

Technical Memorandum No. 86-68220-06-19

The Status of Razorback Suckers in the Colorado River between Davis and Parker Dams (Lake Havasu), 2003 to 2005



U.S. Department of the Interior
Bureau of Reclamation



U.S. Department of the Interior
U.S. Geological Survey

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EXECUTIVE SUMMARY

A great deal has been learned regarding the razorback suckers that were stocked into Lake Havasu. Undoubtedly, this population represents the most successful reintroduction effort of a riverine population of razorback suckers in the Colorado River basin. Probably our greatest accomplishment was the discovery of a large spawning aggregate located upstream of Needles, California. Several hundred spawners were using this site. Access to these fish will help make monitoring more effective in the future. Our sampling data revealed three trends during the past seven years (1999-2005): 1) The catch per unit effort steadily decreased, 2) the sex ratio of fish sampled has reversed, and 3) the majority of fish captured during this study have come from more recent stockings even though they are fewer in number. These trends reflect a maturing adult community that has established and consolidated spawning activities. The absence of any detectible natural recruitment supports our data; indicating the population is in decline. Population estimate during the past three years suggested razorback suckers numbered 3,570 (CL=1,306-8,925) in 2003, 1,768 (CL=878-3,867) in 2004, and 1,652 fish (CL=706 to 5,164) in 2005. Accuracy of these estimates is hindered by the difficulty of contacting large numbers of fish. This issue should be solved by the discovery of the spawning area. The community also contains over 100 razorback suckers from Lake Mohave that successfully came through Davis Dam Power Plant. Overall survival appears to be roughly 5% for the 31,516 razorbacks stocked into Lake Havasu; however, survival rates appear to be greater for fish stocked further upstream. Calculated survival rates based on the rate of returns varied by location and year ranging from 18 to 76% at Laughlin Lagoon, 12 to 19% at Topock Marsh, 5% at Windsor Beach and no fish were contacted that were released in the lower portion of the reservoir.

INTRODUCTION

Since 1993, 31,516 razorback suckers (*Xyrauchen texanus*) and 31,480 bonytail chubs (*Gila elegans*) have been stocked into Lake Havasu and the Colorado River below Davis Dam (Figure 1). These fish were stocked as a multiagency effort to augment or reestablish endangered fish populations in this stretch of the Colorado River as part of the Lake Havasu Fish Improvement Project. The purpose of this study is to determine the present population size of these fish, with particular focus on razorback suckers and to determine where razorback suckers may be spawning.

The U.S. Geological Survey (USGS) and Bureau of Reclamation (BOR) studied the fish community living in the Colorado River from Davis Dam downstream to the Lake Havasu delta from 1999 to 2002 (Mueller, 2003). During this period,

238 razorback suckers and 1 bonytail were collected. Sampling in that study was distributed randomly along the Colorado River from Davis Dam downstream to the Lake Havasu delta. This study further developed what was learned from previous efforts by focusing sampling during the spawning season when suckers congregate and are most vulnerable to capture. The goals of this study were to: 1) maximize contacts with razorback suckers, 2) improve population estimates, and 3) identify specific spawning sites of razorback suckers.

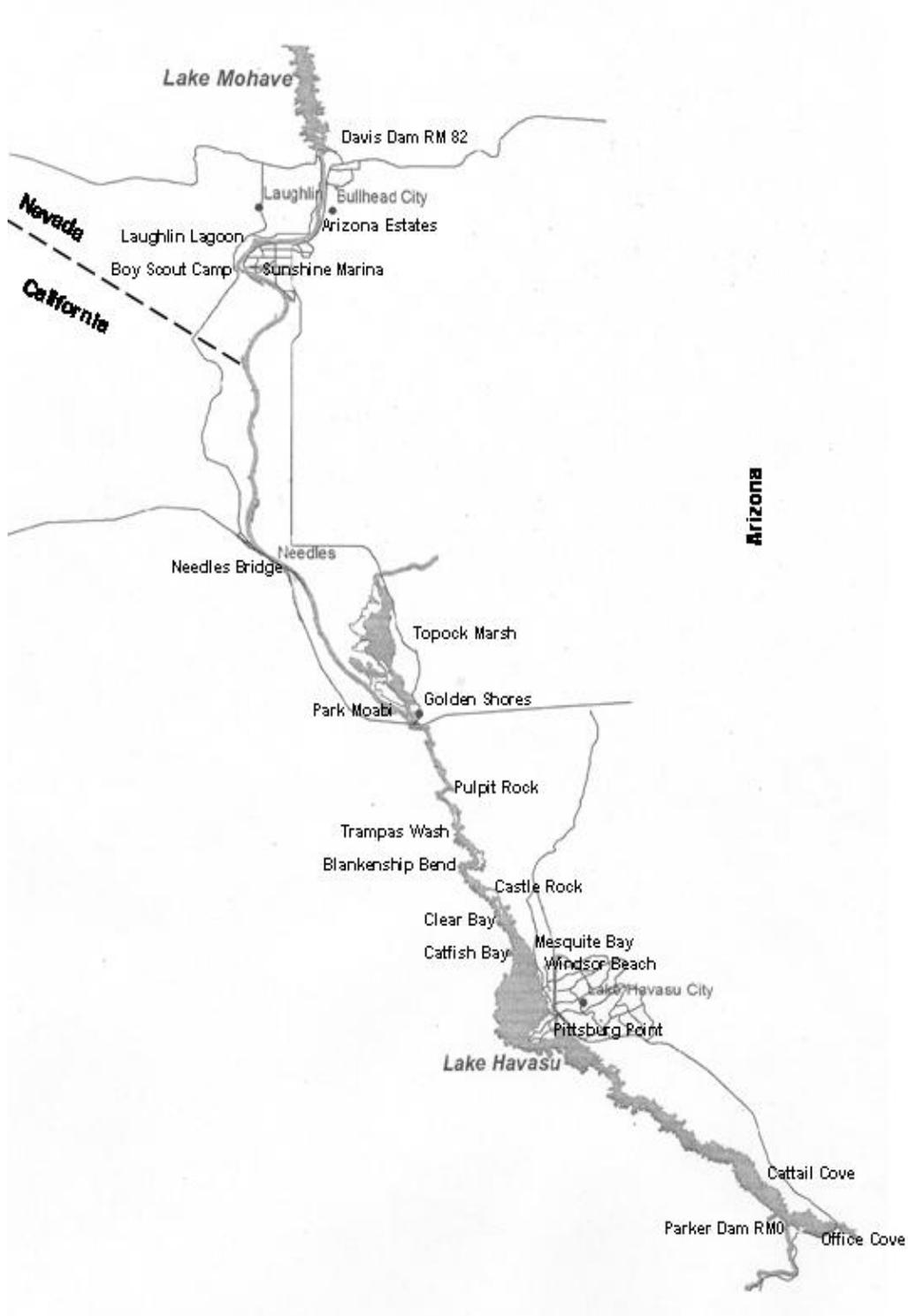


Figure 1: Map of study area found on the Colorado River between Davis Dam and Parker Dam. River Miles (RM) used throughout this report are miles upstream of Parker Dam (Parker Dam = RM 0).

METHODS

Data collection techniques used in this study included sampling with trammel nets, telemetry work, light trapping for sucker larvae, and visual searches and counts of fish from boats. Descriptions of these methods are presented below:

Trammel Netting

Trammel nets were 6 feet in depth and varied in length ranging from 75 to 300 feet. They were constructed of multifilament twine with 1.5-inch bar mesh inner panels and 7-inch bar mesh outer panels. We also had a few three hundred foot nets that were constructed with 2-inch bar mesh inner panels and 7-inch bar mesh outer panels. The length of net was selected to best fit the site without interfering with navigational access. Nets were fished on the bottom, set prior to dusk, and retrieved early the next morning to reduce fish stress and mortality and to minimize conflicts with other boaters. Nets were primarily set in backwaters off the main channel and to a lesser degree in the main channel along eddy fences with mild current where fish were normally concentrated.

All fish captured were measured for total length and released at site of capture. All native fish were scanned for passive integrated transponders (PIT tags). Those found without PIT tags, were injected with one. In addition, razorback suckers were scanned for wire tags with magnetic wands.

Individual fish and sampling effort data was entered into Excel spreadsheets. Catch per unit effort (CPUE) was calculated by dividing the total number of fish caught during the sampling season by the total square meters of trammel nets fished overnight and multiplied by 1000 in order to express the razorback sucker CPUE in terms of whole fish.

Sampling in 2003 was conducted from February 10 to April 18 from Laughlin (RM78) downstream to Mesquite Bay (RM24) in Lake Havasu. The placement of a security boom downstream of Davis Dam after 9/11 restricted access to the tailrace immediately downstream of Davis Dam. Twenty-seven sampling nights produced 381 overnight net sets. The sampling effort was broken down to 16 nights between Park Moabi and Blankenship bend; 7 nights between Blankenship bend and Mesquite Bay; and 4 nights in the Laughlin reach.

Sampling in 2004 started January 26 and continued until April 29. Netting effort extended from Laughlin Lagoon (RM74) downstream to Contact Point (RM16) in Lake Havasu. Twenty-seven sampling nights resulted in 375 overnight net sets. Sampling effort was broken down to 19 nights between Park Moabi and Catfish

Cove; 4 nights on Lake Havasu from Mesquite Bay to Contact Point; and 4 nights in the Laughlin reach.

In 2005, sampling started January 24 and continued until April 15 from Laughlin downstream to Cattail Cove (RM5) in Lake Havasu. Thirty-three sampling nights produced 368 overnight net sets. Sampling effort was broken down to 22 nights between Park Moabi downstream to Catfish Cove, 4 nights between Mesquite Bay and Cattail Cove in Lake Havasu, and 7 nights in the Laughlin reach.

Telemetry Studies

In 2003, five sexually ripe adult male razorback suckers were fitted with external 60-day sonic transmitters in belief that they would lead us to spawning groups. Areas where fish were located were netted in hopes of capturing others. Spot searches for these fish were routinely conducted in conjunction with setting nets. Resources were not available to do comprehensive searches for these fish.

Radio transmitters were used to help increase detection range in the river during the 2004 and 2005 seasons. Excessive background noise and the short detection range of sonic transmitters made them impractical for use to track long-ranging fish with our limited resources. Six 120-day radio tags were externally attached to adult razorbacks in 2004. Spot searches were routinely conducted in areas where we were sampling with nets. Two comprehensive searches were conducted to locate these fish. A search was done February 24 from a helicopter. The entire shoreline of Lake Havasu and both sides of the river upstream to Needles were searched. An extensive search for these fish was conducted by boat on March 13-14. The search began at the security boom located just downstream of Davis dam ending downstream at Havasu Landing Resort (RM 21). The entire river and all backwaters off the river channel were searched during this effort.

In 2005, four 120-day radio tags were externally attached to adult males. Two comprehensive searches were conducted by boat to locate these fish. On February 18, a boat search was conducted from Willow Valley Estates (RM58) downstream to Park Moabi. On March 5-6 a boat search was conducted from Willow Valley Estates downstream to Clear Bay. Spot searches were also routinely conducted in conjunction with setting nets.

Larval Light Traps

Larval light traps were set during the 2005 razorback sucker spawning season to determine the presence of larval suckers and help direct sampling effort toward active spawning sites. Quadra foil larval traps were constructed out of clear PVC Pipe. Larvae were attracted into the trap by a waterproof light constructed inside a clear PVC tube with three flashlight bulbs and powered by two D-cell batteries.

A conical shaped net was attached to the trap to capture larvae as water drained out of the trap. Traps were set at dusk and retrieved early the following morning. Larval fish were sorted, razorback sucker larvae counted and all fish released except for validation samples. Light Traps were set from March 1, 2005 to April 5, 2005 between Willow Valley Estates (RM 58) and Catfish Cove and from April 6, 2005 to April 14, 2005 between Arizona Estates (RM 76) and Sunshine Marina (RM 71).

Visual Searches by Boat

Visual searches were conducted in 2005 to estimate the number of razorback suckers utilizing the spawning site near Needles, CA. All fish that could be identified were counted as the boat floated downriver over the suspected spawning area. The area being sampled was determined by multiplying downstream distance (measured by GPS) by an estimate of the river's width that could be seen from the boat. Fish densities were determined by dividing number of fish seen by area observed. Fish density was extrapolated to the total area of the spawning reach ultimately calculating the number of fish actively spawning.

RESULTS

Trammel Netting

A total of 12,119 fish were captured from January 2003 to April 2005. In 2003, 3,153 were captured, 4,604 were collected in 2004 and 4,362 were taken in 2005. The majority (11,661-96.2%) were non-native species. Fifteen non-native species were taken with the majority being common carp (*Cyprinus carpio*), redear sunfish (*Lepomis microlophus*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), and yellow bullhead (*Ameiurus natalis*) (Figure 2 and Table 1).

SPECIES COMPOSITION
2003 - 2005
n = 12,119

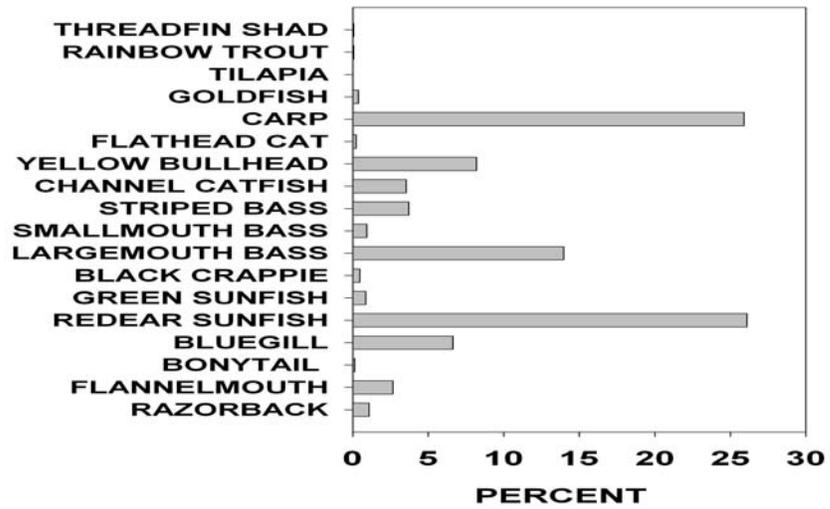


Figure 2: Species composition of fish collected using trammel nets in the Colorado River from Davis Dam to Lake Havasu from January 2003 to April 2005.

Table 1: Catch per 1000 m² of trammel net set overnight in the Colorado River between Davis Dam and Lake Havasu, AZ-CA-NV between January 2003 and April 2005.

Species	2003	2004	2005
Razorback Sucker	1.69	1.44	1.04
Flannelmouth Sucker	3.75	2.46	4.16
Bonytail	0.03	0.02	0.47
Bluegill Sunfish	20.47	16.83	21.24
Redear Sunfish	27.35	39.18	33.01
Green Sunfish	1.03	1.54	0.64
Black Crappie	0.69	0.61	0.54
Largemouth Bass	15.20	22.85	15.91
Smallmouth Bass	0.72	1.54	0.64
Striped Bass	0.52	3.10	10.69
Channel Catfish	3.34	5.50	4.70
Yellow Bullhead	10.04	11.61	9.66
Flathead Catfish	0.03	0.55	0.23
Rainbow Trout	0.07	0.00	0.24
Tilapia	0.07	0.00	0.04
Common Carp	23.18	33.53	42.54
Goldfish	0.28	0.61	0.57
Threadfin Shad	0.00	0.00	0.04
Total m ² of netting	29,072	33,989	9,808
Total number of fish	3,153	4,604	4,362

Three native fish species were caught each year. Four hundred, fifty-eight native fish were captured from January 2003 to April 2005. They included 129 razorback suckers, 313 flannelmouth suckers, and 16 bonytail chubs (Table 2).

Table 2: Number of native fish collected each year from the Colorado River between Davis and Parker Dams during 2003, 2004 and 2005.

	Razorback Sucker	Flannelmouth Sucker	Bonytail
2003	54	109	1
2004	45	80	1
2005	30	124	14
Total	129	313	16

Razorback Sucker:

2003 Fifty-four different razorbacks were captured during the 2003 sampling season (Table 2). Fifty-two were first time captures. Two were marked recaptured fish from previous sampling efforts. Sixteen were caught at Park Moabi, 12 were caught at Blankenship Bend (California side), 6 were captured at Clear Bay, 2 were taken at Castle Rock, 2 were netted in Trampas Wash, 1 was caught in Catfish Cove and 6 were caught in Laughlin Lagoon (Table 3). No fish were taken from Golden Shores, the Arizona side at Blankenship bend, Pulpit Rock, or Lake Havasu proper. In addition, most of the small backwaters from Park Moabi downstream to Lake Havasu were sampled; however, no razorback suckers were caught in these backwaters.

PIT tags were found in nine fish. One had been previously captured and tagged in Park Moabi in 2001 and caught again in 2002. Six PIT tagged razorbacks originated from fish stocked in Laughlin lagoon by the BOR in December 2001. One of these was previously caught in Laughlin Lagoon in 2002. The origin of two fish was traced back to fish released into Lake Mohave. A fish (PIT tag 424E477C7F) originally released at Davis Cove in Lake Mohave was captured February 13, 2003 at Trampas Wash. Another fish (PIT tag 521C2B644F) released at Princess Cove in Lake Mohave was captured at Boy Scout Lagoon on April 16, 2003. Both of these fish must have passed through Davis Dam's Power Plant.

Forty of the 45 fish that were not PIT tagged were scanned for wire tags. Wire tags were found in 27 fish: 2 were wire tagged left dorsal, 6 were wire tagged

right dorsal, 8 were wire tagged left pectoral, and 11 were wire tagged right pectoral. No wire or PIT tags were detected in 13 fish. All of these fish appeared to be young stocked fish. Either our equipment failed to detect the tags or possibly the tags were rejected by the fish.

The majority of razorback suckers (60%) were captured at Park Moabi or Blankenship Bend (California Side) in 2003. The CPUE for Park Moabi was 2.31 fish/1000 m² and 2.23 fish/1000 m² at Blankenship Bend (California side). However, the largest CPUE were in backwaters near the Lake Havasu delta. The CPUE was 4.02 fish /1000 m² at Clear Bay and 3.02 fish /1000 m² in Catfish Bay. These catch rates may have inflated actual fish concentrations because they were not extensively sampled in 2003.

Fifty-one razorback suckers were sexed. Females outnumbered (33:18, 1.8:1) males at all locations except at Topock Gorge where the sex ratio (1:1) was similar. During the spawning season (February 1 - March 15), 24 females and 16 males (1.5:1) were caught and during the non-reproductive period, 9 females and 2 males (4.5:1) were captured.

The razorback sucker population based on recaptured data (Chapman modified single census Petersen method) was estimated at 3,570 (95% CL= 1,306-8,925) fish.

2004 Forty-five different razorbacks were captured during the 2004 sampling season (Table 2). Thirty-nine were first time captures. Five were marked recaptured fish from previous sampling efforts. Eighteen razorback suckers were caught in Park Moabi, 11 were taken from Clear Bay, 6 netted at Blankenship Bend (California side), 3 from Catfish Cove, 2 caught at Castle Rock, 1 taken at both Trampas Wash and Mesquite Bay in Lake Havasu and 5 caught in Laughlin Lagoon (Table 3). Razorback suckers were not encountered at Golden Shores, on the Arizona side at Blankenship bend, at Pulpit Rock, or from the small backwaters from Park Moabi downstream to Lake Havasu.

PIT tags were found in 15 fish. Two recaptured razorback suckers captured in 2003 were again caught in 2004. A spent female netted in Park Moabi on March 10, 2004 was also caught at this location in 2003, 2002, and 2001 when it was originally PIT tagged. It had grown 48 mm in three years. The other fish was an unripe male caught in Laughlin Lagoon on March 30, 2004. It was caught at this location in 2003 and 2002 and was originally released here in 2001. It had grown 118 mm in two years.

Recapture data suggest razorback suckers are quite mobile but also exhibit seasonal fidelity to specific locations. A male and female were captured at Park Moabi in both 2003 and 2004. Right pectoral wire tags indicated these fish were

stocked at Windsor Beach after 2001 and had moved 35 km upstream. A sonic transmitter was attached to the male on February 11, 2003. The fish remained in the Lagoon for nearly a month at which time we lost contact. Another female originally stocked at Windsor Beach was taken from the tailrace of Davis Dam in 1999 and was again recaptured in 2004 at Blankenship Bend. In the 5 years between captures it had grown 101 mm to 671 mm TL. A large gravid female was captured February 3, 2004 at Mesquite Bay and recaptured 5 weeks later (March 12) in Clear Bay appearing totally spent.

Five PIT tagged razorback suckers were recaptured from a stocking in Laughlin Lagoon in 2001. Three fish were recaptured in the Lagoon, one was taken at Park Moabi and the last was caught at Catfish Cove. The origin of a PIT tagged fish was traced back to its release in Topock Marsh in 1997. Another, PIT tagged razorback captured at Park Moabi was a wire tagged fish released at Windsor Beach, which had previously been captured and PIT tagged by Arizona Game and Fish Department (AGFD) near Windsor Beach in 2002. Three PIT tagged razorbacks originated from fish stocked in Lake Mohave. One (42016B254D) was captured in Laughlin Lagoon that had been stocked from Davis Cove in 1997. The second (4241151076) was captured at Park Moabi that had been released in 2001 at Arizona Juvenile Cove and a third (4479314D18) captured at Blankenship Bend (California side) had been released at Princess Cove in 2003.

Wire Tags were detected in 30 fish: 9 were left dorsal wire tagged, 6 were left pectoral wire tagged, and 15 were right pectoral wire tagged. No PIT or wire tags were found in five fish. One of these fish appeared to be an old wild fish that was captured in Laughlin Lagoon while the other four appeared to be recently stocked fish.

The majority (81%) of razorback suckers captured in 2004 were taken from Park Moabi, Blankenship Bend (California side), Clear Bay or Catfish Bay. CPUE was 2.46 razorbacks/1000 m² at Park Moabi and 0.83 fish/1000 m² at Blankenship Bend (California side). The largest CPUE was in the backwaters near the Lake Havasu delta which ranged from 2.11 fish /1000 m² (Catfish Bay) to 4.78 fish /1000 m² (Clear Bay). The CPUE was 0.23 fish /1000 m² in the main reservoir while it reached 1.49 fish /1000 m² in Laughlin Lagoon.

Forty-three razorback suckers were sexed. Twenty-seven were females and 16 were males (1.7:1). The sex ratio (female:male) during the spawning season (February 1 - March 15) was 10:1(22 fish). The ratio substantially shifted to 1:2 (21 fish) in favor of males in the non-reproductive period.

The population based on recaptured fish in 2004 was estimated at 1,768 (95% CL = 878 to 3,867) fish. This includes all fish (e.g., wild adults and fish stocked into

Lake Havasu and Mohave). The population based solely on fish stocked into Lake Havasu was 1,554 (95% CL= 771 to 3,399) fish.

2005 Thirty different razorbacks were captured in 2005. Twenty-six were first time captures and 4 were fish taken in previous years. Fifteen razorback suckers were caught in Clear Bay, 6 were taken at Park Moabi, 3 were captured at Blankenship Bend (California side), 2 were netted in both Catfish Cove and at Castle Rock, 1 was caught in Laughlin Lagoon and the last was taken at Arizona Estates (RM78) (Table 3). No fish were caught at Golden Shores, on the Arizona side at Blankenship bend, Pulpit Rock, Trampas Wash, Lake Havasu proper or from the small backwaters from Park Moabi downstream to Lake Havasu.

PIT tags were found in seven fish. Four were recaptures from previous sampling efforts. A male caught February 14, 2005 at Clear Bay was captured at Park Moabi in 2004 and originally tagged there in 2003. It was 480 mm total length and had grown 29 mm in just over two years. A female caught February 14, 2005 at Clear Bay was originally caught there in 2004. It was 600 mm total length and had grown 20 mm in about a year. Another female caught March 2, 2005 at Clear Bay was originally netted at Park Moabi in 2003. It was 607 mm total length and had grown 40 mm in two years. One other PIT tagged fish caught at Park Moabi was stocked into Laughlin Lagoon by the BOR in December 2001. One PIT tagged male caught at Park Moabi was originally released at Topock Marsh by FWS/BLM on March 27, 1997. One PIT tagged fish was traced back to a fish released in Lake Mohave. It (5340522B6D) was a ripe female captured at the Lagoon at Arizona Estates (RM76) on April 14, 2005. It was originally released in Lake Mohave on June 17, 2004 at Oro Cove. It had grown 42 mm in ten months.

Wire tags were detected in 20 fish: 4 were left dorsal wire tagged, 2 were right dorsal wire tagged, 7 were left pectoral wire tagged, and 7 were right pectoral wire tagged. Tags were not found in five fish, all appeared to be recently stocked fish.

All thirty-razorback suckers were sexed. Eighteen were females and 12 were males (1.5:1). During the spawning season (February 1 – March 15) the female/male sex ratio was 1.9:1 (23 fish). The ratio shifted toward males (1:1.3) during the non-reproductive season.

In 2005, the majority (80%) of razorback suckers were caught at Clear Bay, Blankenship Bend and Park Moabi. CPUE was 2.70 fish/1000 m² at Clear Bay, 1.20 fish/1000 m² at Blankenship Bend (California side), 1.12 fish/1000 m² at Park Moabi, 1.11 fish/1000 m² at Catfish Cove, 1.84 fish/1000 m² at Castle Rock and 0.23 fish /1000 m² at Laughlin Lagoon. No razorback suckers were captured

at Golden Shores, on the Arizona side at Blankenship bend, Pulpit Rock, Trampas Wash or at the small backwaters from Park Moabi downstream to Lake Havasu.

The population estimate of razorback sucker in Lake Havasu was 1,652 (95% CL= 706 to 5,164) fish that includes wild adults, fish stocked into Lake Havasu and fish that escaped from Lake Mohave. The population estimate for fish just stocked into Lake Havasu was 1,532 (95% CL= 658 to 4,810) fish.

Table 3: Summary of locations where razorback suckers were collected between January 2003 and April 2005.

Location	2003	2004	2005
Arizona Estates	0	0	1
Laughlin Lagoon	6	5	1
Park Moabi	16	18	6
Golden Shores	0	0	0
Pulpit Rock	0	0	0
Trampas Wash	2	1	0
Blankenship Bend	12	6	3
Castle Rock	2	2	2
Clear Bay	6	11	15
Catfish Bay	1	3	2
Mesquite Bay	0	1	0
Lake Havasu	0	0	0

Telemetry Studies

2003 We externally attached sonic tags to 5 male razorback suckers in 2003. We routinely monitored for transmitter signals while setting and retrieving trammel nets. Resources were not available for comprehensive searches for these fish. One telemetry fish was caught at Park Moabi along the south levy about halfway between the entrance and marina on February 11. This fish remained near the marina for two days at which time we lost contact. A second fish was captured in the back of Park Moabi and fitted with a transmitter on February 12. This fish was located numerous times inside the Lagoon near the boat ramp and swim beach. Contact was lost March 3. The third fish was caught on February 26 in the rear end of the lagoon at Park Moabi. It was detected on March 3 and 4 near the marina where it was recaptured in a trammel net apparently moving toward

the river. Contact with this fish was lost after this time. The fourth fish was caught, equipped with a sonic transmitter and released at Blankenship Bend (California side) on February 12 near the rear of the backwater. It was located the following day at the mouth of the backwater after which contact was lost. The fifth fish was caught at Blankenship bend (California side) on March 5. This fish was located numerous times in the rear of this backwater until we lost contact on March 12. We were disappointed in our inability to recontact these fish once they entered the river. Background noise caused by flow and the short detection range of these transmitters, limited their usefulness.

2004 Radio transmitters were used in place of sonic tags for this year. They were externally attached to two male and four female razorback suckers. Signal range greatly increased when fish were close to the surface; however, signal detection degraded rapidly for fish found in water depths exceeding 12 feet. We routinely looked for radio tagged fish in backwaters while setting and retrieving trammel nets, however, static from our outboard motor made it impossible to monitor transmitter frequencies when moving between sampling sites. Two comprehensive searches for radio tagged fish were undertaken; one with the use of a helicopter during the 2004 annual razorback roundup and the other by boat. No fish were detected during the helicopter effort but two were encountered during the boat survey.

One male radio tagged fish was collected at Park Moabi where it remained for about a week before contact was lost. The other radio tagged male was caught at Blankenship bend (California side) where it moved to the rear end of that backwater and remained for a little over two weeks. Contact was lost with this fish after that time.

One radio tagged female was caught at Park Moabi. It remained in the lagoon for about a week, when contact was lost. A second radio tagged female was caught at Trampas Wash (RM33.5). This fish was located about a month after its original capture at Blankenship bend (California side). This is about three miles downstream. A third radio tagged female was caught in the backwater on the California side downstream of Clear Bay (RM 27). This fish was located about a month later in Clear Bay, which is about 0.75 miles upstream. The fourth female was caught, tagged and released in the backwater on Arizona side at Castle Rock (RM 28). It moved 26 miles upstream where it was detected a month later about a mile upstream of Needles, CA. (RM54).

2005 Radio transmitters were again externally attached to four male razorback suckers in 2005. One was attached to a male caught and released at Park Moabi on January 25, 2005. This fish was located February 18 about a mile upstream of the Needles Bridge (Highway 95) where the fish was visually seen with its transmitter with a spawning group of eight razorbacks. Water depth was about 1

meter and the substrate consisted of large clean gravel and cobble (Figures 3 & 4). Three radio tags were attached to male razorbacks caught at Clear Bay. Contact was lost with these three fish within a day after release. It was unclear if contact was lost because of water depth, the fish left the area, or the tags simply failed. All four tags used in 2005 were left over from 2004, so, the batteries were over a year old.



Figure 3: Panoramic view looking downstream of razorback sucker spawning site in 2005. Fish were actively spawning on both sides of the power line. Notice the Needles Bridge in the far right of picture. The water level was very low through February 2005 due to rain and low irrigation demands.

We conducted visual counts of razorback suckers on a four-mile stretch of river starting about two miles upstream of the Needles Bridge and ending at the entrance to the BOR dredge facility. We counted all razorbacks, which could be

seen as the boat floated downstream. Approximately fifteen meters of the 90 meter wide river bottom could be seen at one time. Individual fish as well as small groups of fish (5 to 20) were scattered throughout this stretch of river. We counted 126 razorback suckers during this effort. The majority (101) was in a one-mile stretch located one half to one and a half mile upstream of the Needles Bridge. Most of this one-mile stretch of river was about 0.75 to one meter deep with a large cobble substrate (3 inch diameter rocks) that has been deposited into the riverbed from Piute Wash entering the river from the California side. Most of the remaining area surveyed consisted of deeper water that was about two meters deep with a small cobble to sand substrate. By projecting the amount of fish seen in this stretch of river to the total area of the riverbed, we estimated about 625 razorback suckers were utilizing this stretch of river.



Figure 4: Underwater photograph of the substrate being used by spawning razorback suckers. The larger rocks in this picture are about 3 in diameter.

Light Traps

Larval sucker were absent from samples collected upstream of Willow Valley Estates (RM 58) but were found in samples taken from the Needles spawning site downstream to Clear Bay (Figure 5). Relatively high densities were taken at the entrance channel of Park Moabi. This suggested razorback suckers were only spawning in significant numbers at the Needles site or further downstream.

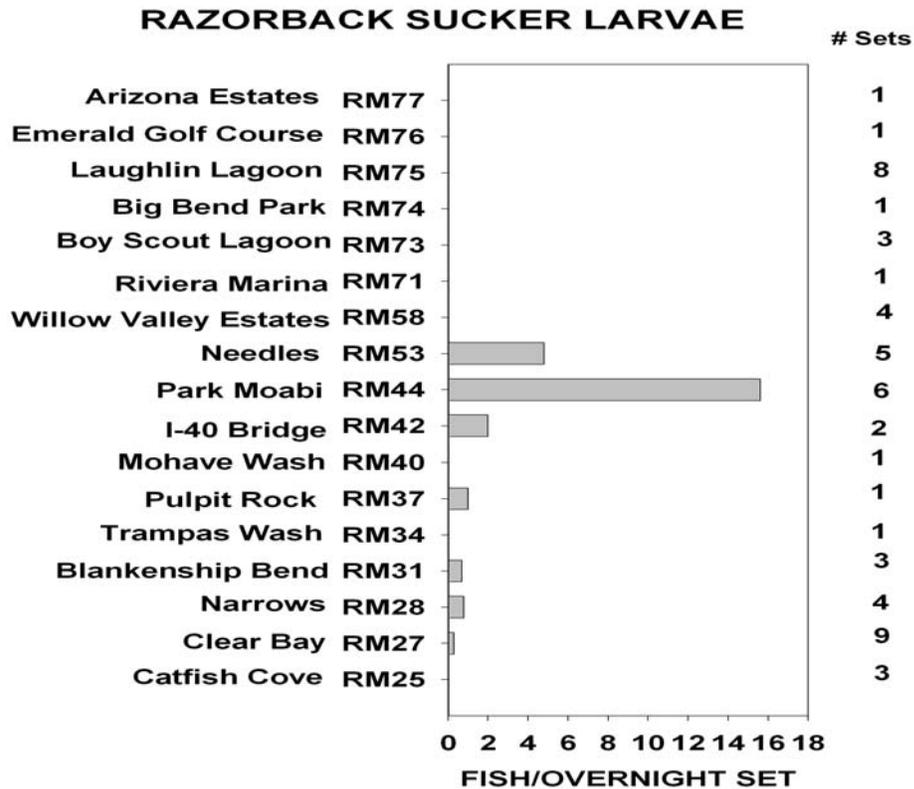


Figure 5: Number of larval razorback suckers caught in light trap set overnight in the Colorado River from Arizona Estates (RM77) to Catfish Cove (RM25) in 2005.

Flannelmouth Sucker

A total of 109 flannelmouth suckers were captured during 2003. Twenty-five of these were caught between Park Moabi and the Lake Havasu Delta (RM 24 - 43).

Three of these fish appeared to be sexually mature while the remainders were smaller (325-425 mm) and probably younger fish. Eighty-four were captured between Laughlin and Boy Scout Camp (RM 70-77), of these, 66 appeared to be adults. The remaining 18 were again smaller, ranging from 325 to 425 mm. The 2003 flannelmouth sucker population based on recaptured fish is estimated at 4,625 fish (Chapman modified Petersen single census method).

A total of 80 flannelmouth suckers were caught in 2004. Eight of these fish were caught between Park Moabi and the Lake Havasu Delta and the remaining 72 were captured between Laughlin Lagoon and Boy Scout Camp. In 2005, 124 flannelmouth suckers were netted, 3 were taken between Park Moabi and the Lake Havasu Delta. The remainders were caught around Laughlin (RM 70-78).

Bonytail

A single bonytail was captured during the 2003 sampling season. It was caught on March 19 from a small cove on the California shore between Catfish and Clear Bays (RM 26.5, 11S 0739746 3824054). It was 463 mm in total length and weighed 715 grams. This fish was scanned for a PIT tag, but none was found. It appeared to be wire tagged near the dorsal fin on the left side, which suggests the fish was originally stocked in Lake Mohave by the USFWS. This fish was PIT tagged (424E0E0708) prior to being released.

Another bonytail was captured on January 30, 2004 at Park Moabi (RM 43, 11S 0728440 3845642). It was 364 mm total length and weighed 375 grams. It had been PIT tagged (422F09180C) prior to its release at Office Cove on the Bill Williams Arm of Lake Havasu on August 28, 2002. At its release, it was 250 mm TL. In 17 months, it had grown 114 mm and moved 48 miles upstream.

Fourteen bonytails were captured in 2005. Ten were caught at Park Moabi, 2 at Clear Bay, 1 at Pulpit Rock, and 1 in a small backwater on the California side (RM30). All were released into Lake Havasu in November 2004. One caught at Clear Bay had been released near Partner's Point in Lake Havasu. The remainder were released at Golden Shores.

DISCUSSION

Three basic trends were noticed in the data collected during the past seven years (1999 to 2005). 1) CPUE steadily decreased, 2) the sex ratio of razorbacks caught changed, and 3) the majority of fish captured came from more recent stockings. We suspect all three trends reflect changes in the distribution pattern of the razorback sucker community as it matured and consolidated spawning.

There has been an ongoing effort to find where these fish spawn. Resource managers have flown the reservoir and sections of the river for several years and have conducted the Lake Havasu Round-Up searching for spawning aggregates. Large spawning aggregates similar to those in Lake Mohave had not been found and far more suckers were being captured in the river than in Lake Havasu. Furthermore, CPUE steadily decreased, falling from 9.2 fish/ 1000 m² to 1.0 fish/ 1000 m² in 2005 (Figure 6). Initially we suspected the decline was due to poor survival, but closer scrutiny of our growing database suggested something else might be happening.

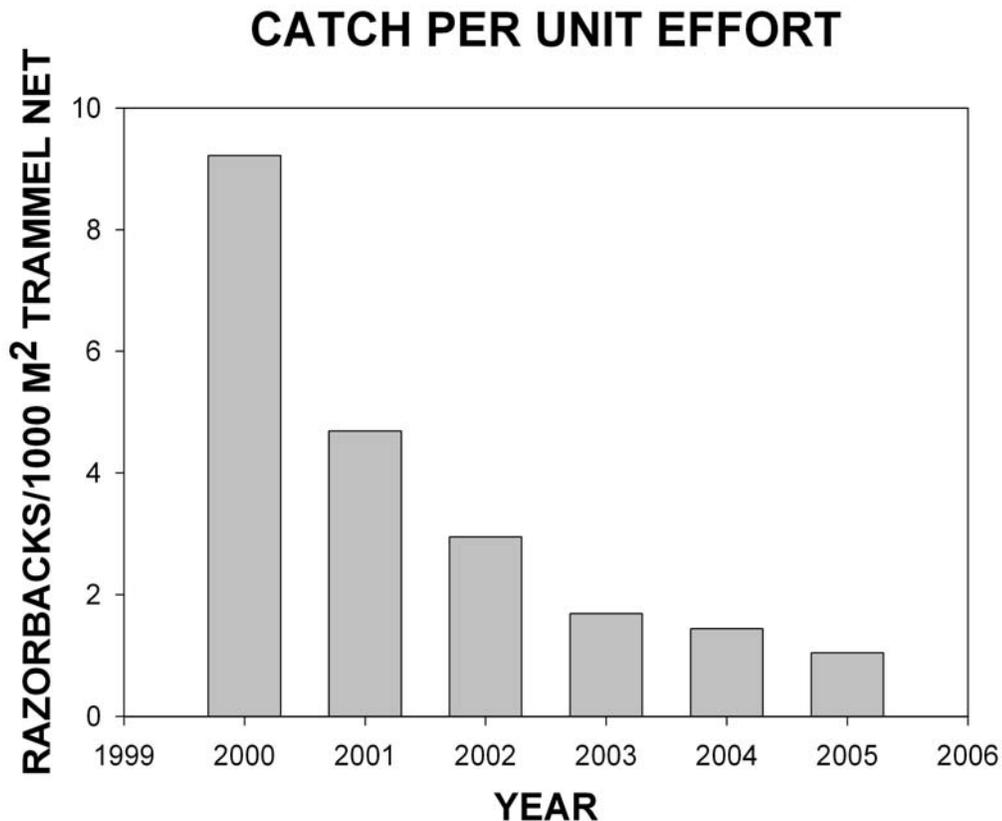


Figure 6: Catch per unit effort of razorback suckers captured in trammel nets in the Colorado River between Davis Dam and Parker Dam from 2000 to 2005.

The second noticeable trend was a change in ratio of males and females being caught. Initially sexually ripe individuals were randomly captured throughout the study reach suggesting spawning might have been scattered. From 2000 to 2002, our sample consisted of two-thirds males and one-third females (Figure 7). A sex ratio similar to that reported for Lake Mohave at spawning sites (Minckley 1983).

Telemetry studies conducted on that reservoir using wild adults, suggested that spawning males generally spent most of their time on spawning grounds while females tend to wander making males more abundant on spawning sites (Mueller and others, 2003). The high proportion of sexually ripe males and the collection of larvae prior to 2003 suggested razorback sucker spawning was scattered in areas such as Park Moabi, Blankenship Bend and Clear Bay (Mueller, 2003).

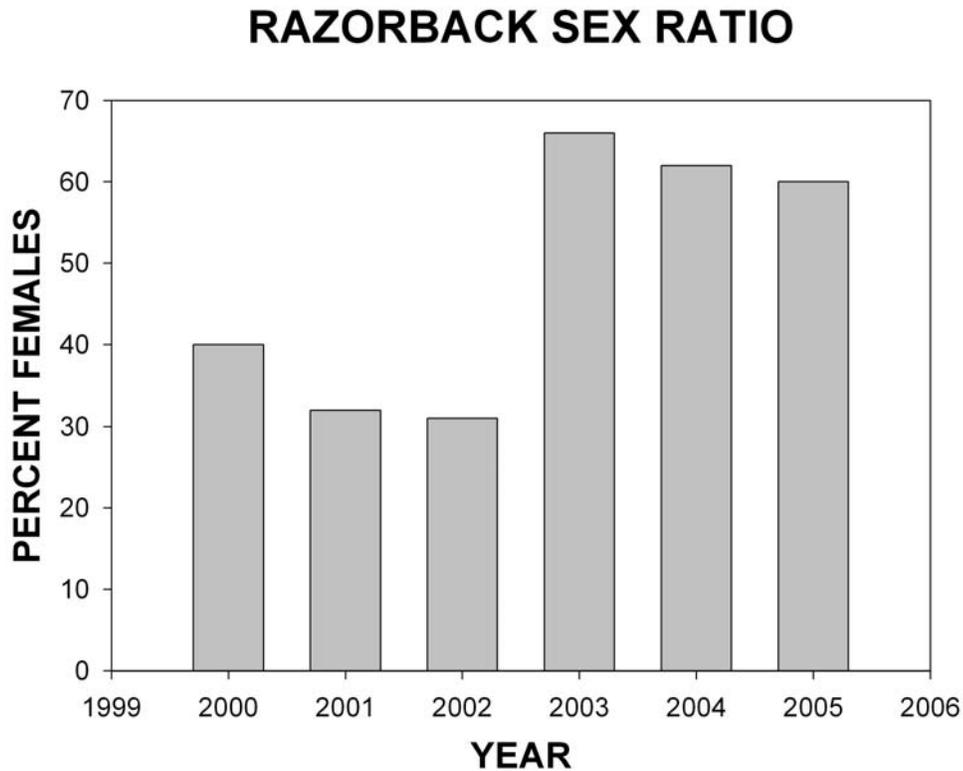


Figure 7: Percentage of female razorback suckers caught in the Colorado River between Davis Dam and Lake Havasu from 2000 to 2005.

In 2003, the ratio completely shifted toward females (Figure 7). Males became extremely difficult to find. Catch rates continued to decline and we captured most of our suckers early or late in the spawning season, being either gravid or spent. In the last two years it became increasingly obvious that we were intercepting fish as they were going to and returning from spawning.

This brings us to our third trend; the majority of fish captured in this study (2003-2005) came from more recent stockings (Figure 8). This may be interpreted different ways; for instance these young may be going through the maturing process as described above, trying to find the spawning site, which is 30 miles

upstream. We feel it equally likely there are far fewer older fish that were stocked prior to 2000. Unfortunately, the reported mortality rate of adults on Lake Mohave appears to be nearly 25% (Brian Kesner, 2005, ASU, oral communication). We can only speculate at this time, but the capture of more recently stocked fish is likely a combination of both factors.

In 2005, we made a major discovery. Several hundred spawners were found actively spawning in the river upstream of Needles California. The site was found by following a male sucker, which we had put a radio transmitter on. That fish was seen with several others on a spawning bar. Local residents reported this location was a historical spawning area (Mueller and Marsh 2002). We had examined this site in previous years and did observe 3 razorback suckers just upstream of the Needles Bridge; however we didn't observe this congregation (Mueller 2003). We suspect it has been only in recent years that large numbers of fish have been using this area to spawn.

Currently it isn't known whether this is the only site or one of many. If this is the predominate spawning site for fish from both Lake Havasu and lower portions of the river, our sampling program was geographically biased which may influence our population estimates. Natural recruitment has not been detected so it's fairly safe to assume the population is declining or would certainly decline without continued stocking, but the rate of decline may not be as severe as previously feared. Additional sampling and refinement of techniques is necessary to accurately measure the rate of decline.

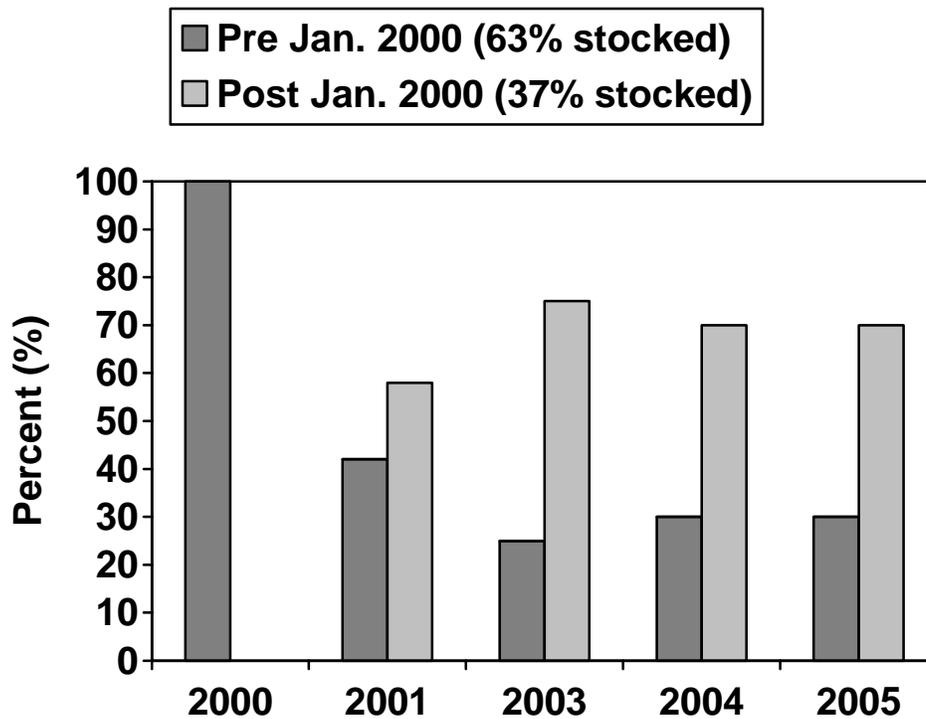


Figure 8: Sample composition of razorback suckers caught in Colorado River between Davis and Parker Dams from 2000 to 2005 based on time of stocking (pre-post January 1, 2000). The darker bars represent 63% of the 31,516 razorback suckers which have been released into Lake Havasu since 1993. The gray represent the remaining 37% of fish which were released after January 2000. Note that the majority of fish captured came from more recent stockings.

Stocking and Capture Locations

A total of 31,516 razorback suckers have been stocked into Lake Havasu by various agencies since 1993. There have been 27,716 razorbacks stocked by the AGFD, 3,054 by the Fish and Wildlife Service/Bureau of Land Management (FWS-BLM), and 746 by the BOR (Table 4). The razorbacks stocked by the AGFD were wire tagged and released at Windsor Beach in Lake Havasu. Razorbacks stocked by the FWS/BLM and BOR were PIT tagged. FWS-BLM released their fish at three locations; 360 were released at Topock Marsh near Golden Shores and 2,694 were released at Partners Point or at Office Cove in the Bill Williams Arm of Lake Havasu. BOR released their fish at Laughlin Lagoon. There are also razorback suckers that entered the area by passing through Davis Dam from Lake Mohave.

We were able to trace the stocking origin of 254 razorback suckers captured between 1999 and 2005. Because of possible tag shed or lack of wire tag wand, we could not detect the origin of 18% of fish captured. The majority (163) of fish encountered were stocked into Lake Havasu by the AGFD. All but three were captured between Park Moabi and Mesquite Bay, or the lower portion of the river and upper portion of the reservoir. It did not appear as though many of the AGFD fish had moved upstream of Park Moabi.

Seventy-eight razorback suckers released by the BOR have been caught since they were released in Laughlin Lagoon in 2001. Seventy were captured inside Laughlin Lagoon, three near the Lagoon, two at Park Moabi and one fish was taken at Pulpit Rock, Blankenship Bend, and Catfish Cove.

Seven FWS/BLM stocked fish were caught between 1999 and 2005. Six were caught at Park Moabi and one at Golden Shores. All of these fish were released in Topock Marsh near Golden Shores. None of the razorback suckers released by FWS/BLM in Lake Havasu at Office Cove or Partners Point were encountered.

Table 4: Distribution of razorback suckers caught with trammel nets between January 2003 and April 2005 in relation to the location of their stocking.

	Lower L. Havasu	Windsor Beach	Topock Marsh	Laughlin Lagoon
Total Fish Released	2,694	27,716	360	746
Davis Dam to Stateline	0	3	0	73
Stateline to Topock Gorge	0	91	7	2
Topock Gorge to L. Havasu	0	68	0	3
Lake Havasu Proper	0	1	0	0
Total	0	163	7	78
Recapture %	0.0%	0.6%	1.9%	9.8%

Population and Survival Estimates

Population estimates for 2003 to 2005 were relatively close and suggested a downward trend. Relatively low numbers of recaptures resulted in broad confidence limits; however, each estimate fell into the confidence range of the proceeding year. The 2003 population estimate was 3,570 fish; similar to previous estimates (2000-2002) that ranged from 1600 to 3600 fish (Mueller, 2003). The 2004 population was lower at 1,768 razorback suckers and the 2005 estimate dropped slightly lower at 1,554 razorback suckers.

We attempted to estimate the survival rate of fish stocked at geographically different locations. This was based on the assumption that all groups were equally vulnerable to our sampling and used fish recaptured in 2005 to estimate surviving numbers from original stocks. Recapture data is limited; however, preliminary information suggests that 18% of the fish stocked at Laughlin Lagoon were alive, 19% of those stocked at Topock Marsh had survived and 5% of the fish released into Upper Lake Havasu had also survived. No fish were recaptured from those released into Lower Lake Havasu. Similar extrapolations were made for 2004 and 2003 (Figure 9).

It is interesting to note that it appears that survival increases as one stocks fish further upstream of Lake Havasu. Several factors could have an impact on the survivorship of fish released at these different locations: 1) location in respect to water outtake structures, 2) the size of razorbacks at time of release, and 3) differences in large predator populations around release sites. These factors deserve closer study.

SURVIVAL OF RAZORBACK SUCKERS STOCKED INTO LAKE HAVASU

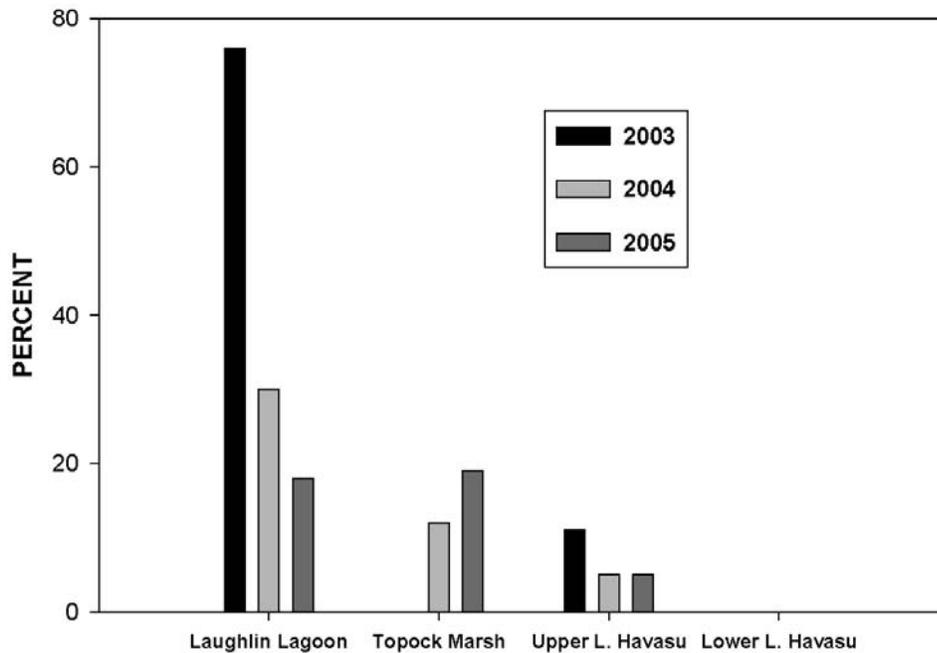


Figure 9: Percent survival of fish released into Lake Havasu at Windsor Beach, into Topock Marsh near Golden Shores, or into Laughlin Lagoon.

Recommendations for Future Work

A high priority should be to continue monitoring the razorback suckers spawning near Needles. Visual float counts that could estimate the population at the spawning site would provide an excellent method to monitor trends in this population without the need to handle and stress these fish. In 2006, we were able to collect a large sample of razorbacks at the Needles spawning area by electrofishing. Continuation of the electrofishing effort would allow more intense examination on the impact stocking location has on the survival of repatriated razorback suckers.

Another high priority should be a telemetry study to determine the movements of the fish spawning near Needles. Based on our limited recapture data from

our trammel netting and telemetry work, it appears that we were catching staging razorback suckers prior to spawning at Needles or fish returning to Lake Havasu or the delta region of the Colorado River after spawning and not actually catching spawning fish. A telemetry study would be able to confirm if this actually is the case. If this study was conducted over a three or four-year period, the tagged fish may lead us to other spawning aggregates of razorback suckers in the lake.

Our PIT and wire tag data suggest that fish tend to stay where they are stocked and any movement that does occur is mostly downstream. Our efforts encountered fish released at Laughlin lagoon, Topock Marsh and Windsor Beach, but no fish released into lower Lake Havasu were encountered. It might be a good idea to conduct an extensive trammel netting effort on lower Lake Havasu over the next few years to see if the razorback suckers released into lower Lake Havasu have established another spawning site. Larval light traps could also be used to direct trammel netting effort toward suspected spawning sites in the lower reservoir.

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PEER REVIEW DOCUMENTATION

PROJECT AND DOCUMENT INFORMATION

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REVIEW CERTIFICATION

Peers Reviewer - I have reviewed the assigned Items/Section(s) noted for the above document and believe them to be in accordance with the project requirements, standards of the profession, and Reclamation policy.

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