	196	184	70	Y
1700	10/16/2017	SMB	Tournament	Callville Bay	346	329	490	Y
1701	10/16/2017	LMB	Tournament	Callville Bay	340	327	520	Y
1702	10/16/2017	SMB	Tournament	Callville Bay	334	316	480	Y
1703	10/16/2017	SMB	Tournament	Callville Bay	451	427	1,180	Y
1704	10/16/2017	SMB	Tournament	Callville Bay	321	301	410	Y
1705	10/16/2017	LMB	Tournament	Callville Bay	390	372	810	Y
1706	10/16/2017	SMB	Tournament	Callville Bay	419	396	950	Y
1707	10/16/2017	SMB	Tournament	Callville Bay	338	318	450	Y
1708	10/16/2017	SMB	Tournament	Callville Bay	397	380	740	Y
1709	10/17/2017	SMB	Tournament	Callville Bay	444	422	970	Y
1710	10/17/2017	SMB	Tournament	Callville Bay	332	319	490	N
1711	10/17/2017	LMB	Tournament	Callville Bay	379	363	670	Y
1712	10/17/2017	LMB	Tournament	Callville Bay	517	504	2,090	Y
1713	10/18/2017	SMB	Tournament	Callville Bay	406	385	840	Y
1714	10/18/2017	SMB	Tournament	Callville Bay	368	354	680	Y
1715	10/18/2017	SMB	Tournament	Callville Bay	382	359	720	Y
1716	10/18/2017	SMB	Tournament	Callville Bay	422	403	1,050	Y
1717	10/18/2017	SMB	Tournament	Callville Bay	336	321	440	Y
1718	10/18/2017	SMB	Tournament	Callville Bay	379	365	690	Y
1719	10/19/2017	SB	Gill Netting	Black Point	239	222	130	Y
1720	10/19/2017	SB	Gill Netting	Black Point	214	199	110	Y
1721	10/19/2017	SB	Gill Netting	Black Point	224	208	120	Y
1722	10/19/2017	SB	Gill Netting	Black Point	231	218	140	Y
1723	10/19/2017	SB	Gill Netting	Black Point	355	327	430	Y
1724	10/19/2017	SB	Gill Netting	Black Point	466	438	610	Y
1725	10/19/2017	SB	Gill Netting	Black Point	234	220	140	Y
1726	10/19/2017	SB	Gill Netting	Black Point	599	552	1,220	Y
1727	10/19/2017	SMB	Gill Netting	Black Point	227	219	150	Y
1728	10/19/2017	SB	Gill Netting	Bluepoint Bay	421	392	660	Y
1729	10/19/2017	SB	Gill Netting	Bluepoint Bay	487	449	820	Y
1730	10/19/2017	SB	Gill Netting	Bluepoint Bay	341	315	350	Y
1731	10/19/2017	SB	Gill Netting	Bluepoint Bay	400	367	540	Y
1732	10/19/2017	SB	Gill Netting	Bluepoint Bay	311	286	210	Y
1733	10/19/2017	SB	Gill Netting	Stewarts Bay	478	443	970	Y
1734	10/12/2017	SB	Gill Netting	Lime Cove	229	214	130	Y
1735	10/4/2017	SB	Gill Netting	James Bay	303	282	310	Y
1736	10/4/2017	SB	Gill Netting	James Bay	394	367	630	Y
1737	10/4/2017	SB	Gill Netting	James Bay	366	339	500	Y
1738	10/4/2017	SB	Gill Netting	James Bay	365	338	470	Y
1739	10/4/2017	SB	Gill Netting	James Bay	362	335	470	Y
1740	10/4/2017	SB	Gill Netting	James Bay	412	381	680	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1741	10/4/2017	SMB	Gill Netting	James Bay	290	278	300	N
1742	10/4/2017	SMB	Gill Netting	James Bay	176	168	60	N
1743	10/4/2017	SMB	Gill Netting	James Bay	307	293	350	Y
1744	11/14/2017	SB	Gill Netting	Catclaw Cove	71	58	30	Y
1800	2/27/2018	SB	Trammel Net	Las Vegas Bay	470	434	760	Y
1801	2/27/2018	SB	Trammel Net	Las Vegas Bay	488	450	1,020	Y
1802	2/27/2018	SB	Trammel Net	Las Vegas Bay	480	440	740	Y
1803	2/27/2018	SB	Trammel Net	Las Vegas Bay	421	394	680	Y
1804	2/27/2018	SB	Trammel Net	Las Vegas Bay	485	446	810	Y
1805	2/27/2018	SB	Trammel Net	Las Vegas Bay	401	374	690	Y
1806	2/27/2018	SB	Trammel Net	Las Vegas Bay	453	422	710	Y
1807	2/27/2018	SB	Trammel Net	Las Vegas Bay	450	416	950	Y
1808	2/27/2018	SB	Trammel Net	Las Vegas Bay	465	425	840	Y
1809	2/27/2018	SB	Trammel Net	Las Vegas Bay	418	395	600	Y
1810	2/27/2018	SB	Trammel Net	Las Vegas Bay	455	420	840	Y
1811	2/27/2018	SB	Trammel Net	Las Vegas Bay	408	380	640	Y
1812	2/27/2018	SB	Trammel Net	Las Vegas Bay	432	402	560	Y
1813	2/27/2018	SB	Trammel Net	Las Vegas Bay	380	355	570	Y
1814	2/27/2018	SB	Trammel Net	Las Vegas Bay	455	425	780	Y
1815	2/27/2018	SB	Trammel Net	Las Vegas Bay	431	408	840	Y
1816	2/27/2018	SB	Trammel Net	Las Vegas Bay	395	364	460	Y
1817	2/27/2018	SB	Trammel Net	Las Vegas Bay	455	420	690	Y
1818	2/27/2018	SB	Trammel Net	Las Vegas Bay	454	423	860	Y
1819	2/27/2018	SB	Trammel Net	Las Vegas Bay	310	290	310	Y
1820	2/27/2018	SB	Trammel Net	Las Vegas Bay	480	445	930	Y
1821	2/27/2018	SB	Trammel Net	Las Vegas Bay	429	396	650	Y
1822	2/27/2018	SB	Trammel Net	Las Vegas Bay	480	441	880	Y
1823	2/27/2018	SB	Trammel Net	Las Vegas Bay	455	425	960	Y
1824	2/27/2018	SB	Trammel Net	Las Vegas Bay	356	329	420	Y
1825	2/27/2018	SB	Trammel Net	Las Vegas Bay	327	311	410	Y
1826	2/27/2018	SB	Trammel Net	Las Vegas Bay	524	484	1,380	Y
1827	3/7/2018	LMB	Trammel Net	Pumphouse	360	342	650	N
1828	3/7/2018	LMB	Trammel Net	Pumphouse	420	411	1,222	N
1829	3/7/2018	LMB	Trammel Net	Pumphouse	435	418	1,350	N
1830	3/7/2018	LMB	Trammel Net	Pumphouse	395	379	860	N
1831	3/7/2018	SB	Trammel Net	Echo Bay	429	398	500	N
1832	3/7/2018	SB	Trammel Net	Echo Bay	466	433	700	N
1833	3/7/2018	SB	Trammel Net	Echo Bay	473	439	670	N
1835	3/6/2018	SB	Trammel Net	Overton Arm	490	459	840	N
1836	3/6/2018	SB	Trammel Net	Overton Arm	439	408	640	N
1837	3/6/2018	SB	Trammel Net	Overton Arm	595	550	1,780	N
1838	3/6/2018	SMB	Trammel Net	Echo Bay	309	294	330	N
1839	3/6/2018	SB	Trammel Net	Echo Bay	506	464	1,120	N
1840	3/6/2018	SB	Trammel Net	Echo Bay	425	400	730	N
1841	3/6/2018	LMB	Trammel Net	Echo Bay	502	481	2,010	N
1842	3/1/2018	SB	Trammel Net	Echo Bay	480	430	715	N
1843	3/1/2018	LMB	Trammel Net	Echo Bay	315	290	415	N
1844	3/1/2018	SMB	Trammel Net	Echo Bay	332	310	495	N
1845	3/1/2018	LMB	Trammel Net	Echo Bay	472	460	795	N
1846	3/1/2018	LMB	Trammel Net	Echo Bay	292	278	300	N
1847	3/1/2018	LMB	Trammel Net	Echo Bay	295	282	305	N

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1848	3/1/2018	LMB	Trammel Net	Echo Bay	338	325	495	N
1849	3/1/2018	LMB	Trammel Net	Echo Bay	307	292	375	N
1850	3/1/2018	SMB	Trammel Net	Echo Bay	300	281	315	N
1851	2/26/2018	SMB	Trammel Net	Las Vegas Bay	360	342	510	N
1852	2/26/2018	SB	Trammel Net	Las Vegas Bay	450	412	670	N
1853	2/26/2018	SB	Trammel Net	Las Vegas Bay	469	436	1,050	N
1854	2/26/2018	SB	Trammel Net	Las Vegas Bay	441	407	545	N
1855	2/26/2018	SB	Trammel Net	Las Vegas Bay	470	435	1,100	N
1856	2/26/2018	SB	Trammel Net	Las Vegas Bay	443	410	700	N
1857	2/26/2018	SB	Trammel Net	Las Vegas Bay	457	420	1,005	N
1858	2/26/2018	SB	Trammel Net	Las Vegas Bay	466	435	935	N
1859	2/26/2018	SB	Trammel Net	Las Vegas Bay	445	410	660	N
1860	2/26/2018	SB	Trammel Net	Las Vegas Bay	455	390	720	N
1861	2/26/2018	SB	Trammel Net	Las Vegas Bay	420	400	800	N
1862	2/26/2018	SB	Trammel Net	Las Vegas Bay	470	435	1,030	N
1863	2/26/2018	SB	Trammel Net	Las Vegas Bay	456	485	670	N
1864	2/26/2018	SB	Trammel Net	Las Vegas Bay	426	395	700	N
1865	2/26/2018	SB	Trammel Net	Las Vegas Bay	403	370	565	N
1866	2/26/2018	SB	Trammel Net	Las Vegas Bay	450	469	770	N
1867	3/6/2018	LMB	Trammel Net	Echo Bay	450	434	1,340	N
1868	3/7/2018	SB	Trammel Net	Overton Arm	514	478	900	Y
1869	3/30/2018	LMB	Trammel Net	Bonelli Bay	372	357	690	Y
1870	3/30/2018	LMB	Trammel Net	Bonelli Bay	330	320	520	N
1871	4/3/2018	LMB	Trammel Net	Bonelli Bay	465	437	1,580	N
1872	4/3/2018	LMB	Trammel Net	Bonelli Bay	548	525	2,500	N
1873	4/3/2018	LMB	Trammel Net	Bonelli Bay	292	277	350	N
1874	4/3/2018	LMB	Trammel Net	Bonelli Bay	303	287	370	N
1875	4/3/2018	SMB	Trammel Net	Bonelli Bay	297	280	330	N
1876	4/3/2018	SB	Trammel Net	Bonelli Bay	485	446	860	N
1877	4/3/2018	SB	Trammel Net	Bonelli Bay	500	460	920	N
1878	6/17/2018	SB	Tournament	Boulder Basin	486	453	1,089	Y
1879	6/17/2018	SB	Tournament	Boulder Basin	435	408	771	Y
1880	6/17/2018	SB	Tournament	Boulder Basin	440	408	726	Y
1881	6/17/2018	SB	Tournament	Gov't Wash	475	440	907	Y
1882	6/17/2018	SB	Tournament	Gov't Wash	466	430	839	Y
1883	6/17/2018	SB	Tournament	Gov't Wash	444	410	748	Y
1884	6/17/2018	SB	Tournament	Gov't Wash	444	411	748	Y
1885	6/17/2018	SB	Tournament	Vegas Wash	465	430	1,440	Y
1886	6/17/2018	SB	Tournament	Gov't Wash	527	486	1,179	Y
1887	6/17/2018	SB	Tournament	Gov't Wash	495	458	748	Y
1888	6/17/2018	SB	Tournament	Vegas Wash	516	480	1,270	Y
1889	6/17/2018	SB	Tournament	Vegas Wash	510	475	1,202	Y
1890	6/17/2018	SB	Tournament	Vegas Wash	510	475	1,156	Y
1891	6/17/2018	SB	Tournament	Vegas Wash	488	455	1,020	Y
1892	6/17/2018	SB	Tournament	Vegas Wash	566	525	1,542	Y
1893	6/17/2018	SB	Tournament	Vegas Wash	513	475	1,179	Y
1894	6/17/2018	SB	Tournament	Vegas Wash	499	465	1,088	Y
1895	6/17/2018	SB	Tournament	Vegas Wash	495	465	1,065	Y
1897	9/16/2018	SB	Tournament	Unknown	480	449	890	N
1898	9/16/2018	SB	Tournament	Unknown	475	440	850	N
1896	9/16/2018	SB	Tournament	Unknown	543	503	1,160	Y

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1899	9/16/2018	SB	Tournament	Unknown	490	450	910	Y
1900	9/16/2018	SB	Tournament	Unknown	492	455	930	Y
1901	10/3/2018	SB	Gill Netting	Lovers Cove	362	338	470	Y
1902	10/3/2018	SB	Gill Netting	Lovers Cove	349	324	450	Y
1903	10/3/2018	SB	Gill Netting	Lovers Cove	215	201	100	Y
1904	10/3/2018	SB	Gill Netting	Lovers Cove	226	209	120	Y
1905	10/3/2018	LMB	Gill Netting	Water Barge	390	374	720	Y
1906	10/3/2018	SB	Gill Netting	Roadrunner	514	475	1,190	Y
1907	10/3/2018	LMB	Gill Netting	Water Barge	231	222	90	N
1908	10/4/2018	SB	Gill Netting	Anchor Cove	478	444	910	Y
1909	10/4/2018	SB	Gill Netting	Anchor Cove	451	420	630	Y
1910	10/4/2018	SB	Gill Netting	Anchor Cove	461	420	630	Y
1911	10/4/2018	SB	Gill Netting	Anchor Cove	429	403	420	Y
1912	10/4/2018	SB	Gill Netting	Anchor Cove	405	369	540	Y
1913	10/4/2018	LMB	Gill Netting	Cottonwood	278	263	270	N
1914	10/4/2018	SMB	Gill Netting	Cottonwood	165	158	---	N
1915	10/4/2018	SB	Gill Netting	Cottonwood	391	368	460	Y
1916	10/4/2018	SB	Gill Netting	Cottonwood	421	393	420	Y
1917	10/4/2018	LMB	Gill Netting	Quail Bay	164	156	30	Y
1918	10/4/2018	SMB	Gill Netting	Cottonwood	350	334	530	N
1919	10/4/2018	SB	Gill Netting	Echo Bay	338	315	380	Y
1920	10/4/2018	SB	Gill Netting	Echo Bay	435	410	520	Y
1921	10/4/2018	LMB	Gill Netting	Cottonwood	446	430	1,220	N
1922	10/5/2018	LMB	Gill Netting	Flamingo	419	401	880	N
1923	10/5/2018	SMB	Gill Netting	Bearing Point	338	363	740	N
1924	10/9/2018	LMB	Gill Netting	Cathedral Cove	214	---	120	Y
1925	10/9/2018	LMB	Gill Netting	Cathedral Cove	291	---	290	Y
1926	10/9/2018	SB	Gill Netting	Lime Cove	487	450	820	Y
1927	10/9/2018	LMB	Gill Netting	Glory Hole	455	---	1,340	N
1928	10/16/2018	LMB	Tournament	Unknown	378	364	730	Y
1929	10/16/2018	LMB	Tournament	Unknown	363	346	630	Y
1930	10/17/2018	LMB	Tournament	Unknown	393	378	690	Y
1931	10/19/2018	LMB	Gill Netting	Hamblin Bay	419	---	960	N
1932	10/19/2018	SB	Gill Netting	Finger Cove	507	476	1,330	Y
1933	10/19/2018	SMB	Gill Netting	Finger Cove	321	---	430	N
1934	10/19/2018	LMB	Gill Netting	Indian Canyon	359	---	550	N
1935	10/19/2018	SMB	Gill Netting	Finger Cove	355	---	600	N
1936	10/19/2018	LMB	Gill Netting	Finger Cove	311	---	450	Y
1937	10/19/2018	SB	Gill Netting	Beacon Rock	498	464	1,120	Y
1938	11/2/2018	SB	Gill Netting	Bluepoint Bay	399	368	550	Y
1939	11/2/2018	SB	Gill Netting	Stewarts Bay	220	201	100	Y
1940	11/2/2018	LMB	Gill Netting	Rogers Bay	214	---	60	Y
1941	11/2/2018	SB	Gill Netting	Bluepoint Bay	451	418	840	Y
1942	11/2/2018	LMB	Gill Netting	Rogers Bay	217	---	90	Y
1943	11/2/2018	SB	Gill Netting	Bluepoint Bay	394	365	620	Y
1944	11/2/2018	SB	Gill Netting	Bluepoint Bay	355	330	440	Y
1945	11/2/2018	SB	Gill Netting	Stewarts Bay	219	202	90	Y
1946	11/2/2018	SB	Gill Netting	Fultons Reef	384	355	340	Y
1947	11/2/2018	SB	Gill Netting	Bluepoint Bay	229	211	130	Y
1948	11/2/2018	SB	Gill Netting	Fultons Reef	221	205	110	Y
1949	11/2/2018	LMB	Gill Netting	Bluepoint Bay	350	---	600	N

Envelope Number	Date	Species	Survey type	Area caught	TL mm	FL mm	Weight g	Otolith Y/N
1950	11/2/2018	LMB	Gill Netting	Rogers Bay	290	279	290	N
1951	11/2/2018	SB	Gill Netting	Stewarts Bay	226	214	80	Y
1952	11/2/2018	SB	Gill Netting	Belsmeir Beach	213	199	240	Y
1953	11/2/2018	SB	Gill Netting	Belsmeir Beach	196	184	90	Y
1954	11/2/2018	SB	Gill Netting	Belsmeir Beach	399	371	580	Y
1955	11/2/2018	SB	Gill Netting	Belsmeir Beach	405	376	620	Y
1956	11/2/2018	SB	Gill Netting	Fire Bay	720	673	3,420	N
1957	11/2/2018	LMB	Gill Netting	Fultons Reef	204	194	110	N
1958	11/2/2018	LMB	Gill Netting	Fultons Reef	162	155	50	Y
1959	11/2/2018	LMB	Gill Netting	Fultons Reef	216	206	120	Y
1960	11/2/2018	SB	Gill Netting	Fire Bay	176	163	60	Y
1961	11/2/2018	SB	Gill Netting	Fire Bay	496	472	1,170	Y
1962	11/2/2018	SB	Gill Netting	Fultons Reef	215	203	110	Y
1963	11/2/2018	LMB	Gill Netting	Fultons Reef	162	155	50	Y
1964	11/2/2018	SB	Gill Netting	Fultons Reef	214	201	100	Y
1965	11/2/2018	SB	Gill Netting	Fultons Reef	220	205	100	Y
1966	11/2/2018	SB	Gill Netting	Fultons Reef	219	201	110	Y
1967	11/2/2018	SB	Gill Netting	Fultons Reef	234	216	120	Y
1968	11/2/2018	LMB	Gill Netting	Fultons Reef	174	163	60	Y
1969	11/2/2018	SB	Gill Netting	Fultons Reef	221	205	110	Y
1970	11/2/2018	SB	Gill Netting	Fultons Reef	320	301	340	Y
1971	11/6/2018	SB	Gill Netting	Salt Bay	562	525	1,690	N
1972	11/6/2018	LMB	Gill Netting	Salt Bay	230	222	160	Y
1973	11/6/2018	SB	Gill Netting	Salt Bay	411	382	670	Y
1974	11/6/2018	SB	Gill Netting	Salt Bay	487	446	930	Y
1975	11/6/2018	LMB	Gill Netting	Salt Bay	246	235	190	N
1976	11/6/2018	SB	Gill Netting	Sand Island	411	381	620	Y
1977	11/6/2018	SB	Gill Netting	Sand Island	448	417	770	Y
1978	11/6/2018	SB	Gill Netting	Salt Bay	434	412	620	Y
1979	11/6/2018	SB	Gill Netting	The Meadows	222	207	100	Y
1980	11/6/2018	SB	Gill Netting	Sand Island	442	406	700	Y
1981	11/6/2018	SB	Gill Netting	Sand Island	466	431	910	Y
1982	11/6/2018	SB	Gill Netting	Salt Bay	166	151	30	Y
1983	11/6/2018	SB	Gill Netting	Salt Bay	196	182	60	Y
1984	11/6/2018	SB	Gill Netting	Salt Bay	182	173	40	Y
1985	11/6/2018	SB	Gill Netting	Salt Bay	192	177	50	Y
1986	11/6/2018	LMB	Gill Netting	Salt Bay	214	205	130	Y

Appendix 2. Floy tagged smallmouth bass (SMB), largemouth bass (LMB), and striped bass (SB), 2016-2018.

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 The Meadows	515	412	480
5458	3/23/2016	LMB	N. of The Meadows	405	394	850
5459	3/23/2016	LMB	N. of The Meadows	383	375	810
5461	3/23/2016	LMB	N. of The Meadows	235	215	130
5462	3/23/2016	LMB	N. of The Meadows	219	208	130
5463	3/23/2016	LMB	N. of The Meadows	221	212	130
5464	3/23/2016	LMB	N. of The Meadows	360	342	560
5465	3/23/2016	LMB	N. of The Meadows	209	196	140
5466	3/23/2016	LMB	N. of The 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	1,170
5468	3/24/2016	LMB	The Meadows	335	325	475
5469	3/24/2016	LMB	The Meadows	375	360	670
5475	3/24/2016	SB	The Meadows	526	485	1,170
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	1,590
5550	10/12/2016	SMB	James Bay	298	282	300
5550*	10/24/2016	SMB	Middle of narrows	Not	measured	
7700	10/12/2016	LMB	Sidewinder Cove	322	310	410
7699	10/12/2016	SMB	Bearing Point	327	316	520
7698	10/12/2016	LMB	Auxiliary Point	389	372	680
7697	10/17/2016	LMB	Last Chance Cove	386	---	---
7696	10/20/2016	SMB	Hideaway Cove	235	225	110
7695	10/20/2016	SB	Callville Wash	524	495	1,380
7694	10/24/2016	LMB	Saddle Cove	327	311	460
5648	3/21/2017	SMB	Echo Bay	344	325	510
5649	3/21/2017	LMB	Echo Bay	440	421	1,140
5650	3/21/2017	SMB	Echo Bay	310	295	330
5627	10/4/2017	SMB	Bearing Point	231	219	130
5401	10/4/2017	SMB	Bearing Point	161	155	40
5628	10/4/2017	LMB	Bearing Point	302	290	400
5630	10/4/2017	SB	Bearing Point	330	309	390
5626	10/4/2017	LMB	Bearing Point	260	249	240
5403	10/4/2017	SMB	Bearing Cove	306	291	370
5402	10/4/2017	LMB	Bearing Cove	296	281	320
5407	10/4/2017	SMB	Auxiliary Cove	321	301	920
5408	10/4/2017	SMB	Auxiliary Cove	345	326	500
5408*	10/17/2017	SMB	Unknown/harvest	332	319	490
5409	10/4/2017	SMB	Auxiliary Cove	256	245	240
5410	10/4/2017	SMB	Auxiliary Cove	422	399	840
5411	10/4/2017	SMB	Quiet Cove	381	358	710
5412	10/4/2017	SMB	Quiet Cove	303	290	330
5413	10/4/2017	LMB	Quiet Cove	286	269	290

Tag number	Date	Species	Capture site	TL mm	FL mm	WT g
5414	10/4/2017	LMB	Quiet Cove	345	329	480
5416	10/10/2017	LMB	Painters Cove	483	460	1,710
5417	10/10/2017	SMB	Painters Cove	167	161	60
5418	10/10/2017	SMB	Painters Cove	144	137	40
5421	10/10/2017	LMB	Rock Island	268	255	5,421
5422	10/10/2017	LMB	Boulder Island	449	421	940
5423	10/10/2017	SMB	Boulder Island	261	254	210
5424	10/10/2017	LMB	Boulder Island	332	317	500
5426	10/11/2017	SMB	Cathedral Cove	241	---	170
5427	10/11/2017	SB	Ramshead Island	510	472	670
5428	10/11/2017	SB	Preachers Cove	479	441	830
5429	10/11/2017	SMB	Preachers Cove	436	418	1,360
5429*	10/18/2017	SMB	Unknown/tournament live release	439	419	1,280
5430	10/11/2017	SMB	Preachers Cove	299	286	310
5431	10/11/2017	SMB	Preachers Cove	330	314	430
5431*	10/18/2017	SMB	Unknown/tournament live release	334	312	440
5432	10/11/2017	SMB	Cottonwood Cove	200	193	120
5432*	10/26/2017	SMB	Boulder Islands/live release	~279	---	---
5433	10/11/2017	LMB	Cottonwood Cove	278	268	250
5434	10/11/2017	LMB	Cottonwood Cove	188	180	70
5435	10/11/2017	LMB	Cottonwood Cove	236	232	140
5437	10/12/2017	SMB	Calico Cove	176	167	50
5438	10/12/2017	SMB	Calico Cove	309	296	300
5439	10/12/2017	SMB	Calico Cove	190	184	60
5440	10/12/2017	SMB	Calico Cove	348	329	500
5441	10/12/2017	LMB	Anchor Cove	210	204	110
5444	10/12/2017	LMB	Anchor Cove	293	284	360
5445	10/12/2017	LMB	Anchor Cove	364	347	500
5446	10/12/2017	LMB	Anchor Cove	300	287	340
5436	10/12/2017	SMB	Whale Rock	286	271	260
510	10/19/2017	LMB	Echo Bay	407	---	1,005
7693	11/14/2017	SB	Twin Springs Cove	473	437	680
7692	11/14/2017	SB	Twin Springs Cove	420	390	400
7691	11/14/2017	SMB	Twin Springs Cove	342	328	500
5447	11/21/2017	LMB	Whale Rock	522	---	2,110
5448	11/21/2017	LMB	Whale Rock	335	---	180
5449	11/21/2017	SB	Quail Bay	300	---	240
5450	11/21/2017	LMB	Heron Island	251	---	180
7635	2/27/2018	SMB	Las Vegas Bay	360	342	510
7636	2/27/2018	SB	Las Vegas Bay	450	412	670
7637	2/27/2018	SB	Las Vegas Bay	469	436	1,050
7638	2/27/2018	SB	Las Vegas Bay	441	407	545
7639	2/27/2018	SB	Las Vegas Bay	470	435	1,100
7640	2/27/2018	SB	Las Vegas Bay	443	410	700
7641	2/27/2018	SB	Las Vegas Bay	457	420	1,005
7642	2/27/2018	SB	Las Vegas Bay	466	435	935
7643	2/27/2018	SB	Las Vegas Bay	445	410	660
7644	2/27/2018	SB	Las Vegas Bay	455	390	720
7645	2/27/2018	SB	Las Vegas Bay	420	400	800
7646	2/27/2018	SB	Las Vegas Bay	470	435	1,030
7647	2/27/2018	SB	Las Vegas Bay	456	485	670
7648	2/27/2018	SB	Las Vegas Bay	426	395	700

Tag number	Date	Species	Capture site	TL mm	FL mm	WT g
7649	2/27/2018	SB	Las Vegas Bay	403	370	565
7650	2/27/2018	SB	Las Vegas Bay	450	469	770
7625	3/1/2018	SB	Echo Bay	480	430	715
7626	3/1/2018	LMB	Echo Bay	315	290	415
7627	3/1/2018	SMB	Echo Bay	332	310	495
7627*	3/29/2018	SMB	Echo Bay	Not	measured	
7628	3/1/2018	LMB	Echo Bay	472	460	795
7629	3/1/2018	SB	Echo Bay	417	393	395
7630	3/1/2018	LMB	Echo Bay	292	278	300
7631	3/1/2018	LMB	Echo Bay	295	282	305
7632	3/1/2018	LMB	Echo Bay	338	325	495
7633	3/1/2018	LMB	Echo Bay	307	292	375
7634	3/1/2018	SMB	Echo Bay	300	281	315
4045	3/6/2018	SB	Echo Bay	450	434	1,340
7614	3/6/2018	SB	Overton Arm	490	459	840
7616	3/6/2018	SB	Overton Arm	439	408	640
7617	3/6/2018	SB	Overton Arm	595	550	1,780
7619	3/6/2018	SMB	Echo Bay	309	294	330
7620	3/6/2018	SB	Echo Bay	506	464	1,120
7621	3/6/2018	SB	Echo Bay	425	400	730
7622	3/6/2018	LMB	Echo Bay	502	481	2,010
7624	3/6/2018	LMB	Echo Bay	372	364	650
7607	3/7/2018	LMB	Echo Bay	395	379	860
7607*	3/20/2018	LMB	Echo Bay	~393	---	---
7608	3/7/2018	SB	Echo Bay	429	398	500
7609	3/7/2018	SB	Echo Bay	466	433	700
7611	3/7/2018	SB	Echo Bay	473	439	670
7604	3/8/2018	LMB	Pumphouse Bay	360	342	650
7605	3/8/2018	LMB	Pumphouse Bay	420	411	1,222
7606	3/8/2018	LMB	Pumphouse Bay	435	418	1,350
7606*	4/6/2018	LMB	Pumphouse Bay	Not	measured	
7603	3/29/2018	LMB	Bonelli Bay	330	320	520
7601	4/2/2018	LMB	Bonelli Bay	465	437	1,580
7602	4/2/2018	LMB	Bonelli Bay	548	525	2,500
8245	4/2/2018	SB	Bonelli Bay	485	446	860
8246	4/2/2018	SMB	Bonelli Bay	291	280	330
8247	4/2/2018	SB	Bonelli Bay	500	460	920
8248	4/2/2018	LMB	Bonelli Bay	292	277	350
8250	4/2/2018	LMB	Bonelli Bay	303	287	370
8201	10/3/2018	LMB	Water Barge	231	222	90
8203	10/4/2018	LMB	Cottonwood Cove	446	430	1,220
8204	10/4/2018	LMB	Cottonwood Cove	278	263	270
8205	10/4/2018	SMB	Cottonwood Cove	350	334	530
8206	10/5/2018	LMB	Flamingo	419	401	880
8207	10/5/2018	SMB	Bearing Point	338	363	740
545	10/8/2018	SMB	S Cove	317	---	200
546	10/8/2018	LMB	S Cove	492	---	1,180
547	10/8/2018	LMB	Ebony Cove	555	---	2,320
8208	10/9/2018	LMB	Glory Hole	455	---	1,340
7052	10/19/2018	LMB	Hamblin Bay	419	---	960
7054	10/19/2018	SMB	Finger Cove	321	---	430
7055	10/19/2018	SMB	Finger Cove	355	---	600

Tag number	Date	Species	Capture site	TL mm	FL mm	WT g
8209	10/19/2018	LMB	Indian Canyon Cove	359	---	550
7688	11/1/2018	SB	Fire Cove	720	673	3,420
7689	11/1/2018	LMB	Fultons Reef	204	194	110
7687	11/2/2018	LMB	Bluepoint Bay	350	---	600
7685	11/2/2018	LMB	Rogers Bay	290	279	290
7683	11/6/2018	SB	Salt Bay	562	525	1,690
7682	11/6/2018	LMB	Salt Bay	246	235	190

*recaptured