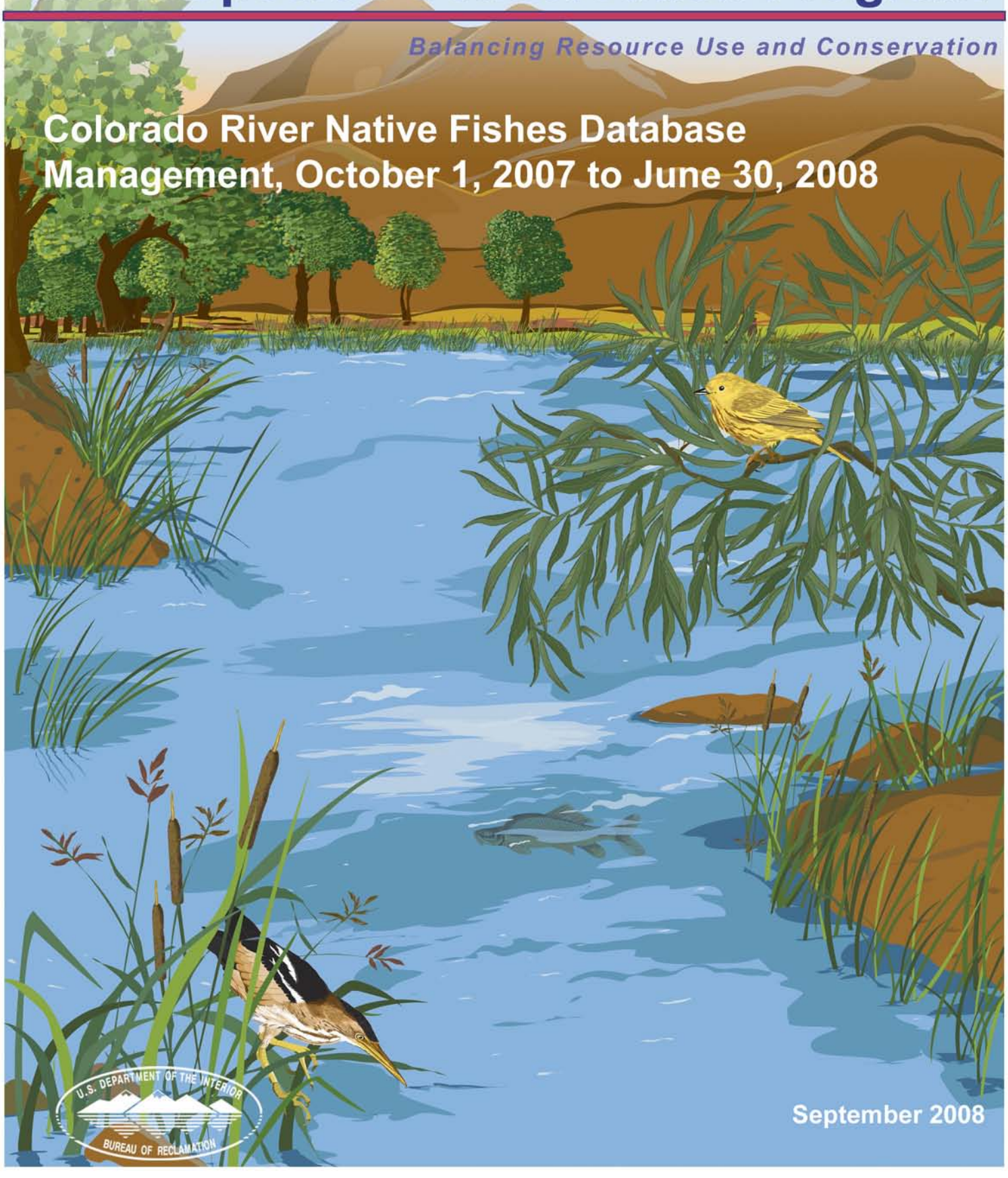
Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Colorado River Native Fishes Database Management, October 1, 2007 to June 30, 2008



September 2008

Lower Colorado River Multi-Species Conservation Program
Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
The Cocopah Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.

Lower Colorado River
Multi-Species Conservation Program

Colorado River Native Fishes Database Management, October 1, 2007 to June 30, 2008

Prepared by Carol A. Pacey and submitted by Paul C. Marsh, School of Life Sciences, Arizona State University, Tempe, Arizona

In fulfillment of Agreement Number 07-FG-30-0002 between Arizona State University and Bureau of Reclamation, Boulder City, Nevada

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

September 2008

SUMMARY

One of the primary purposes of the Colorado River native fishes database is to support periodic estimation of population abundance of razorback sucker in Lake Mohave in behalf of its conservation in the lower basin. The March 2008 population estimate for wild adult razorback sucker in the lake was 47 fish, based upon mark-recapture data for 2007-2008. This is substantially less than the previous year's (March 2006-2007) estimate of 218 fish. The March 2008 repatriate razorback sucker population estimate was 1,232 fish, which represents < 1 % of nearly 126,500 fish stocked prior to March 1, 2007. This estimate was based upon mark-recapture data for 2007-2008.

BACKGROUND AND DATABASE MANAGEMENT

Arizona State University (ASU) has served for nearly 20 years as a central repository of field data gathered by the lower Colorado River Lake Mohave Native Fish Work Group (NFWG) which formed in 1990 with representation from Arizona Game and Fish Department (AZGFD), ASU, Biological Resources Division of U.S. Geological Survey (BRD-GS), Nevada Department of Wildlife (NDOW), Bureau of Reclamation (BR), U.S. Fish and Wildlife Service (FWS) and U.S. National Park Service (NPS). The primary mission of the NFWG is to capture and rear native lower Colorado River fishes for repatriation, in particular razorback sucker, *Xyrauchen texanus*. Larvae are collected annually during the winter-spring spawning season from the shallows along Lake Mohave's shorelines, and these initially were reared in several off-site facilities including Willow Beach National Fish Hatchery (NFH) AZ, Boulder City NV Golf Course Ponds, and Boulder City NV Wetland Ponds; the last two sites are no longer in service for native fish. Some fish are (or were) stocked directly into the lake from these sites, while others are retained at Willow Beach NFH or transferred for grow-out at various locations, including predator-free lakeside backwaters such as Yuma and Davis coves in AZ, and Dandy and Chemehuevi coves in NV, Lake Mohave. Once they attain a size thought to be relatively safe from predation (initially 250 mm, now increased to 500 mm), the juvenile fish are tagged with PIT tags, measured and stocked into the lake.

In addition to capturing young, the NFWG continues to oversee Lake Mohave monitoring programs that periodically assess population status of wild adult and repatriated razorback suckers, and other components of the fish community. W.L. Minckley and ASU initiated these programs in 1968. Members of the NFWG annually revisit the same localities at the same times of year and deploy the same kind of collection devices, capturing untagged and previously PIT-tagged native fishes as well as many non-native species. In addition to traditional sampling areas, spatial coverage has been expanded recently through the efforts of Reclamation to include the lowermost part of the reservoir and the upstream, riverine portion of the lake.

Field expeditions typically occur in March (also referred to as the Razorback Round-up), May and November, generally targeting spawning, post-spawning and pre-spawning periods, respectively, and employing several fishing methods, primarily trammel netting and electrofishing. It is during these expeditions that repatriates are captured and/or recaptured, generally as mature adults as they co-mingle with other repatriates or any remaining wild adults on spawning grounds, but also as juveniles at scattered locations.

Field data sheets are regularly received at ASU and data are manually entered into electronic Excel (Microsoft ® Excel 2003, © 1985-2003 Microsoft Corporation) spreadsheets or directly into an Access (Microsoft ® Access 2003, © 1992-2003 Microsoft Corporation) database; electronic field data files are generally received already in Excel. Data generally include collection or stocking date, collection location, stocking or rearing site with associated state and river mileage (north from Davis Dam, for Lake Mohave), Global Positioning System (GPS) coordinates in either Universal Transverse Mercator (UTM) coordinates or in latitude/longitude degrees/minutes, agency, gear, PIT tag number, total length (TL in mm or cm), weight (g or lb), gender, status and field comments. Gender categories are defined as "juvenile" (a young fish that has not attained sexual maturity and does not exhibit external secondary characters that allow reliable sex determination), male, female, and "unknown" (an adult fish whose gender cannot reliably be determined). Status refers to fish capture, recapture or stocking history, and field comments are generally related to fish health but also may indicate mortality or involvement in an in-situ or hatchery research study.

All manually-entered PIT tagging data are proofed using text to speech software (Zoom Text® 8.1, © 2003-2004 Ai Squared) before they are imported into the NFWG's database maintained in Access; electronic field data files are generally sorted for duplicates, but not proofed. All razorback sucker data from reservoirs Mead, Mohave, and Havasu and in the river below Parker Dam are maintained in this single database, using a species/reservoir identification key to differentiate between reservoirs, and a record identification number to identify each individual record regardless of reservoir. Data queries are initiated based on information requirements and generically written to accommodate any reservoir.

ASU typically handled several dozen requests for specific searches each year from biologists working for a suite of state and federal entities until we made access to the database via the internet in FY 2005. This made retrieval of fish capture histories easier and faster for NFWG members. However we also did this because the database in its entirety was no longer made available to NFWG members in any software format due to its complexity and size. Currently our website is hosted by ASU on an independent server. In FY 2007, we changed the formatting such that members could search up to three PIT tags at one time versus the previous format of searching only one tag at a time. We also added online an accessible release summary table.

In FY 2007 NFWG members began double-tagging fish such that fish captured with 400 kHz tags generally received new 134.9 kHz tags. In the Access database, we added a new field for these tags such that we amended its release and/or capture records to include this new tag. This allows NFWG members to search the online database for either tag, and the complete capture history associated with both tag frequencies is returned.

This report provides a summary and analysis of information on razorback sucker and an assessment of wild adult and repatriated population status as of 30 June 2008. As used below, "short-term recapture(s)" are recaptures within 7 d of capture.

RESULTS

The comprehensive Lake Mohave survey on 10-14 March 2008 captured a total of 242 razorback suckers of which 22 (9%) were untagged and 220 (91%) were PIT-tagged (Table 1). The 22 untagged fish were omitted from any further analysis (e.g., not counted as captures or reported as wild fish) because 400 kHz tags may have been present, but not found by the tag scanner. Among all fish captured, 118 (49%) were female, 119 (49%) were male and 5 (2%) were juveniles or of indeterminate gender. Of the remaining 216 PIT-tagged fish, 87% (*N*=189) were repatriates while 9% (*N*=19) were wild adults; eight tags were not represented in the database and therefore categorized as "unknown" (Table 2). There were four short-term recaptures among the 220 PIT-tagged fish, and these were omitted from further analysis. Of the repatriates collected, the female:male ratio (85:100) was only modestly skewed toward males (1.2).

Off-site rearing facilities contributed 58% (*N*=109) of the total number of repatriated fish sampled (*N*=189) during the survey, with both off-site and lakeside backwaters supplying fish with average TL at stocking larger than 300 mm (Table 3). Release year ranged from 1992 to 2007 (only 1994 was not represented), with the average time at large approximately five years (Table 4). Appendices A.1 and A.2 provide summaries of the release and collection location of PIT-tagged repatriated razorback sucker collected 10-14 March 2008 in Lake Mohave; Appendix A.3 provides release/capture location information. This information is also presented by zone (Appendix B) with zone physical boundary and UTM coordinates provided in Appendices C and D. There were six fish with unknown rearing locations that were collected at Tequila and Yuma Coves (*N*=1 and 5, respectively).

Wild Adult Population Size

For the consecutive second year, fish captured without PIT tags were recorded as repatriated fish in the database, whereas in previous years since the inception of the database, they were noted as wild fish, which may have inflated the wild adult population estimate. Wild adult razorback sucker population abundance of 47 fish as of March 2007 was estimated from 2007 and 2008 sample data and using the adjusted

Peterson Method formula (i.e., the single census Chapman modification, Ricker 1975). The 95% confidence interval ranged from 24 to 175 fish. This estimate is substantially less than the most recently published estimate of 2,698 in 2001 (Marsh et al. 2003), which was derived from all of March data in 2001 and 2002. Nonetheless, it confirms the dramatic population decline over the past decade when the estimate was near 44,000, which was still at that time substantially lower than historical estimates (see Minckley et al. 2003).

Juvenile Repatriate Stocking and Repatriate Population Size

A total of 861 PIT-tagged razorback sucker juveniles were stocked into Lake Mohave from October 1, 2007 through Jun 30, 2008, (Appendix E). Off-site and lakeside backwaters contributed to the total, with Willow Beach NFH and Yuma Cove contributing 70% and 19%, respectively, of the total (*N* = 601 and 165, respectively). The average TL at release was closer to 500 mm for lakeside backwaters as compared to off-site facilities; actual average TLs were 487 and 395 for lakeside and off-site facilities, respectively.

Repatriate population size was estimated using March-only captures (1 March to 31 March) from 2007 and 2008 without short-term recapture data and applying it to a modified Peterson method formula (i.e., Chapman modification; Seber 1973); fish released after March 1, 2007 were excluded from this analysis (*N*=23). The March 2007 repatriate razorback sucker population estimate was 1,232 fish, which represents about 1% of nearly 126,562 fish stocked prior to March 1, 2007. This estimate was based upon mark-recapture data for 2007-2008.

CONCLUSIONS

Since 1992, the program to replicate the dwindling Lake Mohave population of wild adult razorback suckers with juveniles has been successful in repatriating a population of about 1,279 as of March 2007. However, that number is far from the target of 50,000 repatriates, and the wild population now has dwindled from probable recent-historical levels in the hundreds of thousands to fewer than 50. Repatriate capture/recapture data

demonstrate unequivocally that fish released at larger size have a higher survival probability than smaller fish. Young razorback suckers should be reared to an individual minimum total length of 50 cm prior to release, and larger sizes should be attained if practical, even if that means fewer fish are being released.

Overall survivorship of repatriated razorback suckers in Lake Mohave is low. It was predicted that a substantial increase in survivorship would accompany an increase in size at stocking, but this has not yet been reflected in the available capture data. This situation may change with the recent (2007) increase to 50 cm (see Kesner et al. 2008).

ACKNOWLEDGEMENTS

NFWG members representing ASU, AZGFD, BR, FWS, NDOW, NFS and USGS-BRD and others are thanked for their continuing logistic and programmatic support. Appreciation is extended to all participants in field operations. Special appreciation for their leadership roles goes to Tom Burke (BR), Mike Burrell (NDOW), Andy Clark (AZGFD), Chuck Minckley (FWS, retired), Gordon Mueller (USGS-BRD, retired) and Ross Haley (NPS). Reclamation, Boulder City, NV provided funding for this project.

REFERENCES

Kesner, B. K., A. P. Karam, C. A. Pacey, and P. C. Marsh. 2007. Demographics and post-stocking survival of repatriated razorback sucker in Lake Mohave. Final 2006 Annual Report, Reclamation Agreement No. 06-FC-300003. Arizona State University, Tempe. 33 pages.

Marsh, P. C., C. A. Pacey, and B. R. Kesner. 2003. Decline of the razorback sucker in Lake Mohave, Colorado River, Arizona and Nevada. Transactions of the American Fisheries Society 132(6):1251-1256.

Minckley, W. L., P. C. Marsh, J. E. Deacon, T. E. Dowling, P. W. Hedrick, W. J. Matthews, and G. Mueller. 2003. A conservation plan for native fishes of the lower Colorado River. BioScience 53: 219-234.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of Fisheries Research Board of Canada 191. 382 pages.

Seber, G. A. F. 1973. The Estimation of Animal Abundance. Hafner Press, New York. 506 pages.

Table 1. Field data summary of razorback sucker collected 10-14 March 2008 (*N*=242) in Lake Mohave, AZ-NV.

Field data	*N* fish collected (% Total; % Sum)		Sum (% Sum total)
Sampling agency	Without PIT tags	With PIT tags	
ASU	0	14 (6;6)	14 (6)
AZGFD and FWS	6 (27;2)	17 (8;7)	23 (9)
BR	4 (18;2)	30 (14;12)	34 (14)
FWS	9 (41;4)	131 (59;54)	140 (58)
NDOW and NPS	3 (14;1)	28 (13;12)	31 (13)
Total (% Sum total)	22 (9)	**220** (91)	242
Fish gender			
Female	14 (64;6)	104 (47;43)	118 (49)
Male	7 (32;3)	112 (51;46)	119 (49)
Unknown	1 (5;5)	4 (2;2)	5 (2)
Total (% Sum total)	22 (9)	**220** (91)	242

Table 2. Summary of PIT-tagged razorback sucker collected 10-14 March 2008 (*N*=220) in Lake Mohave, AZ-NV. Gender was determined in the field. Classification into one of the three categories (wild, repatriate and unknown) was based upon information in the NFWG razorback sucker database; fish listed as unknown were recorded as "recaptures" in the field data, but had no information in the database to identify them as either wild adult or repatriate. Four fish were captured and recaptured during period and omitted from analysis.

Fish gender	*N* fish collected (% Total; % Sum)			Sum (% Sum total)
	Wild adult	Repatriate	Unknown	
Female	14 (74;6)	85 (45;39)	2 (25;1)	101 (47)
Male	5 (26;2)	100 (53;46)	6 (75;3)	111 (51)
Unknown gender	0	4 (2;2)	0	4 (2)
Total (% Sum total)	19 (9)	**189** (87)	8 (4)	216

Table 3. Summary of rearing location by rearing type and total length (TL) in mm at release of PIT-tagged repatriated razorback sucker collected 10-14 March 2008 (*N*=189) in Lake Mohave, AZ-NV. See Appendix A.3 for release location information.

Rearing location	*N* fish collected (% Total; % Grand total)	Release TL (mm)			
		Avg	SD	Min	Max
Lakeside backwater					
Arizona Juvenile	10 (13;5)	385	61	310	500
Dandy Cove	6 (8;3)	443	55	340	495
Davis Cove	3 (4;2)	408	178	220	575
Nevada Larvae	3 (4;2)	377	71	295	425
Nine Miles Cove	2 (3;1)	343	11	335	350
North Chemehuevi Cove	7 (9;4)	352	83	250	460
South Sidewinder Cove	5 (7;3)	308	30	260	340
Willow Cove	3 (4;1)	428	28	400	455
Yuma Cove	35 (47;19)	383	91	225	535
Total (% Grand total)	74 (39)	382	84	-	-
Off-site facility					
Boulder City Golf Course Ponds	9 (8;5)	323	48	250	370
Boulder City Wetlands Park	29 (27;15)	353	58	270	485
Bubbling Ponds	7 (6;4)	328	45	275	385
Willow Beach NFH	64 (59;34)	381	39	250	460
Total (% Grand total)	109 (58)	365	50	-	-
Grand total	**189**[a]	379	75	220	635

[a]Includes six fish (3% of grand total) with unknown rearing sites.

Table 4. Summary of time at large of PIT-tagged repatriated razorback sucker collected 10-14 March 2008 (*N*=189) in Lake Mohave, AZ-NV. Time at large is differentiated into days at large (DAL), months at large (MAL) and years at large (YAL).

Release year	*N* fish collected (% total)	DAL	MAL	YAL
2007	23 (12)	223	7	1
2006	21 (11)	721	24	2
2005	45 (24)	1,082	36	3
2004	13 (7)	1,346	45	4
2003	4 (2)	1,715	57	5
2002	11 (6)	2,089	70	6
2001	9 (5)	2,427	81	7
2000	14 (7)	2,749	92	8
1999	7 (4)	3,132	104	9
1998	11 (6)	3,515	117	10
1997	7 (4)	3,844	128	11
1996	12 (6)	4,165	139	11
1995	6 (3)	4,536	151	12
1993	1 (< 1)	5,430	181	15
1992	5 (3)	5,595	186	15
Total	**189**	1,983	66	5

Appendix A.1 Rearing and collection locations of PIT-tagged repatriated razorback sucker reared in lakeside backwaters collected 10-14 March 2008 (*N*=74) in Lake Mohave, AZ-NV.

Location		*N* fish collected
Rearing	Collection	
Arizona Juvenile	Cottonwood Cove East	1
	Owl Point Cove	1
	Tequila Cove	1
	Yuma Cove	7
Dandy Cove	Half-way Wash	1
	Tequila Cove	2
	Valhalla Cove to 17.61 RM (willow cluster)	2
	Yuma Cove	1
Davis Cove	Owl Point Cove	1
	Yuma Cove	2
Nevada Larvae	Telephone Cove	1
	Yuma Cove	2
Nine Mile Cove	Half-way Wash (south of)	1
	Yuma Cove	1
North Chemehuevi Cove	Carp Cove (back of)	1
	Cottonwood Cove East (back of)	1
	Tequila Cove	1
	Valhalla Cove to 17.61 RM (willow cluster)	1
	Yuma Cove	3
South Sidewinder Cove	Yuma Cove	5
Willow Cove	Nine Mile Coves	1
	Yuma Cove	2
Yuma Cove	Half-way Wash (south of)	1
	Nine Mile Coves	2
	Owl Point Cove	2
	Telephone Cove	1
	Tequila Cove	7
	Valhalla Cove to 17.61 RM (willow cluster)	2
	Yuma Cove	20
	Total	74

Appendix A.2 Rearing and collection locations of PIT-tagged repatriated razorback sucker reared in off-site facilities collected 10-14 March 2008 (*N*=109) in Lake Mohave, AZ-NV.

Location		*N* fish collected
Rearing	Collection	
Boulder City Golf Course Ponds	Half-way Wash	1
	Tequila Cove	2
	Yuma Cove	6
Boulder City Wetlands Park	Cottonwood Cove East	1
	Half-way Wash	3
	Nine Mile Coves	2
	Nine Mile Coves (south of)	1
	Owl Point Cove	3
	Tequila Cove	2
	Yuma Cove	17
Bubbling Ponds FH	Nine Mile Coves	1
	Nine Mile Coves (south of)	1
	Tequila Cove	1
	Yuma Cove	4
Willow Beach NFH	Carp Cove (back of)	1
	Carp Cove (inside)	1
	Cottonwood Cove East	2
	Cottonwood Cove East (back of)	1
	Half-way Wash	1
	Nine Mile Coves	3
	Nine Mile Coves (south of)	1
	Owl Point Cove	3
	Perkins Cove	1
	Telephone Cove	1
	Tequila Cove	6
	Willow Cove (south of)	1
	Yuma Cove	42
	Total	109

Appendix A.3. Zone, release/collection location, state and approximate river miles of locations described by ASU for PIT-tagged repatriated razorback sucker collected 10-14 March 2008 in Lake Mohave, AZ-NV. See C and D for more information on zones.

Zone	Release/collection location	State	Approximate river miles
Arizona Bay	Owl Point Cove	AZ	28.7
Arizona Bay	Perkins Cove	AZ	27.9
Arizona Bay	Yuma Cove	AZ	24.5
Basin	Tequila Cove	NV	20.8
Basin	Carp Cove (back of)	AZ	20.5
Basin	Carp Cove (inside)	AZ	20.49
Basin	Cottonwood Cove East (back of)	AZ	20.1
Basin	Cottonwood Cove East	AZ	20.0
Basin	Six Mile Coves	NV	19.1
Basin	Half-way Wash	NV	17.5
Basin	Half-way Wash (south of)	NV	17.4
Basin	Valhalla Cove to 17.61 RM (willow cluster)	NV	16.7
Basin	Nine Mile Coves	NV	16.2
Basin	Willow Cove	NV	16.1
Basin	Willow Cove (south of)	NV	16.0
Basin	Dandy Cove	NV	15.9
Basin	Arizona Juvenile	AZ	15.4
Basin	Nevada Larvae	NV	14.8
Basin	North Chemehuevi Cove	NV	12.2
Lower lake	Telephone Cove	AZ	2.3
Lower lake	Davis Cove	AZ	0.5

Appendix B. Release and collection zone of PIT-tagged repatriated razorback sucker collected 10-14 March 2008 (*N*=189) in Lake Mohave, AZ-NV. See Appendix C and D for specific zone descriptions.

Zone		*N* fish collected
Release	Collection	
Arizona Bay	Arizona Bay	66
	Basin	26
	Lower lake	2
Basin	Arizona Bay	35
	Basin	24
	Lower lake	1
Lower lake	Arizona Bay	9
	Basin	2
River	Arizona Bay	18
	Basin	6
	Total	**189**

Appendix C. Zone physical and approximate river mile boundary on Lake Mohave as described by ASU in release and collection zone of PIT-tagged repatriated razorback sucker collected 10-14 March 2008 (*N*=189) in Lake Mohave, AZ-NV.

Zone	Physical boundary	Approximate rive mile boundary
River	Hoover Dam to Plateau Cove/Fire Mountain Lights	South from dam to 37 RM on NV side/37 RM on AZ side
Arizona Bay	Below Plateau Cove/Fire Mountain Lights to Solicitor Cove	Below 37 RM on NV side/37 RM on AZ side to 23 RM both sides
Basin	Below Solicitor Cove to Clam Cove/South Haystack Cove	Below 23 RM both sides to 12 RM on NV side/12 RM on AZ side
Lower Lake	Below Clam Cove/South Haystack Cove to Davis Dam	Below 12 RM on NV side/12 RM on AZ side to dam

Appendix D. Zone UTM coordinates for NV and AZ sides of Lake Mohave as described by ASU for release and collection zone of PIT-tagged repatriated razorback sucker collected 10-14 March 2008 (*N*=189) in Lake Mohave, AZ-NV.

Zone	UTM			
	NV		AZ	
	Easting	Northing	Easting	Northing
River	709587	3951485	710049	3951650
Arizona Bay	710389	3931947	710838	3931920
Basin	716891	3915253	718073	3915663
Lower Lake	Anything downstream to dam	Anything downstream to dam	Anything downstream to dam	Anything downstream to dam

Appendix E. Rearing locations by rearing type and total length (TL) at release of PIT-tagged juvenile razorback suckers repatriated October 1, 2007 to June 30, 2007 (*N*=861) in Lake Mohave, AZ-NV.

Rearing location	*N* fish repatriated	Release TL (mm)			
		Avg	SD	Min	Max
Lakeside backwater					
North Chemehuevi Cove	89	462	27	405	530
Willow Cove	6	306	18	275	325
Yuma Cove	165	507	36	410	610
Total	260	487	48	-	-
Off-site facility					
Willow Beach NFH	601	355	47	290	508
Grand total	861	395	77	-	-