Horseshoe and Bartlett Reservoirs Habitat Conservation Plan

ANNUAL IMPLEMENTATION REPORT

2010

PREPARED FOR:

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951

PREPARED BY:

Salt River Project
Environmental Services Department
PAB 352
P.O. Box 52025
Phoenix, Arizona 85072-2025

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Appendix A. Horseshoe Reservoir HCP Fish Monitoring Report, Arizona Game and Fish Department

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CERTIFICATION

Under penalty of law, I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate, and complete.

Charles E. Paradzick 11/18/2011

Charles E. Paradzick
Sr. Ecologist
Siting and Studies
Environmental Services Department
Salt River Project

Date

1. Introduction

On May 30, 2008, the U.S. Fish and Wildlife Service (FWS) issued an Incidental Take Permit (ITP) pursuant to Section 10(a)(1)(B) of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended, to Salt River Project (SRP) for southwestern willow flycatcher *(Empidonax traillii extimus)* ("flycatcher"), yellow-billed cuckoo *(Coccyzus americanus)* ("cuckoo"), bald eagle *(Haliaeetus leucocephalus)*, razorback sucker (*Xyrauchen texanus*), Colorado pikeminnow (*Ptychocheilus lucius*), Gila topminnow (*Peociliopsis occidentalis occidentalis*), spikedace (*Meda fulgida*), loach minnow (*Tiaroga cobitis*), roundtail chub (*Gila robusta*), longfin dace (*Agosia chrysogaster*), Sonora sucker (*Catostomus insignis*), desert sucker (*Catostomus clarki*), speckled dace (*Rhinichthys osculus*), lowland leopard frog (*Lithobates yavapaiensis*), Northern Mexican gartersnake (*Thamnophis eques megalops*), and narrow-headed gartersnake (*Thamnophis rufipunctatus*). The activity covered by the ITP is the continued operation by SRP of Horseshoe and Bartlett dams and reservoirs. The ITP is conditioned upon SRP's implementation of the Horseshoe and Bartlett Reservoirs Habitat Conservation Plan ("H-B HCP") (Salt River Project 2008).

The H-B HCP provides measures to minimize and mitigate incidental take of the 16 species listed above "to the maximum extent practicable and ensures that incidental take will not appreciably reduce the likelihood of the survival and recovery of these species in the wild" (FWS 2008). Flycatcher and cuckoo ("covered bird") mitigation efforts include operation of Horseshoe Reservoir to support tall dense vegetation at the upper end of the reservoir, and off-site acquisition and management of suitable nesting habitat. Minimization and mitigation efforts for covered native fish, frog, and gartersnake ("aquatic species") includes operation of Horseshoe Reservoir to minimize non-native fish production, stocking of covered native fish, and supporting stream and water supply protection projects in the Verde River watershed.

2. Annual Reporting Requirements

Obligation: SRP is required to submit an annual report to FWS, City of Phoenix, Arizona Game and Fish Department, and U.S. Forest Service describing all H-B HCP activities occurring during the past year. A draft report must be sent to FWS prior to the annual meeting in October/November of each year. The report is to be finalized by February 1st of the following year.

Actions: SRP submits this report to the FWS, City of Phoenix, Arizona Game and Fish, and U.S. Forest Service to fulfill the annual reporting requirement. The report covers all activities relating to the Horseshoe and Bartlett Reservoirs HCP from November 1, 2009 through October 31, 2010, including a summary of reservoir operations, management activities, monitoring results, status reports and planned future activities.

3. Horseshoe Lake Operation ITP Compliance

a. Horseshoe and Bartlett Operation Summary

Obligation: SRP is required in this annual report to provide a summary of reservoir operations.

Action: Below is a summary of reservoir operations from SRP hydrologists of the 2010 water year (October 2009 – September 2010) and a forecast for the upcoming year. The summary includes watershed conditions for both the Salt and Verde systems.

Summary: The El Niño this winter had the greatest influence on Salt and Verde reservoirs operations this past water year. Water Year 2010 was a productive runoff year ultimately requiring over 660,000 acre feet of water to be released over Granite Reef Diversion Dam. The Climate Prediction Center declared an El Niño for winter 2009/2010. The sea surface temperatures reflected a moderate to strong El Niño event for most of the runoff season. This was significant because the watershed has never seen a dry winter (at least since sea surface temperature data became reliable – 1950 to current) with a moderate or strong El Niño. The winter was no exception. The monsoon season is typically dry following a wet winter; however, the precipitation this monsoon season on the Salt and Verde watersheds was 100% of normal. Unfortunately, cool water in the equatorial Pacific herald a La Niña event this and winter. The seasonal river swap from the Salt System to Verde System was initiated on November 3rd, 2010, slightly later than usual due to maintenance requirements at Bartlett Dam.

Winter Precipitation: Sea surface temperatures across the Equatorial Pacific during the Fall of 2009 were warmer than normal indicating that the Southern Oscillation was in a moderate El Niño phase going into the winter of 2009/2010. Typically, this condition is associated with above normal cool-season precipitation across the Southwestern United States with the biggest impact in Arizona usually observed during the months of December – March. Like several recent years, this past cool season began with very dry fall months followed by much more active winter months.

Average precipitation recorded on the Salt/Verde watershed for the months of October and November only totaled 0.26” which is a mere 8% of normal, but in early December, a strong winter storm system passed that helped bring that month’s watershed average precipitation total to near 2.40” or 126% normal for the month. Although high pressure dominated Arizona’s weather and kept the main storm track over the northern tier of the Western United States for the first half of January, an unprecedented week-long series of winter storm systems tracked over the Southwestern United States starting just after mid-month. The heaviest precipitation during this period occurred on January 21, 2010, when a Salt/Verde watershed average accumulation of 3.76” was observed which set a new record average watershed accumulation

for a 24-hour period. This day's average accumulation served as the base for this series of storm systems, which affected Arizona from January 18-23, 2010, to set record average Salt/Verde watershed accumulations for two through six day periods with the total for the six days equaling 6.76".

Several less intense but productive low-pressure systems passed during February and early March to produce a total of 3.76" for the two months which is near 70% normal. All totaled for the period from December 1, 2009, through March 31, 2010, the Salt/Verde watershed received an average precipitation accumulation of 13.32" which is 145% of normal; by basin for this winter time frame, the Salt Watershed received an average accumulation of 13.90" or 151% of normal and was slightly favored compared to the Verde Watershed which received 12.76" or 138% of normal.

Summer Precipitation: After a typically dry April through June, the North American monsoon got underway in Arizona in early July. Thunderstorms gradually became more numerous and widespread around the state after mid-July and built-up to what was to be the only significant "burst" of the monsoon which occurred in late July and early August. It was during this period that the most widespread, heavy rainfall of the monsoon was observed that helped produce a Salt/Verde watershed average precipitation accumulation for the two months of 5.38" which is 114% of normal. By late August, the monsoonal circulation over the Southwestern United States broke down as westerly winds aloft returned to the region so thunderstorms were much less numerous in early/mid September. Later in the month, the remnants of a decaying tropical storm system interacted with a disturbance in the westerlies and produced heavy rainfall over parts of the Salt/Verde watershed and brought the average watershed accumulation for the water year's last month to 1.25" which is 73% of normal. For the summer months of July through September, the Salt/Verde watershed as a whole received an average accumulation of 6.63" which is 103% of normal; by basin for this summer time frame, the Salt Watershed received an average accumulation of 7.99" or 124% of normal and was again favored compared to the Verde Watershed which received only 5.31" or 83% of normal.

For the water year, October 1, 2009, through September 30, 2010, the Salt/Verde watershed average precipitation accumulation was 20.61" or 104% of normal with the Salt side receiving 22.66" or 115% of normal versus the Verde's 18.63" or 95% of normal. The chart below (Fig. 1) shows how the cumulative average Salt/Verde watershed precipitation recorded during Water Year 2010 compares to that observed during recent past water years and the long-term normal; monthly totals and normal amounts appear in the boxes below the chart.

Reservoir Status: In early January, 2010, total reservoir storage was 73 percent full with the prospect of significant improvement during an El Niño winter. After the major storm events from January 18th to January 23rd, runoff dramatically increased reservoir storage. In January, the watershed produced over 450,000 acre-feet of runoff which is about 40,000 acre-feet less than the entire 2009 winter season. Total runoff this winter (January-May) was approximately

1,420,000 acre-feet. The Verde reservoirs were near capacity from April through June. Roosevelt Lake recorded the highest elevation in history this runoff season at 2152.08 feet on April 26th, 2010.

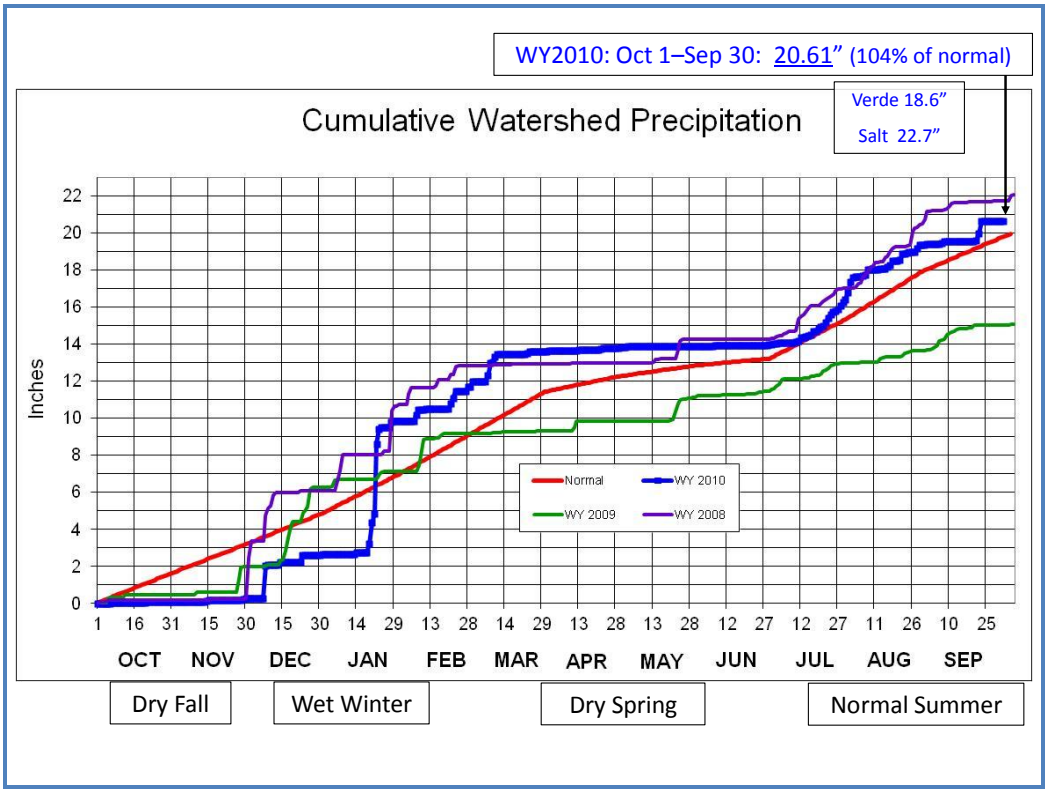

Figure 1. Cumulative watershed precipitation on the Salt River and Verde River watersheds for October 2009 – September 2010 (blue line).

Verde Operations: The winter runoff and the Bartlett Dam maintenance project had the most influence on operations at Horseshoe reservoir. Typical operations call for the water order to be switched from the Verde system to the Salt system in May leaving Bartlett release at minimum. Water stored behind Horseshoe Dam is also typically moved as soon as possible downstream to Bartlett reservoir to reduce the amount of loss from seepage and evaporation, and meet H-B HCP objectives. The water order may be switched sooner depending on the winter runoff. However, a deviation from typical operations was necessary and a portion of the water order remained on the Verde system due to the reservoirs being near capacity in June. Because Roosevelt Reservoir continued to gain storage within the New Conservation Storage pool, Verde releases were stepped down as inflow receded in order to maintain total SRP storage capacity. Once Roosevelt Reservoir inflow fell below demand, increased releases on the Verde could be reinstated. In late May and into early June, reservoir releases from Bartlett Reservoir were increased (see Figure 2) to begin the process of emptying Horseshoe Reservoir as quickly as possible (i.e., implementation of rapid drawdown HCP objective). Due to unforeseen safety issues on the Salt River below Stewart Mountain, a portion of the water order that would have typically been released from the Verde system stayed on the Salt system

slowing the Horseshoe Reservoir drawdown. Also, significant monsoon events in late July and early August produced enough rainfall to produce a 7,000 cfs peak inflow (Figure 3) into Horseshoe Reservoir further delaying the Horseshoe drawdown. Horseshoe Lake reached empty on Thursday, August 26th with only the flow of the Verde River passing through just before noon the same day (Figure 3).

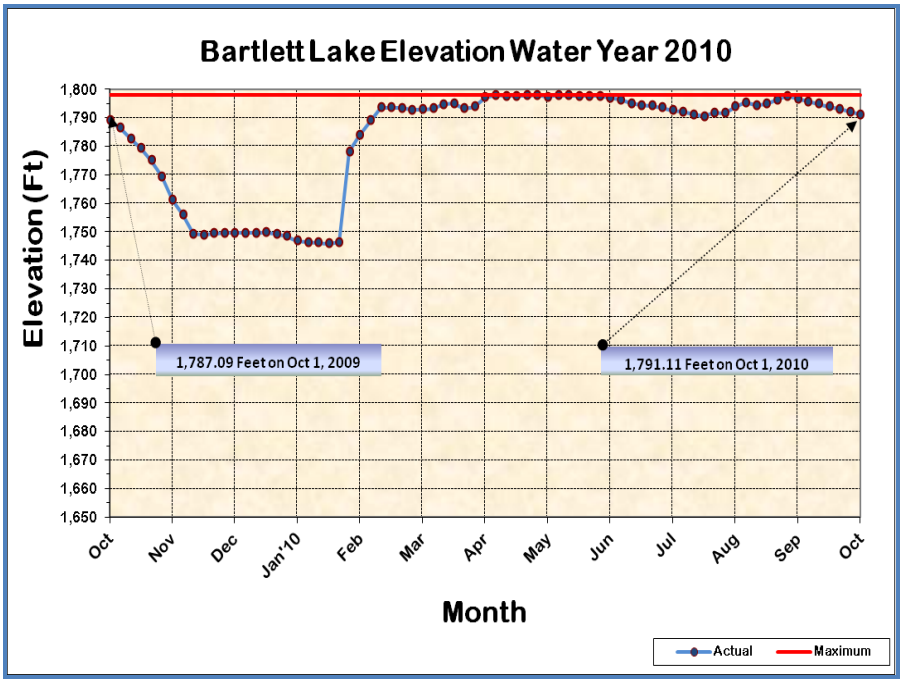

Figure 2. Bartlett Reservoir storage for October 2009 – September 2010.

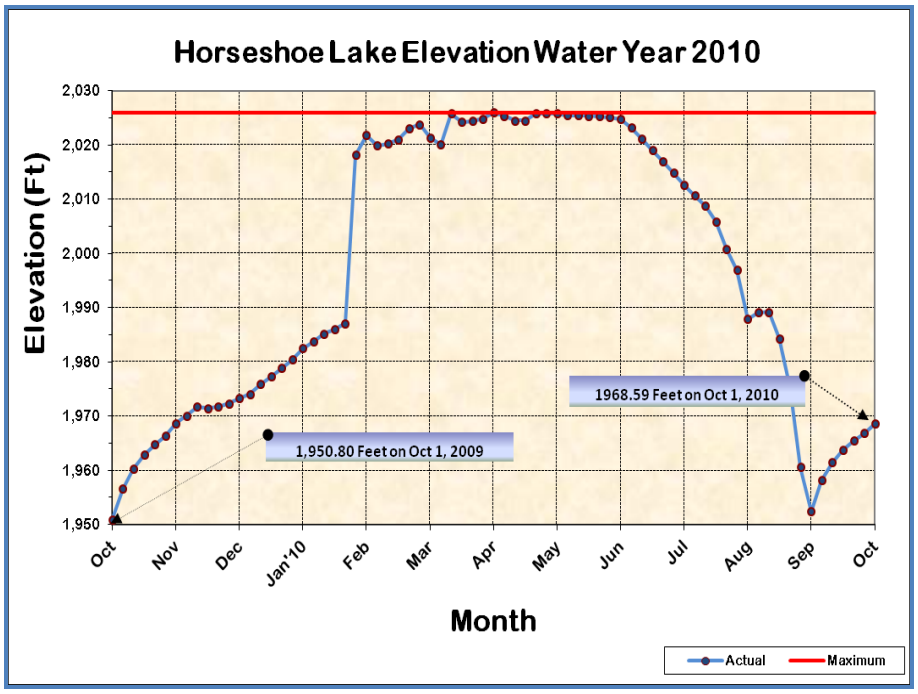

Figure 3. Horseshoe Reservoir storage for October 2009 – September 2010.

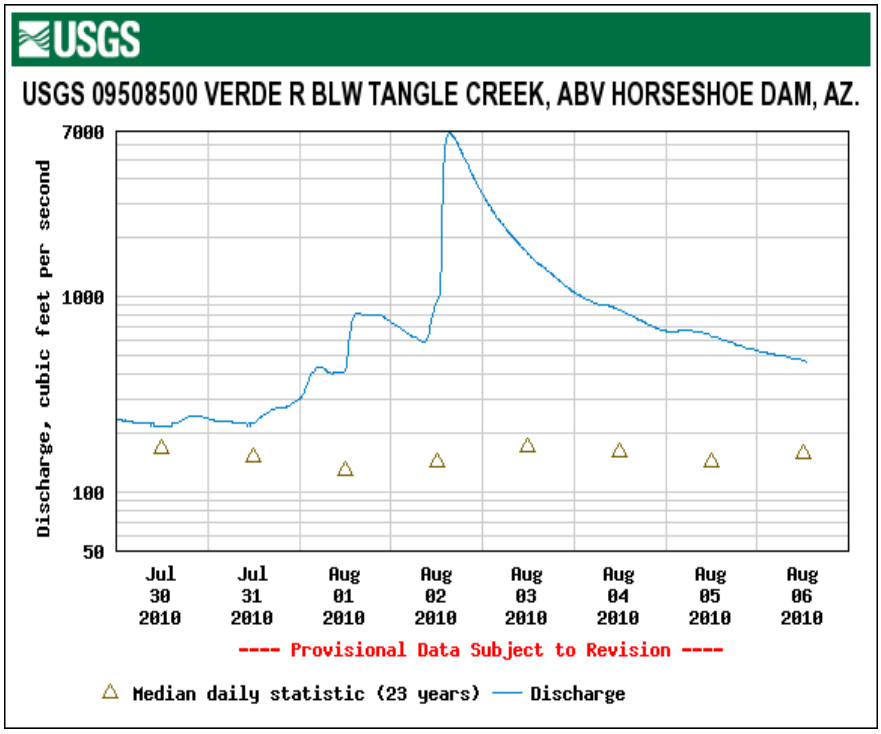

Figure 4. Verde River flows (cfs) recorded at Tangle Creek gauging station upstream of Horseshoe, July 30 – August 6, 2010.

The maintenance project at Bartlett Dam required that divers be in the water to inspect and repair the bulkhead in January of 2010. The bulkhead is used to block flow so work can be performed on the outlet works at Bartlett Dam. The Bartlett Lake elevation was reduced to elevation 1749 feet to increase the safety for the divers and insure that minimum deliveries could still be met. Deliveries were made from the spillway because the outlet works should not be operated with divers in the water. The spillway crest is at elevation 1748 feet. The release from Horseshoe Reservoir was reduced to 25cfs on October 1st, 2009 to hasten the Bartlett drawdown to elevation 1749 feet. However, the January 18th-23rd, 2010 generated record breaking precipitation and enough runoff to force the project to be delayed. The divers returned in mid-October, 2010 to continue the maintenance project. Again, this required a drawdown at Bartlett Reservoir and the release from Horseshoe Reservoir was reduced to 25 cfs on September 1, 2010. The inspection in October revealed that it is no longer necessary to drawdown Bartlett Reservoir to elevation 1749 feet. At this time, more typical operations are in place with the majority of the water order being met from the Verde System. Water currently stored in Horseshoe Reservoir (see Figure 3) will be passed downstream to Bartlett Reservoir.

Weather Outlook: The strongest indicator, El Niño Southern Oscillation (ENSO), has shifted since last winter from El Niño to La Niña conditions. Current conditions along with the latest guidance indicate a moderate to strong La Niña event this winter with Equatorial Pacific sea surface temperatures well below normal. Since 1950, there have been twenty La Niña

winters. Eight of those twenty winters have been dry with eight being normal and four being above normal. Official forecasts from the National Weather Service and the Climate Prediction Center all point to a greater likelihood of a dry winter. The Climate Prediction Center's latest seasonal outlooks for temperature and precipitation through January-March outlooks suggests above normal temperatures and below normal precipitation in the Valley and on the watershed (see Figure 5).

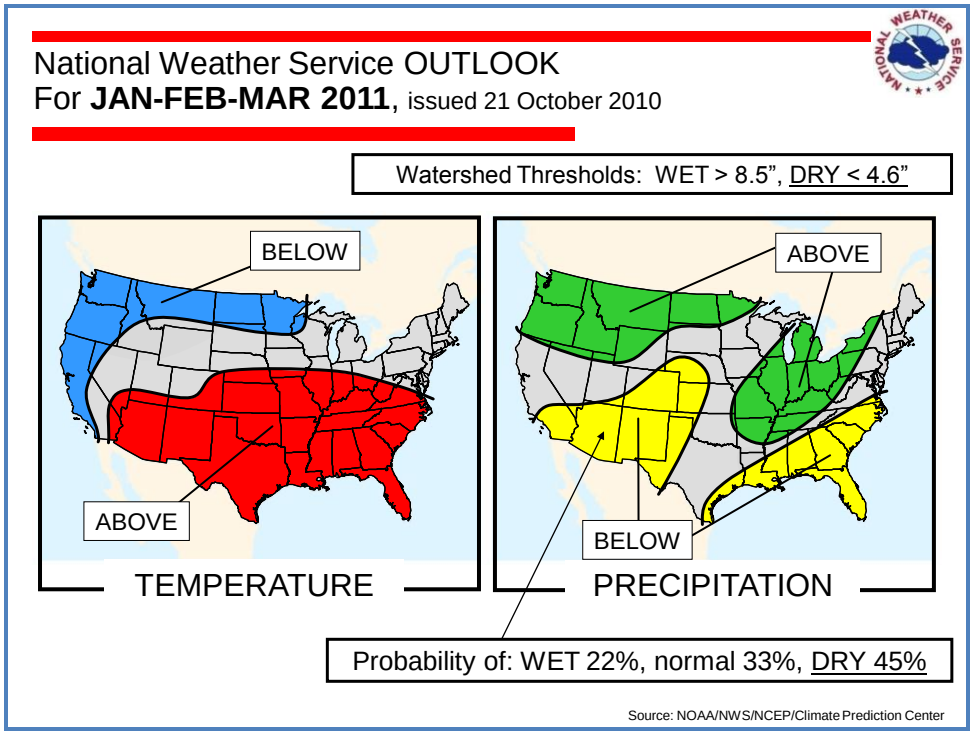

Figure 5. National Weather Service forecast for temperature and precipitation, January – March 2011.

b. Flycatcher and Cuckoo Operation Objective

Obligation: SRP will manage water levels at Horseshoe, conditional on other operation goals, to make riparian habitat available earlier in the nesting season and to maintain riparian vegetation at upper end of the reservoir. After two successive years of low water levels due to drought, Horseshoe will be filled ahead of Bartlett, if feasible, to provide water to tall dense vegetation at upper end of Horseshoe.

Action: Horseshoe storage reached a maximum of 100% full (elevation 2026') the second week of March. Due to high water levels system wide (see Section 3.a) water levels remained high through late May. During early June, WRO commenced drawing down Horseshoe to meet covered bird and fish operation objectives (see next section). Storage on May 1 was approximately 100% full (elevation 2026'). The reservoir was drained to minimum pool by August 26.

2011 Action: Due to storage levels in 2010, the earliest spring to hold water higher after two successive years of low water could occur in 2013.

c. Covered Aquatic Species Operation Objective

Obligation: SRP will manage water levels at Horseshoe, conditional on other operation goals, to minimize the reproduction, recruitment, and survival of nonnative fish by rapidly drawing down the reservoir and minimizing carry-over storage, and in years when the reservoir is held high for flycatcher provide opportunities for razorback sucker reproduction and recruitment.

Action: As explained in Sections 3.a and b above, rapid drawdown was implemented the first week of June. Horseshoe storage increased slightly in early August due to monsoon inflows and then was emptied by August 26. The reservoir remained empty for one week (September 2nd). The reservoir began storing water on September 3rd to allow for Bartlett water levels to be reduced in order to provide safe conditions for maintenance on the dam. Horseshoe storage will be released to Bartlett as soon as feasible, and prior to winter runoff.

2011 Action: Due to the high water levels in 2010, the earliest spring to hold water higher after two successive years of low water to meet flycatcher objectives and support razorback sucker stocking could occur in 2013.

d. Covered Bird Monitoring

i. Vegetation Monitoring

Obligation: SRP will use vegetation monitoring at Horseshoe to identify trends in the amount and height of tall dense vegetation to assist in the evaluation of whether adaptive management thresholds or Permit limits may be exceeded. Vegetation will be monitored once every three years.

Action: We estimate that of the 141 acres of potentially suitable flycatcher breeding habitat (GIS model classes 3-5) that occurred in the reservoir in 2009, approximately 87 acres could have been unavailable on May 1, 2010 (Table 1). The average amount of potentially suitable habitat that may have been unavailable at the beginning of the 2009 and 2010 breeding seasons was 64.5 acres, which is below the 200 acre average long-term permit threshold.

Table 1. Acres of occupied and predicted willow flycatcher habitat based on GIS breeding habitat model in Horseshoe Reservoir, 2008 – 2010

		Occupied habitat (acres)		Predicted habitat Probability Classes 3-5 (acres)	
Year	Reservoir level (ft) on May 1	Occupied flycatcher habitat[1]	Occupied habitat unavailable May 1	Total within reservoir	Estimated habitat unavailable May 1
2008	--	52	--	95	-
2009	2000	--	0[2]	141	42
2010	2026	--	52[3]	28	87
Annual average	--		26	88	65
2011 (predicted[4])					8

[1]Flycatcher surveys preformed every 3 years within reservoir.
[2]The lowest elevation of occupied habitat in 2008 was 1990 ft. Water level on May 1, 2010 was 2000 ft. Trees are assumed to be ≥25 ft tall. Therefore, at least 10 – 15 ft of all occupied habitat (located in 2008) was above water on May 1, 2009 (see assumptions outlined in the H-B HCP page 109).
[3] Same assumptions as #2 above; occupied habitat located at elevations ≤ 2015' would be unavailable due to inundation at full pool on May 1, 2010.
[4]Assumes reservoir at full pool on May 1; habitat assumed unavailable if located at elevations ≤2015' (see assumptions outlined in the H-B HCP page 109).

Because the methodology to map and forecast breeding habitat has not been finalized, we continued to estimate the amount of potential breeding habitat in 2010 that may be unavailable in 2011 using the GIS breeding habitat model and June 2010 satellite imagery (Fig. 6). We estimated that there were 5.9 acres of Class 3, 8.4 acres Class 4, and 14.2 acres of Class 5 habitat - totaling approximately 28.5 acres of higher-probability breeding habitat within the reservoir in 2010. For 2011, assuming the reservoir is at full pool on May 1, approximately 7.7 acres of potentially suitable habitat (classes 3-5) could be unavailable at or below elevation 2015'[1], and approximately 20.7 acres of potentially suitable habitat is located between elevations 2015' and 2026' and would be available as breeding habitat.

SRP continues to investigate (in coordination with the Roosevelt HCP program) if the GIS flycatcher breeding habitat model (Hatten and Paradzick 2003) coupled with LIDAR (Light Detection and Ranging) could be used as a cost effective and accurate method to delineate and forecast suitable breeding habitat within the

[1] Elevation 2015' was used instead of 2010' as conservative estimate for inundation impacts based on analysis and assumptions outlined in the Horseshoe – Bartlett HCP.

conservation space of Horseshoe Reservoir. LIDAR was scheduled to be acquired in November 2010. However, due to the unexpected high reservoir levels in June and anticipated water storage in the fall and winter 2010, which would preclude accurate topographic and vegetation height data collection in lower portions of the reservoir, acquisition of data will be postponed until fall of 2011.

2011 Action: In 2011, we will develop a bid and contract for the acquisition of LIDAR data in November/early December 2011. We will also run the GIS breeding habitat model using summer (~June) 2011 imagery. The habitat model results will be paired with the LIDAR data to generate a breeding habitat map for the 2011 reporting period. Flycatcher surveys will also be conducted and used to refine results. Pending the outcome of the 2011 results, next mapping would be required in the summer of 2014.

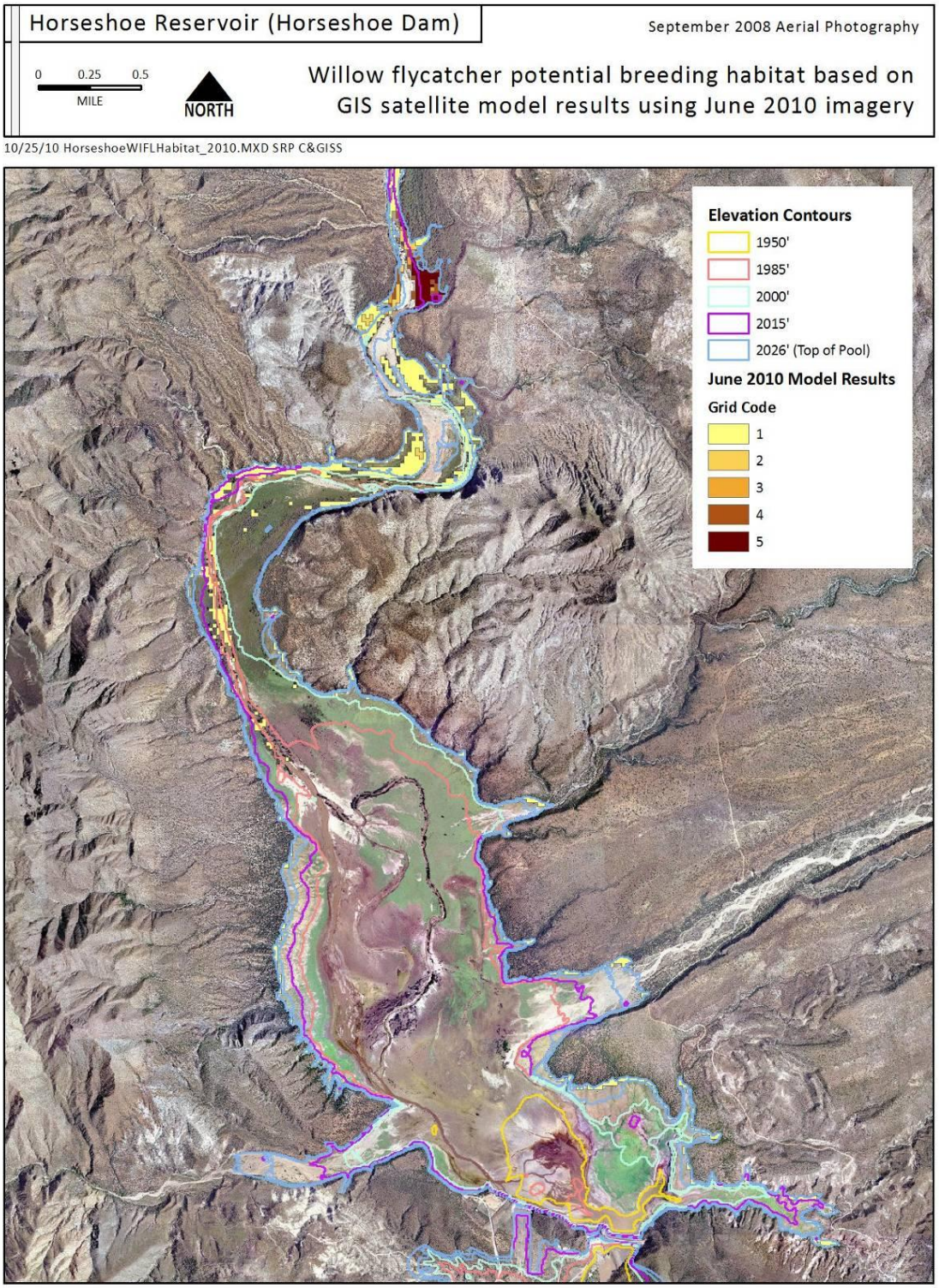

Figure 6. Willow flycatcher potential breeding habitat in Horseshoe Reservoir based on GIS satellite model results using June 2010 imagery.
[note: model grid code scale: 1 = lowest breeding probability, 5 highest breeding probability; sediment contour interval 1950' ≈ 0% storage; 1985' ≈ 25% storage; 2000≈ 50% storage; 2015' ≈ 75% storage; 2025' ≈ 98% storage.]

ii. Flycatcher Monitoring

Obligation: SRP will monitor the flycatcher population to assist in the evaluation of ITP compliance relative to thresholds for adaptive management and the cap on harm of occupied habitat. The method used to determine occupied habitat is explained in Section IV.B.1.B of the HCP. The adaptive management threshold is an annual average of 200 acres of potentially impacted occupied habitat and the cap is 400 acres. Flycatcher surveys will be conducted every three years.

Action: No surveys were conducted in 2010. Based on flycatcher surveys in 2008 and habitat monitoring (Section 3.d.i, Table 1), the amount of habitat that may have been unavailable in 2010 was < 200 acres.

2011 Action: Flycatcher surveys will be conducted in 2011. As noted in Section 3.d.i, the amount of potential breeding habitat that could be unavailable in 2011 is below the 200 acre annual average threshold for adaptive management.

iii. Yellow-billed Cuckoo Monitoring

Obligation: SRP will monitor cuckoo at Horseshoe to identify the long-term trend in the population. The reservoir will be surveyed every three years.

Action: No surveys were conducted in 2010.

2011 Action: Cuckoo surveys will be conducted in 2011.

iv. Bald Eagle Monitoring and Emergency Rescue Protocol

Obligation: SRP will develop a coordinated plan with FWS and AGFD to identify when recue actions would be required and the process to rescue bald eagle, bald eagle eggs, or nestlings at Horseshoe or Bartlett. The Plan will include triggers for winter monitoring at appropriate effort and frequency to determine if a nest has been built in the conservation space of the reservoir and the likelihood that the nest could be impacted by spring runoff. The Plan will be completed within one year of permit issuance, and the implementation will begin within two years of Permit issuance.

Action: In 2009, SRP completed the Monitoring and Rescue Plan (see 2009 H-B HCP annual report). Eagles did not nest within a tree within the reservoir pool during the 2009 – 2010 nesting season.

2011 Action: SRP will continue to implement the monitoring and rescue plan in 2011.

e. Covered Aquatic Species Monitoring at Horseshoe and in the Verde River.

Obligation: SRP will monitor covered aquatic species populations and the effectiveness of minimization and mitigation measures. Periodic surveys in Horseshoe and several locations in the Verde River will be conducted. Native fish composition and age class information will be recorded, and fish will be tagged in Horseshoe to assess movements from the reservoirs. In first 5 years of implementation surveys will be focused near Horseshoe Reservoir.

Action: SRP conducted fish surveys in 2010 at Horseshoe Reservoir, Verde River (Childs – Sheep Bridge), and Lime Creek. As required in the HCP, the sampling effort focused on Horseshoe to assess fish composition, population structure and tagging fish to study movements during future survey efforts. SRP contracted with the Arizona Game and Fish Department (AGFD) Research Branch to complete the survey at Horseshoe and co-funded the Verde River sampling (Appendices A, B). SRP staff, US Forest Service, and Arizona Game and Fish sampled Lime Creek. (Appendix C). A summary of these efforts are described below:

Summary of Horseshoe Results:
AGFD sampled Horseshoe Reservoir on April 6 – 9 when the reservoir was at full pool, and again on September 1 – 2 at minimum pool. Canoe electroshocking equipment, gill nets, and fyke nets were used at full pool. AGFD used electroshocking equipment at minimum pool due shallow water levels, dense vegetation, and muddy substrates. AGFD followed their standardized sampling protocol.

A total of 1,390 fish were captured during both surveys. Goldfish and carp comprised 86% and 84% of the catch during full pool and minimum pool surveys, respectively (Figs. 7, 8). Smallmouth and largemouth bass comprised 5% of the catch during full pool sampling, and largemouth bass made up 17% of the catch in the minimum pool sampling. Multiple size classes of carp, goldfish, channel catfish, and small and largemouth bass were found during the full pool survey. During minimum pool sampling, multiple size classes of goldfish, carp, and largemouth bass were found. Multiple size classes are indicative of reproduction and recruitment of these species.

Of the fish captured, 927 were able to be marked (> 150 mm) using dorsal spine clipping (carp and goldfish) and spaghetti tags (other species) (Fig. 9). Of the fish marked, 91% were goldfish and carp, 4% were smallmouth and largemouth bass, and 3% were channel catfish. For those marked with spaghetti tags, AGFD also punch a hole in the dorsal fin to test tag retention in future years.

Between 2005 – 2010, 4,628 nonnative fish have been marked, of which 95% are carp and goldfish, 2% are channel catfish, and 1% are largemouth bass (Fig. 10). No tagged nonnative fish were recaptured in 2010. However, two tagged Colorado pikeminnow were captured in Horseshoe Reservoir during the survey of the full pool in 2010. The two pikeminnow were stocked by AGFD at Beasley Flat on January 7, 2010.

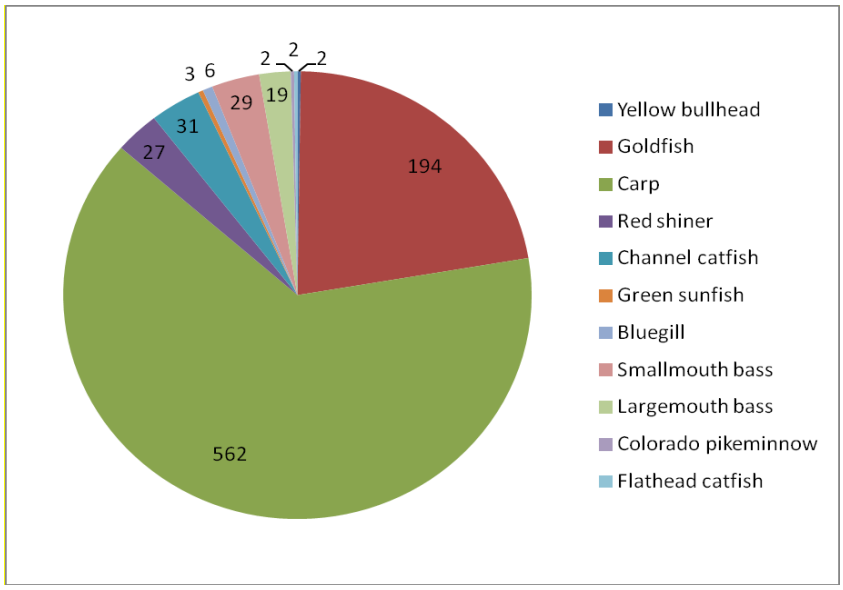

Figure 7. Composition of fish species captured in Horseshoe Reservoir at full pool, April 6 - 9, 2010. Values indicate number of fish caught using the three gear types (electroshocking equipment, gill nets, fyke nets).

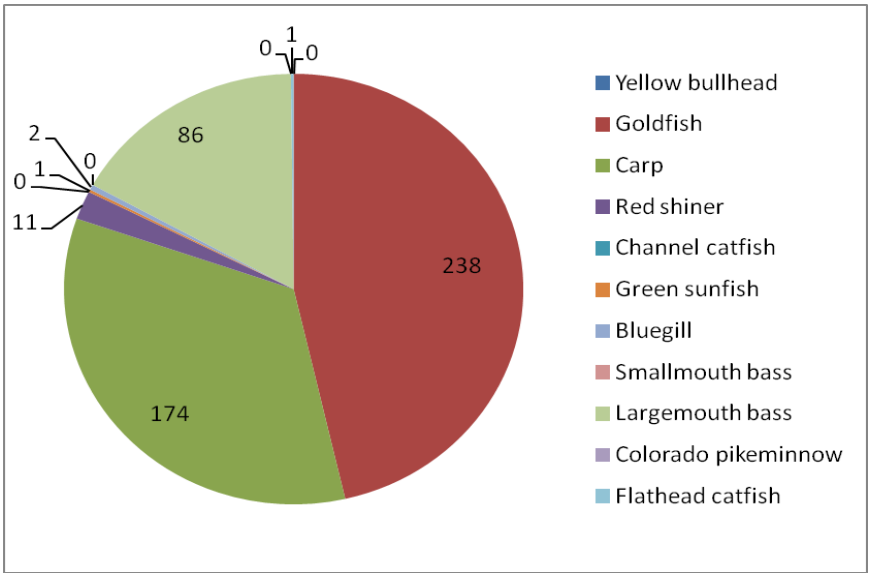

Figure 8. Composition of fish species captured in Horseshoe Reservoir at minimum pool, Sept 1 - 2, 2010. Values indicate number of fish caught using electroshocking equipment.

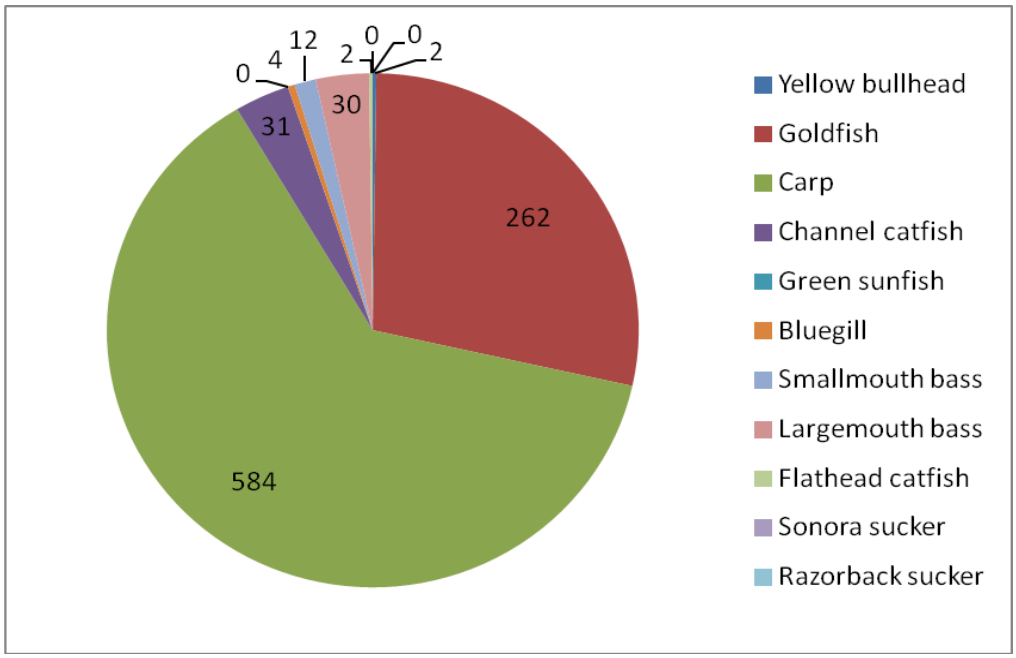

Figure 9. Composition of fish tagged/marked (n= 927) during full and minimum pool surveys of Horseshoe Reservoir (April 6 – 9; Sept 1 -2, 2010). Values indicate number of fish marked.

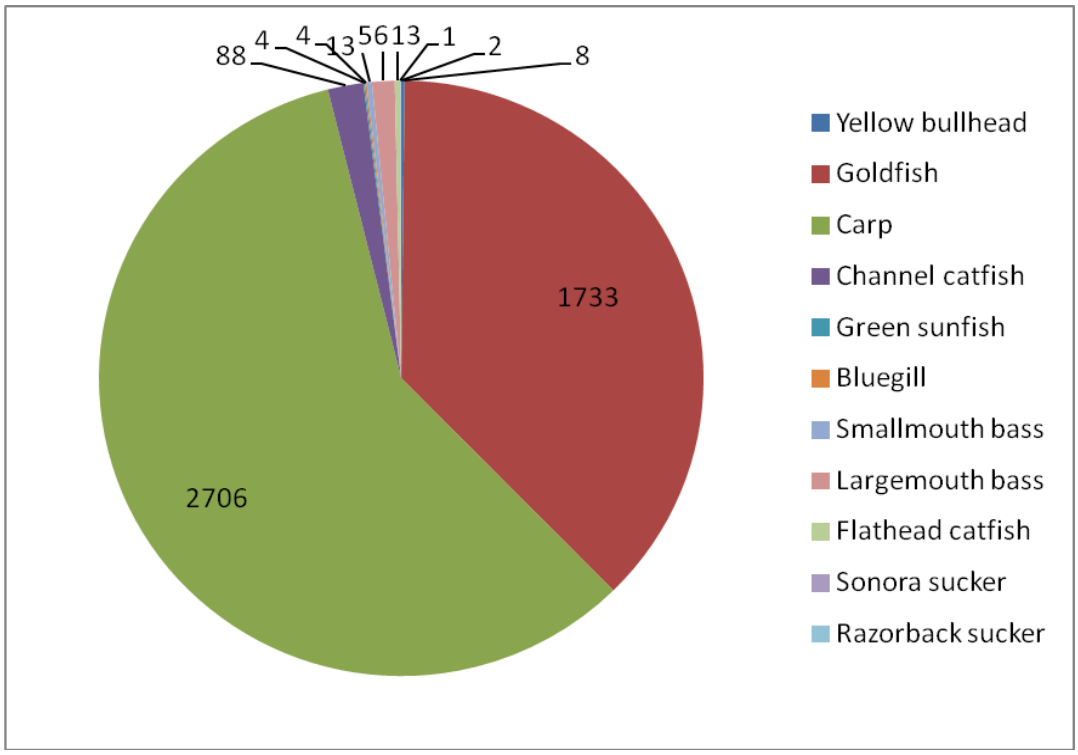

Figure 10. Composition of fish tagged/marked (n= 4628) by SRP (AGFD contracts) in Horseshoe Reservoir in 2005, 2006, 2009, and 2010 sampling years. Values indicate number of fish marked.

Summary of Verde River Sampling:
AGFD sampled the Verde River from Childs to Sheep Bridge (~33 mi) from May 24 – 28, 2010. The purposes of the survey were to 1) monitor razorback sucker and pikeminnow reintroductions; 2) evaluate the fisheries populations in the reach; and 3) sample for marked nonnative fish (n = 4,485 at time of sampling) that moved upstream from Horseshoe Reservoir. The main channel of the Verde River was sampled using a canoe electroshocker, and seines were used in backwaters. A gill net was used to sample one large pool. AGFD followed their standardized sampling protocol, but were only able to sample 28 of the 40 sites planned due to the canoe capsizing on day 4 of the trip. Thus, 12 sites in the downstream portion of the reach closer to Sheep Bridge were not sampled.

AGFD caught 361 fish using the electrofishing unit (Fig. 11.); the sample was comprised of smallmouth bass (28%), carp (24%), Sonora sucker (17.5%), red shiner (16%), and desert sucker (7.8%). The remaining species (e.g., largemouth bass, catfish, sunfish) were < 2% of the catch. In backwater areas, 459 fish were captured using seines and 2 fish (carp and Sonora sucker) were captured using a gill net in a large main channel pool. Of the fish captured using a seine, 60% were native suckers, 28% were red shiner, and 11% were bass. Nonnative predators (bass, catfish) were made up of primarily smaller (<250mm) individuals. One pikemonnow was captured on the first day of the trip (upstream portion of the reach sampled). No tagged nonnative fish were captured.

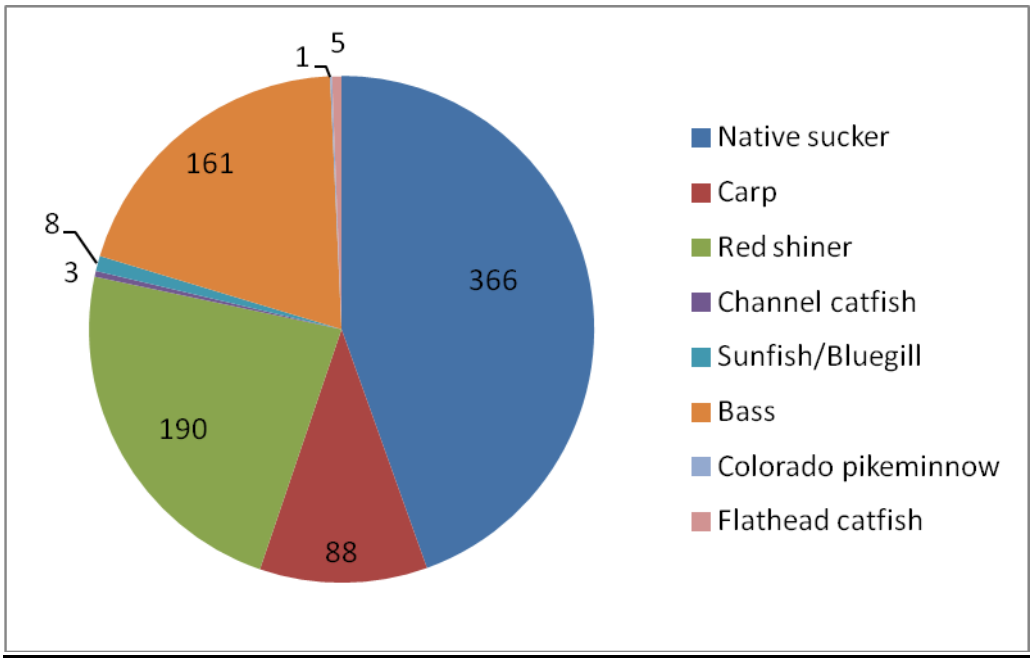

Figure 11. Composition of fish species captured (n= 822) in Verde River (Childs – Sheep Bridge), May 24 – 28, 2010. Values indicate number of fish caught using electroshocking, seining, and gill nets.

Primary conclusions of the surveys were:

1. The resident fish population in Horseshoe continues to be dominated by goldfish and carp, which are habitat generalists (breeding in both the river and reservoir habitats).
2. Annual reservoir fluctuations and inundation of floodplain-like habitat within the reservoir pool continues to favor spawning and recruitment of goldfish and carp because these species are better able to utilize densely vegetated aquatic zones for reproduction and foraging compared to other species.
3. Rapid drawdown and minimization of carryover storage has greatly reduced the population of centrarchids (bass and sunfish). However, delay in drawdown in 2010 likely supported largemouth bass spawn as noted by increase number of small individuals captured in the fall/minimum pool survey.
4. In 2010, the relative abundance of native sucker, bass (primarily smallmouth bass), and red shiner are greater in the river reach sampled compared to Horseshoe. Carp has much higher relative abundance in Horseshoe compared to the river sampled. Although goldfish comprises >30% of the population in the reservoir, no goldfish were detected in the river reach sampled (Fig. 12).
5. Based on population structure of species, smallmouth and largemouth bass, as well as other nonnative species, have self sustaining populations in the Verde River.
6. Recapture of tagged/marked nonnative fish in the river or reservoir was essentially zero during the 2005-2006, and 2009-2010. In 2009, 4 marked fish were recaptured in Horseshoe but were thought to have been tagged the day before. It remains unclear the fate of >4000 tagged fish in Horseshoe.

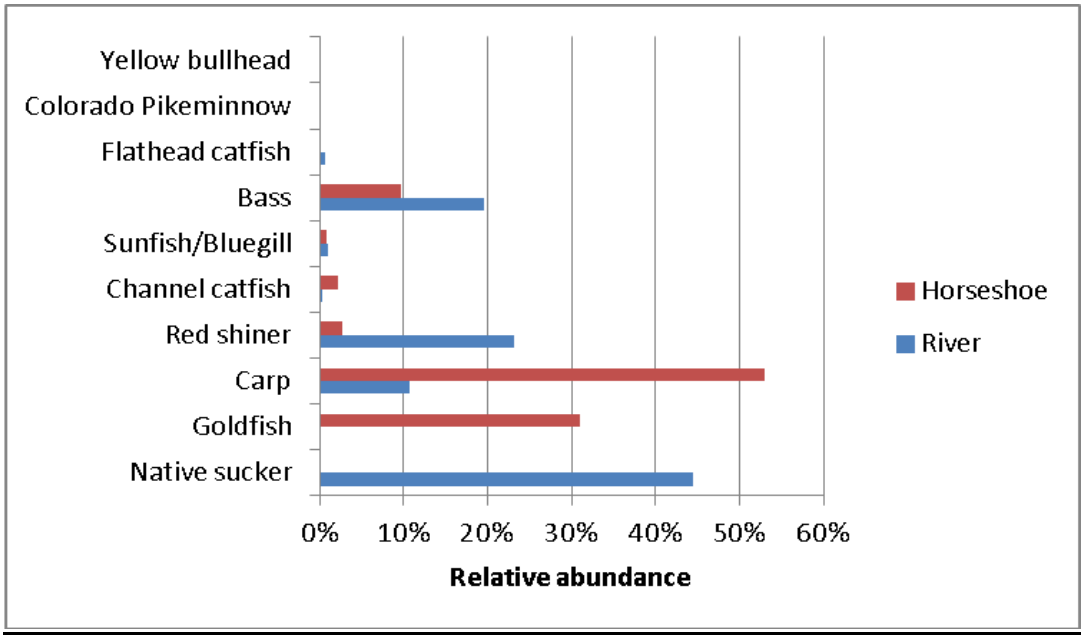

Figure 12 . Relative abundance of fish species in Verde River (Childs – Sheep Bridge) and Horseshoe Reservoir, 2010.

Summary of Lime Creek Sampling:
On July 14, 2010, Chuck Paradzick (SRP), Todd Willard and Andre Silva (U.S. Forest Service (USFS), and Ross Timmons (AGFD) performed fish sampling in Lime Creek. Unlike 2009, surface flow was present from upstream of the barrier site to near the Lime Creek delta with Horseshoe (but was not connected to the reservoir at time of sampling). Flood scouring of the channel was evident based on down cutting, sediment deposits and channel migration, debris piles > 6-8 ft above thalweg, and many trees in the floodplain were toppled and/or stripped of bark (photos of the trip are included in Appendix C) .

The creek was sampled using a seine (12 seine hauls were conducted) and minnow traps. Longfin dace were found in very high abundance from above the proposed barrier site to last pool on the downstream end. Six mosquitofish (*Gambusia affinis*) were collected in a pool near the confluence with the reservoir. Other species observed included 2 dead black-necked gartersnakes, mating Sonoran desert toads (and recently hatched eggs and stringers of egg masses in a few pools), and lowland leopard frogs young/adult and tadpoles.

2011 Action: SRP will continue fish sampling in 2011 with an emphasis on Horseshoe. SRP plans to survey the reservoir using similar methods and timing as 2010. SRP is also coordinating and discussing possible funding assistance for AGFD Region 3 or 6 for late spring survey of the Verde River in Camp Verde area or downstream of Bartlett Dam. The effort will gather data on general fish population composition, abundance, and movements of marked fish.

4. Status of Mitigation Property Acquisitions

Obligation: SRP must acquire and manage in perpetuity 200 acres of riparian habitat by fee title or conservation easements. Within one year of the permit issuance date, at least 150 acres of mitigation will be in place, and within 10 years an additional 50 acres will be protected.

Action: On August 11, 2009 SRP and Freeport McMoran executed a conservation agreement to secure the protection of the 150 acre preserve near Ft Thomas. No additional action is needed until 2023 when the property will be purchased in fee.

Verde Valley:

- On November 17, 2009, SRP conducted a field trip with The Nature Conservancy (TNC) to review their existing information of riparian lands in the Verde Valley and identify possible parcels that may meet requirements for HCP mitigation. TNC recommended assessing the following parcels:
    1. Spur Land & Cattle, APN 404-19-154 and 404-19-155
    2. Cemex, APN 403-14-006E
    3. Robinson, APN 403-24-002B and 403-14-001B
    4. Shield Ranch, APN 404-14-004 (has been acquired by TNC/State Parks)
    5. Verde Village Property Owners Association, APN 406-47-606

- On September 28, 2010 SRP and Alicyn Gitlin (formerly with Northern Arizona University) visited the Verde Village Property (Figs. 12, 15) and the Bustamante Property (located ~1/4 downstream of Verde Village) (Fig 14, 16). Both parcels are narrow strips along the river adjacent to residential subdivisions. Habitat suitability and potential for flycatchers and cuckoos appeared low due to existing sparse and low density forest vegetation and the narrow flood plain width, which limit the potential for dense wide stands of woody riparian vegetation to develop in the future. Management concerns included close proximity to residential houses (Figs. 14, 16) and difficulty with controlling access and establishing fencing (boundary within floodplain).

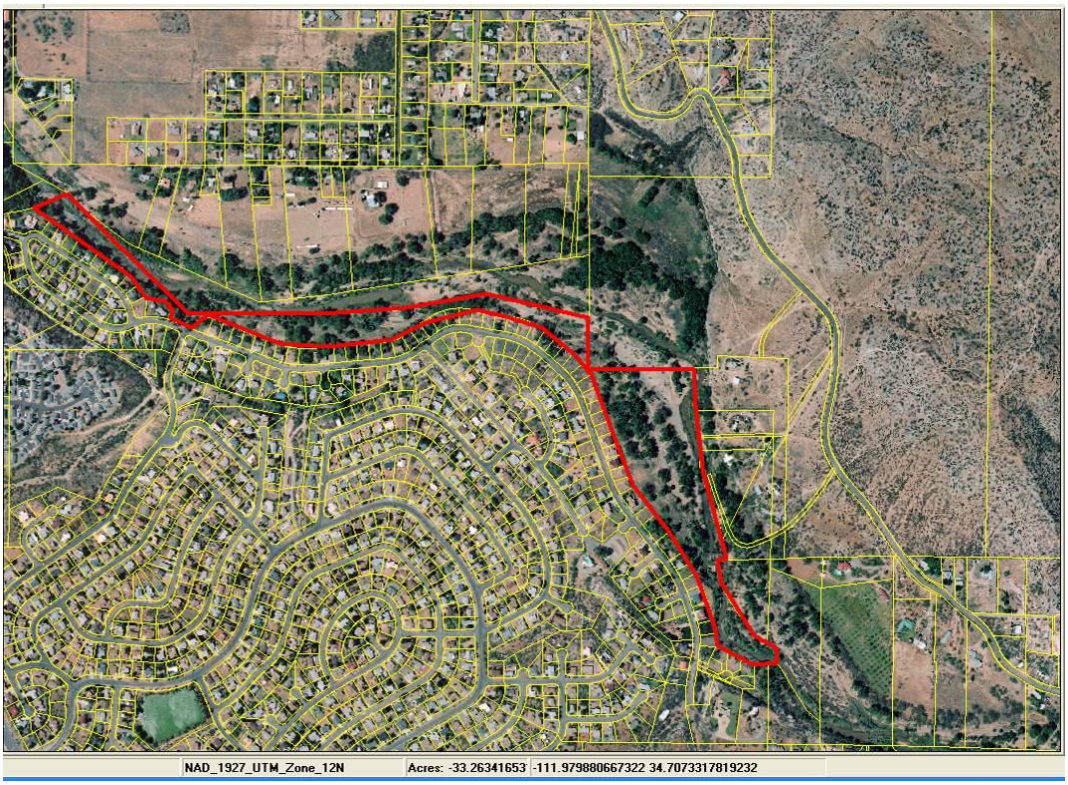

Figure 13. Verde Village parcel (outlined in red).

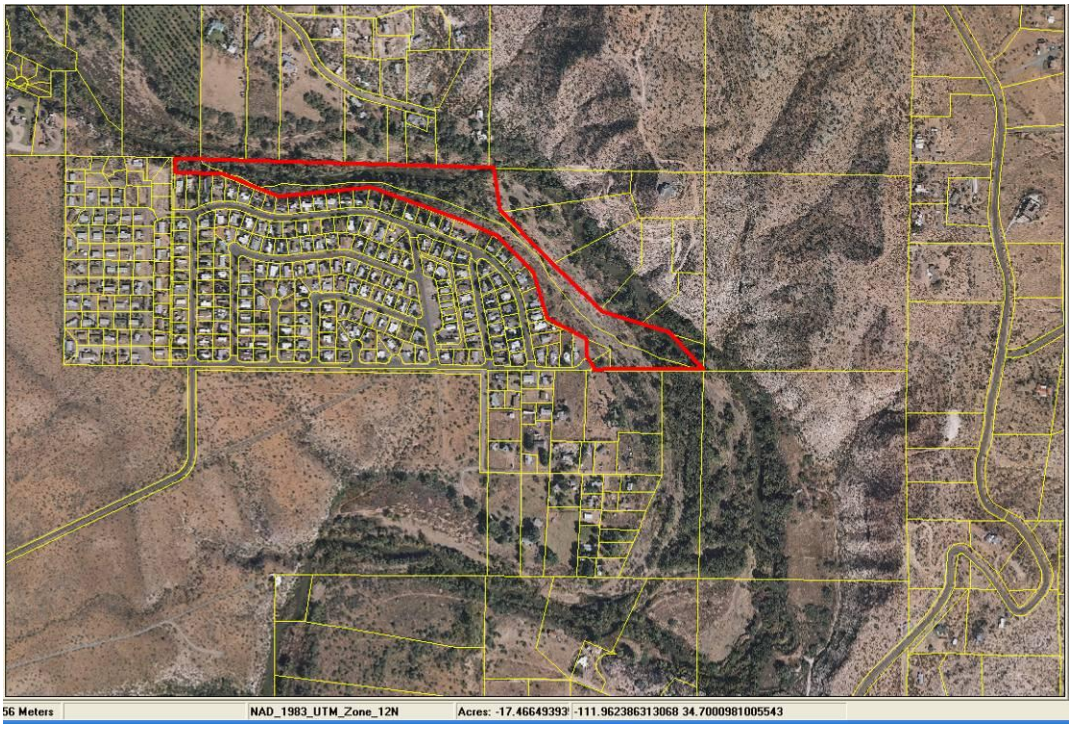

Figure 14. Bustamante property on the Verde River.

Figure 15. Photo of Verde Village parcel riparian area.

Figure 16. Photos of Bustamante parcel riparian area.

- To further assess potential parcels (~50 acres) that could serve as mitigation for flycatcher and cuckoo, SRP created a GIS spatial data base (Fig. 17). The database included recent aerial photography, Yavapai County parcel information, and the results of the AGFD flycatcher habitat statewide modeling effort in 2001, which provides a snapshot of potential habitat. We reviewed parcels along the main channel of Verde River from approximately Dead Horse State Park downstream to Beasley Flat (area delineated as willow flycatcher critical habitat).

- We summarized and evaluated the following criteria to assess each parcel:
    1. Ownership: identified lands in private ownership.
    2. Area: the H-BHCP requires 50 acres of mitigation habitat. We used a parcel threshold size of approximate 30 acres within the floodplain as a cut off for further evaluation, and/or recommendations by field experts.
    3. Habitat potential/suitability based on aerial photos, topography, Flycatcher GIS Breeding Habitat Model, and field knowledge/visits.
    4. Management Concerns: ability to manage and protect riparian habitat values through control of access, ability to fence the property, proximity to residences or other high use areas, and potential management conflicts (e.g., recreation pressure).

- Table 2 and Figure 18 describe the results of the evaluation.

- Based on this review, coupled with the $11,000/acre price ceiling[2], we find that the potential for acquisition of approximately 50 acres of habitat in the Verde Valley that could serve as suitable breeding habitat for flycatcher and cuckoo is low.

- SRP plans to continue to search for and respond to inquiries from landowners in the Verde Valley regarding acquisition. However, SRP also plans to broaden our search to the Safford area (Gila River) and lower San Pedro River.

2011 Action: The following activities are planned for 2011:

<u>Ft. Thomas H-B Preserve</u>:

- Property is protected under a Conservation Easement - no action is needed; land management actions are discussed in Section 5 below.

[2] see H-B HCP page 205, section V.E.4.a.

Verde Valley:

- SRP will continue to identify and evaluate potential mitigation property in Verde Valley. As noted above, SRP plans to search the Safford area (Gila River) and lower San Pedro River for potential parcels that could serve as suitable mitigation habitat.

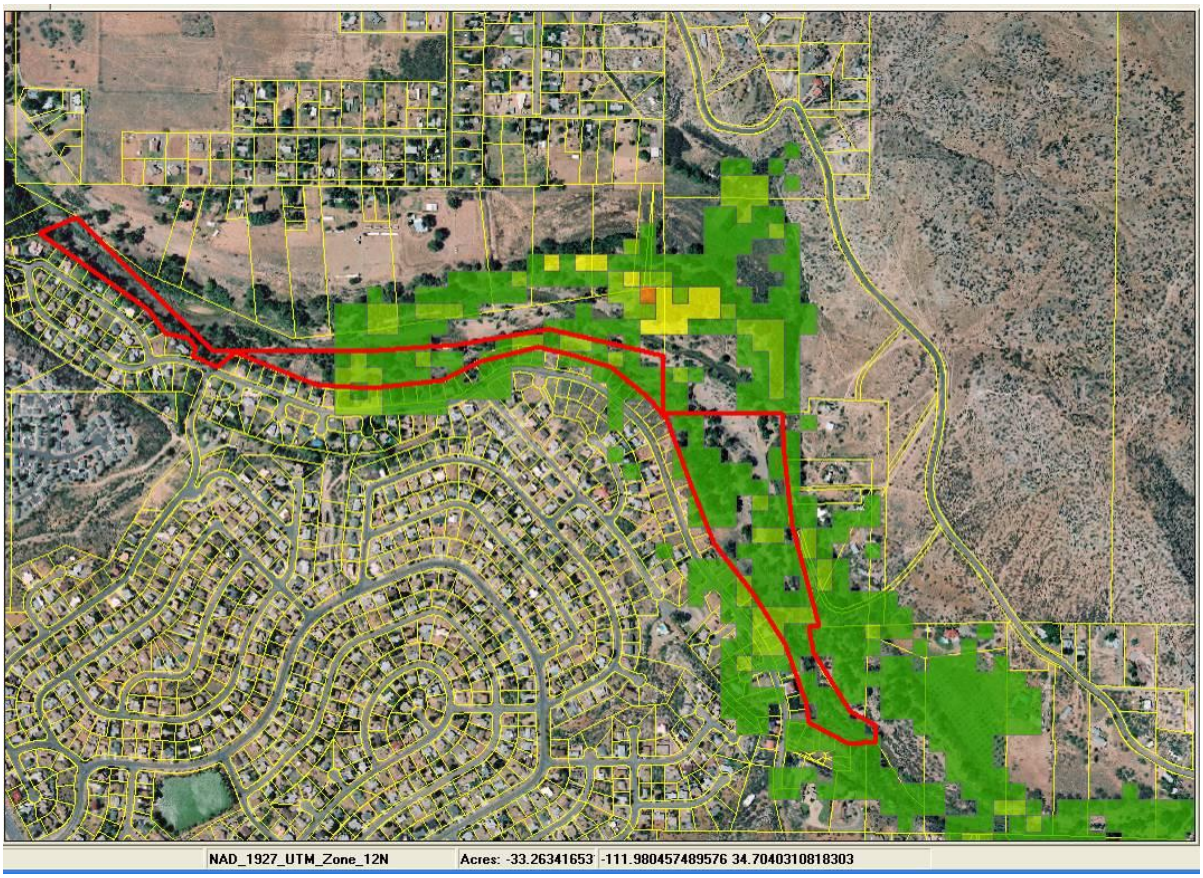

Figure 17. Geospatial database used to evaluate parcels in the Verde Valley for potential mitigation purchase. Layers include 2009 aerial photography, Yavapai County Parcel maps, and results of the AGFD GIS flycatcher breeding habitat model.

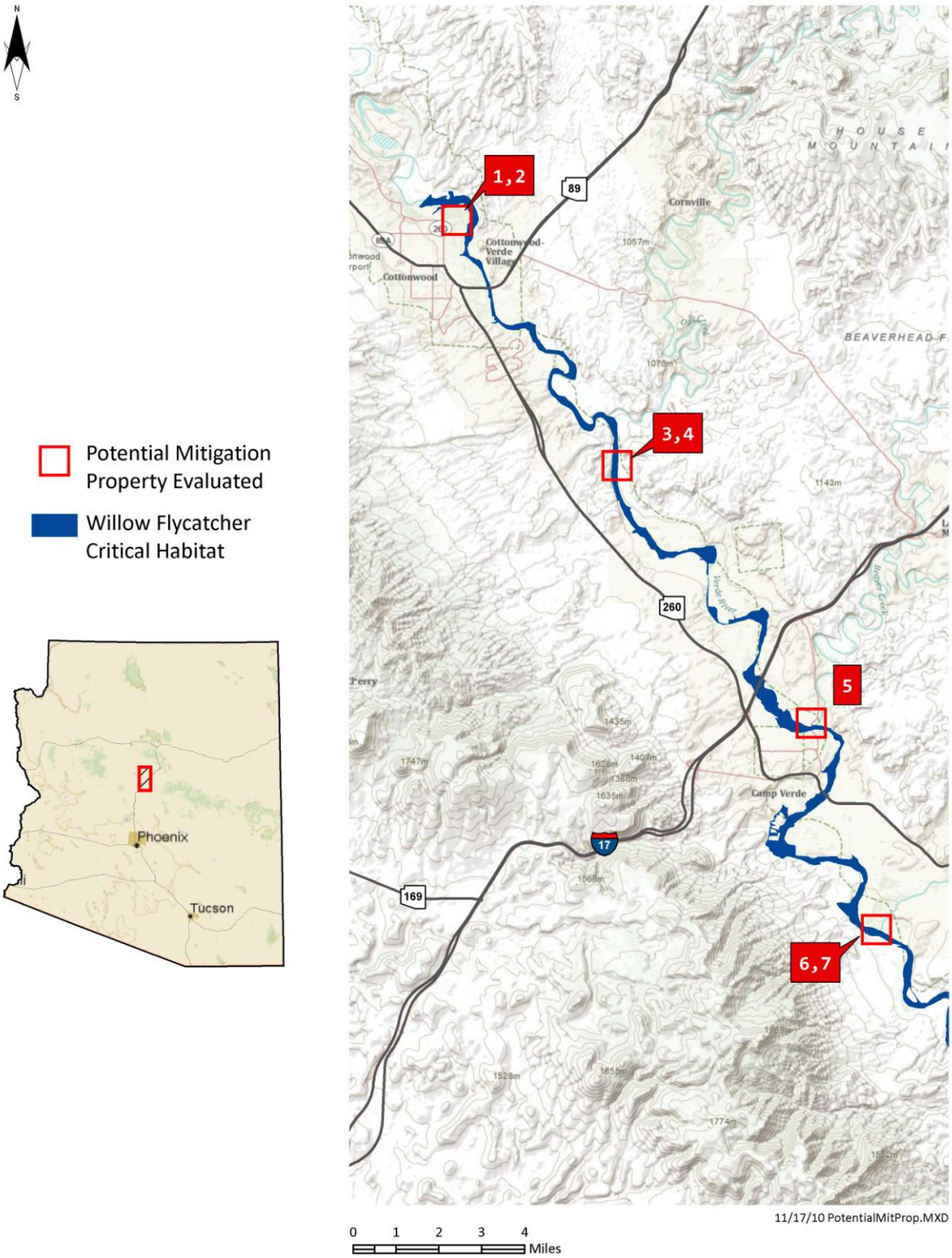

Figure 18. Map of Verde Valley showing parcel locations. (Area numbers correspond to Table 2.

Table 2. Summary of mitigation property evaluation. (Map ID corresponds to Figure 18)

Map ID	APN Parcel(s)	Owner	Acres of Riparian	Habitat Suitability	Management Ability	Comments
1	404-14-004	Verde Village	31	Low	Low	Adjacent to large residential subdivision
2	407-20-002K 407-20-002C	Bustamante	18	Low	Low	Adjacent to large residential subdivision
3	403-14-006E	CEMEX	35	Likely High (based on adjacent TNC parcel)	Med (would need Robinson)	TNC made inquiry – no return call Property line parallel and within river; would need to acquire portion of Robinson.
4	403-24-002B 403-14-001B	Robinson	6	Med (small amount of floodplain forest)	Low (would need CEMEX)	Adjacent to TNC Otter Water. Listed for $34,482/ac - price higher than HCP maximum
5	404-19-154 404-19-155	Spur Land & Cattle	55	High	High	Owned in Trust by Babbitt Family; TNC and SRP has tried to acquire or establish conservation easement in past and unsuccessful.
6		Shield Ranch	(306)	--	--	SOLD - TNC Acquired
7		Rockin' River Ranch	(209)	--	--	SOLD – TNC/State Parks

5. Mitigation Property Monitoring and Management

a. Fort Thomas H-B Preserve

i. Flycatcher and Cuckoo Monitoring

Obligation: SRP will conduct flycatcher and cuckoo surveys the first spring and summer following acquisition. If flycatchers are found, SRP will conduct a second year of surveys to establish a baseline. Once baseline surveys are complete, SRP will survey for flycatcher and cuckoo every other year on average but not less than every third year.

Action: No surveys were conducted in 2010. Baseline surveys were conducted in 2008 and 2009.

Table 3. Southwestern willow flycatcher and yellow-billed cuckoo survey results for the Ft Thomas H-B Preserve, 2008 – 2009.

	Willow flycatcher				Yellow-billed cuckoo	
Year	Resident Adults	Territories	Pairs	Nests	Territory	Pairs
2008	10	6	4		1	1
2009	14	8	6	5	0	0
2010	No Survey	-	-	-	-	-

2011 Action: No surveys are planned for the Ft Thomas property in 2011. SRP will conduct flycatcher and cuckoo surveys in 2012 and the effort will be coordinated with the Roosevelt HCP Ft. Thomas preserve lands to provide a more robust census of the populations in the area.

ii. Vegetation and Habitat Monitoring

Obligation: SRP will conduct field observations of habitat assessing the type, structure, and density of riparian and other vegetation, and on-the- ground photo-points from fixed points will be collected during bird surveys.

Action: No vegetation surveys or photo-points were conducted. Patrols and site visits to the property indicated that no significant vegetation changes occurred in 2010.

2011 Action: No specific field observations will be conducted in 2011 (no bird surveys will occur). Observation and photo-points will be conducted in 2012.

iii. *Management Obligations*

Obligation: SRP's primary goal for management of these properties is to provide ecological and conservation benefits to the flycatcher and cuckoo. Management activities are focused primarily on minimizing or eliminating identified threats to riparian habitat, such as wildfire, groundwater pumping, surface water depletion, trespass livestock grazing, cowbird parasitism and vandalism. Actions to enhance the quality of habitat on a property or reverse past damage may also be conducted.

General management activities required for each property are listed below:

1. SRP will identify a manager for all acquired properties.
2. A management plan will be developed for each property within two years of acquisition in coordination with FWS and will be updated annually.
3. Management activities identified in the management plan will be implemented.
4. Cowbird management will occur on properties that are agreed to by SRP and FWS during the annual H-BHCP meeting.
5. Conservation easements shall be placed on all appropriate mitigation lands and will be held by an agency or organization acceptable to FWS.

Actions: SRP completed the following major management actions on the Ft Thomas H-B Preserve in 2010:

- TNC conducted patrols (which may include inspection and maintenance of access and signage, work and coordination with adjacent landowners and local law enforcement officials, and assistance with biological monitoring).
- Coordinated with RHCP manager and developed and awarded a fence contract (construction to occur in November/December 2010).
- SRP continued to review and revise the baseline inventory developed by Matt Turner in 2008. The Information will be incorporated into the Management Plan and Baseline report.

2011 Actions: SRP plans to conduct the following actions in 2011:

- Complete the fence installation.
- Finalize the baseline and management reports.
- Develop and coordinate with RHCP a fire plan for the property.
- Continue to coordinate with BLM regarding fencing of the riparian area.

- Continue on-the-ground management activities in coordination with the Roosevelt HCP project manager.

b. Special Water Supply Protection Projects

Obligation: SRP will use its best efforts to protect future water supplies for mitigation lands.

Action: To protect water supplies in Oak Creek and the Verde River, SRP assisted the AGFD and the USFS with the establishment of flow monitoring equipment at Sterling Spring. The spring outflow forms the perennial headwaters of Oak Creek, and the goal of the project is to produce a long term record of spring discharge. H-B HCP funded the acquisition of equipment and labor to install the monitoring devices at the two diversions from the spring (Figs. 19, 20). A 2" flow meter was installed within the pipeline serving a USFS campground, and a water level sensor to monitor flow over a crested weir was installed at the AGFD Fish Hatchery; these values are combined to yield total flow. Data is logged on site (1 - 4 hr interval), communicated through a satellite link to SRP. Quarterly site visits will be made to this location to confirm instrument calibrations and equipment integrity. The project was completed and operational on July 14, 2010.

<u>Summary List of Water Supply Protection Efforts</u>:

2009 Purchased piezometer instrumentation to measure shallow water levels to support TNC ecoflow study on the upper and middle Verde River.

2010 Installation of Sterling Springs Hatchery and USFS camp ground flow monitoring equipment – headwater springs of Oak Creek.

Figure 19. Weir at AGFD Sterling Spring hatchery – instrumentation installed by SRP to measure flow.

Figure 20. Flow data logger and satellite communication tower installed by SRP at Sterling Springs Hatchery.

2011 Action: The U.S. Geological Survey (USGS) (James Leenhouts, lead scientist) initiated a new project in April 2010 in cooperation with the Arizona Department of Water Resources and TNC to study the biological and hydrological basis for ecological flows in the Verde River. Both the USGS Arizona and Utah Water Science Centers are involved in the project. The study has begun with an initial two-year phase that will primarily locate and assemble pertinent data into a data base, identify data gaps, conduct an initial hydrologic analysis of flows in the Verde River and tributaries, and assess the utility of the recently completed USGS Northern Arizona Regional Groundwater Model for ecoflow studies. The work plan for this study did not include field work. Ongoing sampling is a critical component for assessing current conditions and maintaining continuity in the data, however,

and USGS has made preliminary assessments of potential field areas. In 2011 and 2012, SRP will provide $12,000 to USGS to support field sampling at the field areas to augment the proposed study. The funding will be used to sample macroinvertebrates at three to six locations following a modified USGS protocol, channel properties will be resurveyed if the channel has changed, flow velocities will be measured at the sampling locations across the channel, and pressure transducer data will be downloaded and the data loggers reset. In addition, USGS is planning to work with staff in their Flagstaff office to obtain discharge measurements at pressure transducer locations when possible to initiate the construction of stage-discharge relations at those sampling sites.

6. Aquatic Species Mitigation

The overall goal of the minimization and mitigation measures for covered aquatic species is to offset the direct impacts caused from stranding and passage through the outlet works, and the indirect impacts (predation and competition) caused by the increase of nonnative fish produced in the reservoirs. Minimization and mitigation obligations under the HCP include: rapid draw down of Horseshoe Reservoir; stocking adult and sub-adult razorback sucker in Horseshoe or elsewhere; installation of a fish barrier on Lime Creek; funding and supporting improvements to Bubbling Ponds Hatchery; stocking covered native fish in the Verde watershed; and watershed management activities that conserve instream flow, species, and habitats. The following implementation actions were taken:

a. Rapid Draw Down of Horseshoe Reservoir

Obligation: See Section 3.c.

Action: See Section 3.c.

2009 Action: See Section 3.c.

b. Stocking of Razorback Sucker at Horseshoe and Other Covered Species in Verde River.

Obligation: SRP will provide support for AGFD to stock razorback sucker during Horseshoe fills when conditions may be favorable. Other river segments may be stocked with razorback sucker upon mutual agreement among AGFD, FWS, and SRP. SRP will provide support to increase stocking of other covered native fish species in the Verde watershed.

Action: On April 23, 2009, SRP and AGFD executed a collection agreement to fund the operation and maintenance of Bubbling Ponds Hatchery (BPH) to support culture of covered native fish, and support transport and stocking of covered fish to

meet this obligation. The collection agreement provides for SRP to annually transfer funds ($40,000) to AGFD to be utilized for O&M and stocking actions throughout the year. In August 2009, AGFD, FWS, and SRP met and identified species culture targets and stocking locations for the first 2 - 3 years of implementation (Table 4). In some instances, H-BHCP funded efforts were anticipated to be part of a multiagency effort (e.g., Fossil Creek).

Table 4. Proposed H-BHCP Bubbling Ponds Hatchery Culture and Stocking Summary, 2009 ~ 2011.

Species	Proposed Stocking Locations[1,2]	Approximate quantity
Razorback sucker	Upper Verde Middle Verde (Beasley-Childs)	1000 2000
Gila Topminnow	Fossil Creek Dutchman Grave Spring Other tanks/locations in Verde watershed Lime Creek (after barrier is constructed)	1000s (for sites as approved)
Roundtail chub	Upper Verde (Stillman Lake) Houston Creek Middle Verde (Beasley-Childs) Deadhorse State Park Oak Creek West Clear Creek Fossil Creek Gap Creek Lower Verde (Bartlett-Salt River confluence)	500 (Stillman) 3000 (for other sites as approved)

[1]Pending AGFD, USFWS, and U.S. Forest Service coordination as necessary.
[2]Other locations may be considered and added with SRP, AGFD, and FWS concurrence.

In 2010, SRP continued funding AGFD O&M and stocking actions at BPH under the collection agreement. As of June 30, 2010, 5,187 native fish were stocked into the Verde River watershed (Table 5). AGFD also drained and prepared a pond at BPH for covered species propagation. In April 2010, SRP discussed with AGFD the status of fish on station at Bubbling Ponds and anticipated needs for stocking – no changes to the species priorities as presented in Table 4 were necessary.

Table 5. Native fish stocked by AGFD in support of H-B HCP though June 30, 2010.

Stocking Date	Species	Number stocked	Pounds stocked	Location
5/8/2009	Roundtail chub	200	12	Roundtree Creek
8/19/2009	Roundtail chub	1,987	125	Verde – Childs
1/7/2010	Colorado pikeminnow	980	1,165	Verde – Beasley Flat
3/26/2010	Razorback sucker	1,026	425	Verde – Camp Verde
3/31/2010	Razorback sucker	994	480	Verde – Camp Verde
Total		**5,187**	**2,207**	

2011 Action: Coordinate a meeting among AGFD, FWS, and SRP in April of 2011 to discuss the status of implementation, changes to the species priorities or locations, and plans for future culture and stocking effort. Continue to fund BPH O&M and stocking activities.

c. Bubbling Ponds Hatchery Improvements

Obligation: SRP will provide $500,000 in funding or in-kind support for planning, design, engineering, and fund raising to improve and expand AGFD's BPH.

Action: In 2010, SRP funded repair of small tanks at BPH to be used for roundtail chub (and other species) rearing. Funding was also used to apply a bentonite liner at one of the small earthen ponds at Page Springs Hatchery for Gila topminnow holding and rearing.

SRP also provided funding to AGFD to develop a hatchery improvement plan and an updated conceptual design (including cost estimates). The information will be used to inform subsequent hatchery improvements and for SRP to attempt to acquire federal funding for a major hatchery renovation. AGFD contracted with HDR consultants to perform the work. HDR drafted a conceptual design of renovations (Fig. 21), and estimated flow needs and water routing through the hatchery. AGFD anticipates that a full draft of the design report will be completed in December 2010.

2011 Actions: Continue to support AGFD BPH upgrade plan development and coordinate its planning and implementation with the Gartersnake Conservation Working Group to account for anticipated effects to the resident northern Mexican gartersnake population. SRP will review the improvement plan document when it becomes available. It is anticipated that the report will be finalized in 2011.

bubbling pond master plan: aerial view

Figure 21. Draft Bubbling Ponds Hatchery renovation concept plan.

d. Installation of a Fish Barrier in Lime Creek

Obligation: SRP will construct and maintain a fish barrier in Lime Creek to benefit resident, covered aquatic species such as Gila topminnow, longfin dace, and lowland leopard frogs.

Action: SRP received a Special Use Permit from the Tonto National Forest in August 2010 to construct, monitor, and maintain a concrete fish barrier in Lime Creek. Construction began on October 18, 2010 and the barrier was completed on November 4, 2010 (Fig. 22). A copy of the Special Use Permit and photos of construction are included in Appendix D.

2011 Actions: SRP will monitor barrier condition and conduct maintenance, as necessary. SRP, in coordination with AGFD and USFS, will also monitor the fish populations in Lime Creek.

Figure 22. Lime Creek fish barrier.

e. Watershed Management Efforts

Obligation: SRP will continue, and expand where feasible, its substantial watershed management efforts to maintain and/or improve stream flows, which benefit all mainstem species.

Actions: SRP took the following actions in 2010 to protect watershed instream flow:

- Public outreach and education
- Funding research and monitoring
- Administrative and legal efforts to protect instream flows

Table 6 provides a detailed list of Watershed Management and Protection projects that occurred in 2010.

2011 Action: SRP will continue supporting watershed protection efforts in 2011.

Table 6. SRP watershed protection efforts accomplished in 2010.

Project Name	Date Initiated	Date Completed	SRP Contribution	Description and Comments	In-kind	Cash
Public Presentations	Ongoing	Ongoing	NA	6 public presentations to community groups and various agencies (e.g., Verde Valley intergovernmental Council, TNC, Committee on Natural Resources, Chaparral Pines Joint Operating Group, Project CENTRL, Prescott Water Issues Subcommittee, and others)	X	
Agreement in Principle re: Big Chino Groundwater withdrawals	Ongoing	Ongoing	NA	Continued work on implementing the Agreement in Principle between SRP, the City of Prescott and Prescott Valley regarding future groundwater withdrawals in the Big Chino sub-basin to ensure appropriate protections against impacts to the Upper Verde River.	X	
Efforts to curtail illegal groundwater pumping and surface water diversions – Verde Valley	Ongoing	Ongoing	NA	SRP continued its work to curtail groundwater pumpers and surface water diversions in the Verde Valley that appear to be illegally using surface water.	x	
NAU Watershed Research and Education program	May-10	May-11	$50,000	Program and Project specific funding for NAU WREP program.		X
USGS/SRP cost share of stream gage maintenance, precipitation monitoring, and data compilation	Oct-09	Dec-10	$130,000	SRP's contribution to the USGS Joint Funding Agreement for the operation and maintenance of stream and reservoir gages in the Verde watershed (amount does not include reservoir gauge operations).		X
WatershedMonitor.com	Sep-07	Ongoing	NA	Maintain the website (www.watershedmonitor.com) which displays real time data for river flows and precipitation across the Salt and Verde Watersheds.	X	
Arizona State Parks Foundation	May-10	May-10	$2,668	Printing of Foundation brochures.		X
Verde River Canoe Challenge	Mar-10	Mar-10	$2,500	Corporate sponsor of the Verde River Canoe Challenge. Note: 2010 Challenge was cancelled due to high water. SRP funds will carry to 2011.		X
Low Flow gages (Black Bridge, Verde Falls, Campbell Ranch, Bubbling Ponds Hatchery, Stirling Springs)	Jan-10	Jan-11	$8,000	2010 O&M and telemetry support for gages.	x	
Assistance to Verde Valley ditch companies & organizations to monitor diversions	Jan-10	Ongoing	$6,500	SRP Water Rights and Contracts staff and Measurement Services provided hydrographic assistance and ditch monitoring gauges/equipment.	x	

Table 6. SRP watershed protection efforts accomplished in 2010.

Project Name	Date Initiated	Date Completed	SRP Contribution	Description and Comments	In-kind	Cash
Verde River Days	Sep-10	Sep-10	$500	SRP donation for event.		X
Arizona Water Story – Production of companion video	Jan-10	ongoing	In-Kind roughly worth $50,000	SRP is producing this water education video as part of the Arizona Water Story to assist 4th grade teachers throughout the state in teaching water science and Arizona history to their students.	x	
Water Education Grants	Oct-07	May-10	$4,750	SRP collaborated with the towns of Prescott and Prescott Valley as well as the Yavapai County Water Advisory Committee and Arizona Department of Water Resources to provide Water Education Grants to outstanding water education programs taking place in Yavapai County. Grants awarded included the Highlands Center's Verde River Riparian Field Trip program, rainwater harvesting at the Primavera School in Prescott, and a water conservation curriculum program in Miller Valley.		X
Yavapai County Cooperative Extension Office /Project WET	Aug-08	ongoing	$45,000	SRP supported Edessa Carr with programming related to water education in Yavapai County. She has conducted numerous trainings on the Arizona Conserve Water curriculum guide, and worked with teachers from Prescott, Prescott Valley, Chino Valley, and Verde Valley towns.		X
ADWR School Water Audits	Apr-09	May-10	$11,300	Funded three water conservation audits at Yavapai County Schools		x

7. Funding Methods and Assurances for HCP Implementation

Obligation: No later than 5 years after the Permit is issued, SRP shall insure that permanent funding is available to meet continuing obligations under the HCP.

Action: On March 24, 2009, SRP provided a letter to FWS indicating that we were proposing to establish an irrevocable trust to fund the H-BHCP. On November 2, the SRP Board approved an amendment to the Roosevelt Lake HCP trust, which allows for the creation and funding of a subaccount to meet the obligation of the H-BHCP. The subaccounts allow for each HCP trust fund to be managed (and reported) independently under a larger umbrella trust agreement. The H-B HCP subaccount was fund in January 2011 with approximately $6.0M to support the estimated $300,000 on average annual expenditures over the life of the permit and *in perpetuity* costs for some of the mitigation obligations.

2011 Action: Completed - no action needed in 2011.

8. HCP Implementation, Survey, and Monitoring 10-year Schedule

Obligation	Completed /Ongoing	Year									
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017+
Horseshoe Reservoir											
Flycatcher and Cuckoo Reservoir Ops	Ongoing	RD[1]	RD	RD	RD	RD	Hold?[2]	X	X	X	X
Aquatic Species Reservoir Ops	Ongoing	RD	RD	RD	RD	RD	Hold?	X	X	X	X
Vegetation Monitoring	Ongoing	X	X	X			X	X			X
Flycatcher and Cuckoo Surveys	Ongoing	X			X			X			X
Bald Eagle Monitoring and Rescue Plan	Completed	X	X								
Bald Eagle Monitoring	Ongoing			X	X	X	X	X	X	X	X
Fish surveys:	Ongoing		X	X	X	X	-	X	X	X	X
Horseshoe			X	X	X	X	-		X		X
Verde (upstream Horseshoe)				X	?	X	-	X	?	X	?
Verde (downstream Bartlett)					?	?	-	?	?	?	?
Lime Creek		x	x	x	x					x	
Frog and Gartersnake survey	Ongoing						X				
Horseshoe/Verde River Aquatic Species Mitigation											
Bubbling Ponds Hatchery (BPH) Improvements		X	X	X	X	?	?				
BPH O & M	Ongoing	-	X	X	X	X	X	X	X	X	X
Stocking RBS & other covered native fish	Ongoing	-	-	X	X	X	X	X	X	X	X
Lime Creek Barrier Construction	Completed	X	X	X							
Watershed Protection Projects	Ongoing	X	X	X	X	X	X	X	X	X	X
Ft. Thomas Mitigation Property (150 acres)											
Execute Conservation Easement	Completed	X	X								
Management	Ongoing		X	X	X	X	X	X	X	X	X
Purchase											2023-
Flycatcher and cuckoo monitoring[3]	Ongoing	X	X			X		X			X
Habitat monitoring	Ongoing	X	X			X		X			X
Camp Verde or Other Area (50 acres)											
Identify suitable property		X	X	X	X	X	X	X	X	X	X
Secure protection and manage											
Special water supply protection projects	Ongoing	X	X	X	X	X	X	X	X	X	X

[1] Rapid drawdown and minimize pool
[2] Hold reservoir high if two successive years of low storage.
[3] Monitoring frequency dependent upon management needs and cowbird parasitism rate.

9. Literature Cited

Fish and Wildlife Service. 2008. Final environmental impact statement for the incidental take permit for operations of Horseshoe and Bartlett Reservoirs. March 2008. Arizona Ecological Services Office, Phoenix, Arizona.

Hatten, J. R. and C. E. Paradzick. 2003. A multiscaled model of southwestern willow flycatcher breeding habitat. Journal of Wildlife Management 67(4): 774-778.

Salt River Project. 2008. Habitat Conservation Plan Horseshoe and Bartlett Reservoirs. Submitted to the U.S. Fish and Wildlife Service Pursuant to Section 10(A)(1)(B) of the Endangered Species Act. Salt River Project, Tempe Arizona.

APPENDIX A

ARIZONA GAME AND FISH DEPARTMENT REPORT

Horseshoe Reservoir HCP Fish Monitoring

Horseshoe Reservoir HCP 2010 Fish Monitoring

Final Report to Salt River Project

William Stewart
Research Branch
Arizona Game and Fish
5000 W. Carefree Highway
Phoenix, AZ 85086

Arizona Game and Fish Department Mission

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Abstract

This report summarizes fish sampling in Horseshoe Reservoir by Arizona Game and Fish Department (AZGFD) in behalf of a long-term Salt River Project (SRP) Habitat Conservation Plan (HCP) for Bartlett and Horseshoe Reservoirs. The sampling period was April 6 through April 8, 2010 and September 1-2, 2010. Standardized sampling protocols for electrofishing, gill netting, and fyke nets as established by AZGFD were implemented. During the survey period the reservoir was at full and minimum pool allowing for the entire shoreline and cross-reservoir transects to be surveyed by electrofishing. Fish greater than 150 mm TL were marked with either a spaghetti tag or by clipping the dorsal spine. A total of 873 fish were captured representing 11 species during the full pool survey, mostly of which consisted of goldfish (*Carassius auratus*) and common carp (*Cyprinus carpio*). A total of 513 fish were captured representing seven species during the minimum pool survey, with goldfish and common carp again dominating the catch. Between the two surveys, 929 fish were successfully marked to monitor future movement upstream and downstream from Horseshoe Reservoir. The timing of this survey was unique because the reservoir reached minimum pool just days before the survey began allowing little time for fish to disperse resulting in high catch rates. Due to the shallow depths of the reservoir during the minimum pool survey, gill nets were not set.

Introduction

Salt River Project (SRP) developed the Habitat Conservation Plan (HCP) for Bartlett and Horseshoe Reservoirs to implement measures to minimize and mitigate incidental take of 16 covered bird, fish, frog, and snake species to the maximum extent practicable, and to ensure that incidental take will not appreciably reduce the likelihood of survival and recovery of these species in the wild (USFWS, 2008). The U.S. Fish and Wildlife Service Record of Decision for the HCP documented the decision to implement Alternate 2, Optimum Operation of Horseshoe and Bartlett Reservoirs and Dams (the preferred alternative). The objectives of Alternative 2 were to operate the reservoir to support stands of tall dense riparian vegetation at the upper end of Horseshoe and to manage Horseshoe water levels to minimize impacts to covered native fish, frog, and gartersnake species; and to benefit the razorback sucker. The background information presented herein was taken from the HCP (USFWS, 2008).

The overall goal of the minimization and mitigation measures for aquatic native species is to offset the future direct impacts to native fish caused from stranding and passage through the outlet works, and the indirect impacts to the native fish, frog, and gartersnake communities caused by operation of Horseshoe and Bartlett dams resulting in a small (relative to baseline) increase of nonnative fish produced in the reservoirs, which may compete with or prey upon aquatic native species. The primary means to offset the direct impacts of operation and the indirect impact of additional predation and competition by nonnative fish on covered native fish will be:

1. Minimizing or reducing nonnative fish reproduction, recruitment, and movement;

2. Augmenting/increasing native fish populations, distribution, and relative abundance;
and
3. Maintaining water flows in the Verde River above Horseshoe.

Monitoring is necessary to determine the effectiveness of minimization and mitigation measures mentioned above and make subsequent adaptive management decisions. Outcomes from monitoring efforts could result in actions described in the collection agreement between Arizona Game and Fish Department (AZGFD) and Salt River Project (AZGFD and SRP, 2009). During the first 5 years of implementation, the emphasis of monitoring will be to tag nonnative fish in Horseshoe Reservoir and survey for fish upstream and downstream in the Verde River to detect movements of marked nonnative fish out of the reservoir. Native fish population indices (i.e., composition and age-class structure) will also be assessed in the reservoir and Verde River in the immediate vicinity. Nonnative fish captured in the reservoir that are large enough will be marked to provide data on survivorship and movement patterns to help assess the effectiveness of the minimization and mitigation measures.

Fish movements in streams and reservoirs have been well studied. Recent surveys by AZGFD (Robinson 2007) in Horseshoe Reservoir found ten species of nonnative fishes (common carp *Cyprinus carpio*, goldfish *Carassius auratus*, red shiner *Cyprinella lutrensis*, largemouth bass *Micropterus salmoides*, green sunfish *Lepomis cyanellus*, bluegill *Lepomis macrochirus*, channel catfish *Ictalurus punctatus*, flathead catfish *Pylodictis olivaris*, yellow bullhead *Ameiurus natalis*, and mosquitofish *Gambusia affinis*), and three native fish species (razorback suckers *Xyrauchen texanus*, Colorado pikeminnow *Ptychocheilus lucius*, and Sonora sucker *Catostomus insignis*). Some of the nonnative fish species have been reported to move long distances in other systems. For instance, common carp have been reported to make long distance movements in the Murray-Darling Basin in Australia (Jones et al. 2009). Carp ranging in size from 400 to 612 mm TL were found to move up to 127 km upstream and nearly 257 km downstream from their original capture location (Jones et al 2009). In Georgia, largemouth bass were found to move upstream nearly 70 km in the Savannah River (Paller et al 2005). Flathead catfish in the Missouri River had a maximum dispersal of 161 km (Travnichek 2004).

The objective of this survey was to estimate species composition and age-class structure of fishes in Horseshoe Reservoir and mark nonnative fish to detect future movement out of Horseshoe Reservoir. Efforts to elucidate these objectives in 2010 were planned to occur during times when the reservoir was at full pool (April) and at minimum pool (September).

Study Site

The overall study area covered by the HCP is the Verde River from the Salt River confluence upstream, including both Horseshoe and Bartlett Reservoirs, to Allen Ditch Diversion near Clarkdale, Arizona. With respect to fish monitoring, focus will be on Horseshoe Reservoir and the Verde River upstream to Beasley Flats near Camp Verde, and the portion of the Verde River downstream of Bartlett Reservoir to the Fort McDowell Indian Reservation Boundary. During 2010, sampling was restricted to Horseshoe Reservoir and the Verde River from Childs Arizona to Sheep's Bridge (see Curtis Gill Verde River 2010 report). At full pool, Horseshoe Reservoir extends upstream 16.1 km from Horseshoe Dam and has a surface area of approximately 1200 ha. Surveys were conducted during a period when the reservoir was at full pool (April) and when the reservoir had reached minimum pool (September). During the minimum pool survey there was less than 2 km of shoreline and a maximum depth less than 2 meters. The upper end of the reservoir was approximately 1 km downstream of the boat ramp.

Of the fish species recently reported (Robinson 2007) from Horseshoe Reservoir, common carp and goldfish tend to be the most numerous species (e.g., ~ 85% of catch during 2005 and 2006), with the other species being far less abundant. Black crappie *Pomoxis nigromaculatus*, walleye *Sander vitreus*, and redear sunfish *Lepomis microlophus* were found in Horseshoe Reservoir between 1987 and 1999, but none have been captured since 1999 (Robinson 2007).

Methods

Sampling gear included electrofishing, experimental gill nets, and fyke nets and were employed according to methods described in the Arizona Game and Fish standardized sampling protocol (AZGFD 2004). All three gear types were used during the full pool survey conducted from April 6th -9th, when reservoir storage was near 110,000-acre feet (Figure 1). Electrofishing and gill netting sites were selected in a randomly stratified manner as described in the Arizona Game and Fish standardized sampling protocol. The full pool reservoir was stratified into three sections; riverine, transition and lacustrine (Figure 2). Each stratification of the reservoir was sampled equally. Sites for fyke nets were selected based on suitable habitat. During the minimum pool survey, September 1st-2nd, there was less than 2 km of shoreline which allowed for the entire reservoir to be sampled (Figure 1). Electrofishing effort during minimum pool was divided into three areas. The first was the reach of river from the boat ramp to the start of the reservoir (approximately 1 km), the second was the entire shoreline of the reservoir, and the third were transects across the reservoir (Figure 3).

During the full pool survey two electrofishing boats were used. One boat was outfitted with an 8 kw water cooled generator, a Smith-Root model VVP-15-B, two adjustable anode arrays mounted on booms, and two "cable whisker" cathode arrays mounted on the bow. The second boat was outfitted with a 5 kw generator, a Smith-Root 5.0 GPP, and two adjustable anode array SAA6 on booms. Both boats electrical output averaged seven amps. During the minimum pool survey two electrofishing canoes were used for this survey each with a 30 cm diameter spherical cathode suspended from a bow mounted boom. The cathodes for one of the canoes were 12 x 334 cm anodize aluminum strips that were permanently affixed to each side of the canoe such that they would be mostly submerged when the canoe was loaded. The cathodes for the second canoe were three cables (8, 10, and 12 ft) that extended from the stern of the canoe. Both canoes were outfitted with a Smith Root 2.5 GPP electrofisher. Output for both canoe electro-fishers ranged from four to seven amps. Gill netting was not used because water levels were considered to be too low to effectively sample. All captured fish were identified to species, measured (mm TL), weighed (g), and with the exception of common carp any species greater than 150 mm were tagged with either a 2 3/8 inch blue spaghetti tag labeled with WMRS followed by a four digit number that ranged from 4201 to 6700. Based on previous studies (Robinson 2007), spaghetti tag retention was low for common carp therefore anal spines were clipped on all common carp. To assess tag retention, a left pelvic fin hole punch was given to all species that were marked with a spaghetti tag.

Analysis

Percent composition of fish was calculated for each gear type and combined for all gear types by species. Percent composition of a particular species was calculated as:

$$\%comp_s = (s/n) \times 100, \qquad (1)$$

where s is number of individuals of a given species and n is the total number of individuals of all species.

Electrofishing catch rate or catch per unit effort (CPUE) was calculated for each of the three areas. One electrofishing effort was defined as a 900 second time period and mean CPUE in each area was calculated as catch per 900 seconds:

$$CPUE = \frac{1}{n} \times \sum_{i=1}^{n} \left(\frac{C_i}{T_i} \right), \quad (2)$$

where C_i = catch in the ith electrofishing site, T_i = number of 900 second increments sampled in the ith transect, and n = number of transects or sites at each area.

Mean catch rates for fyke nets were calculated as follows:

$$CPUE = \frac{1}{n} \times \sum_{i=1}^{n} \left(\frac{C_i}{H_i} \right), \quad (3)$$

where C_i = number of individuals captured in the ith fyke net, H_i = duration in hours that the ith fyke net was set in water, and n = number of nets

Gill netting catch rates were calculated as net night units (NNU):

$$CPUE = \frac{1}{n} \times \sum_{i=1}^{n} \left(\frac{C_i}{Hi/12} \right), \quad (4)$$

where C_i = number of individuals captured in the ith gill net, H_i = duration in hours that the ith gill net was set in water divided by 12 hours, and n = number of nets.

Results

Full Pool Survey (April 6-8th)

A total of 24 gill netting, 24 electrofishing, and 4 fyke nets were set during the course of this survey. A total of 877 fish of 11 different species were captured for all gear types. More fish were captured with gill nets than by electrofishing, however, electrofishing captured a greater diversity of fish. No fish were caught using fyke nets (Table 1).

With the exception of two Colorado pikeminnow, all species caught were nonnative. The two most common species caught were common carp and goldfish. Common carp made up 81% of the gill net catch and goldfish made up 41% of the electrofishing catch. Smallmouth and largemouth bass made up 10% and 7% of the electrofishing catch, respectively (Table 1).

Electrofishing CPUE was greatest for goldfish (4.47 ± 1.36 standard error [SE]) and common carp (3.01 ± 0.58 SE) followed by smallmouth bass (1.14 ± 0.32 SE), and red shiners (1.12 ± 0.69 SE). Catch for all other species was less than one (Table 2). Gill netting CPUE was significantly higher for common carp (13.68 fish/NNU ± 1.37 SE) than any other species, followed by goldfish (2.39 fish/NNU ± 0.79). All other species were < 1 fish/NNU (Table 2).

Multiple size classes of goldfish, common carp, channel catfish, smallmouth and largemouth bass were evident when the frequencies of 10-mm length classes were examined (Figure 4). The mean length of captured goldfish was 175 mm and ranged between 150 to 200 mm TL. The mean length of common carp was 399 mm TL and ranged between 36 and 675 mm TL. Two dominant modes of common carp were captured and measured about 350 mm and 450mm (Table 3). Smallmouth bass also appeared to have two distinct size classes (100-150mm and 200-250 mm TL; Figure 4) and ranged between 101 and 251 mm TL with a mean total length of 157. Largemouth bass ranged from 116 to 419 mm TL and had a mean length of 257 mm TL (Table 3).

A total of 784 fish were marked with goldfish (162) and common carp (555) the predominant species tagged (Table 4). No fish marked during previous surveys were recaptured during April 2010. However, two Colorado pikeminnow marked with a coded wire tag were captured. The location

of the tag was left dorsal indicating these two fish were raised at the Bubbling Ponds Hatchery and stocked on January 7, 2010 near Beasley Flats.

Minimum Pool Survey (September 1-2nd)

The reach of Verde River extending from the boat ramp to the pool, five diagonal transects, and the entire shoreline (broken into four transects) was sampled during the minimum pool survey. A total of 513 fish of seven different species were captured (Table 1). Due to large amounts of submerged vegetation and muddy substrate, no seining sites were identified.

All fish captured were nonnative species. Common carp and goldfish were the species most frequently captured comprising 34% and 46% of the catch. Largemouth bass comprised 17% of the catch. Three other species were captured and comprised < 3% of the catch (Table 1).

Electrofishing CPUE was highest for goldfish (126.28 ± 42.09 SE), common carp (91.89 ± 76.48 SE), and largemouth bass (8.89 ± 1.78 SE) in the Verde River reach. Transects and shoreline electrofishing CPUE within the minimum pool reservoir was significantly lower than the Verde River reach. For both transect and shoreline strata, CPUE was highest for largemouth bass (transect = 2.37 ± 0.87 SE, shoreline = 12.25 ± 2.93; Table 2).

Multiple size classes of goldfish, common carp, and largemouth bass were evident when the frequencies of 10-mm length classes were examined (Figure 5). The mean length for goldfish was 168 mm TL and ranged between 83 and 240 mm TL. The mean length for common carp was 187 mm TL and ranged between 103 and 701 mm TL. The mean length for largemouth bass was 131 mm TL and ranged between 91 and 387 mm TL.

A total of 143 fish were marked with goldfish (100), and common carp (29), and largemouth bass (14) the predominant species tagged (Table 4). No fish marked during previous surveys were recaptured during September 2010.

Discussion

Similar numbers of fish were captured during full and minimum pool sampling in 2010 and minimum pool sampling in 2009, and both years' efforts yielded substantially more fish compared to the numbers captured in April 2005 and March 2006. The greater numbers of fish captured in 2009 was perhaps a result of serendipitous timing (Stewart 2009). Immediately prior to sampling, the reservoir level was reduced to minimum pool, concentrating fish in a small area and thus, the entire reservoir was sampled. Sampling during April 2005 occurred when the reservoir was near full storage. During March 2006, sampling occurred when the reservoir was near minimum pool level but had been near minimum pool levels (i.e., did not exceed 3.5% full) since August 2005, so if fish were abundant they likely had time to disperse upstream or downstream of the reservoir.

Electrofishing and gill nets were identified as the most effective gears to capture fish in past Horseshoe Reservoir surveys (Robinson 2007). However, more fish and a greater number of species are usually captured in gill nets than by electrofishing (Robinson 2007). During September 2010, the maximum depth of the reservoir was less than one meter, prohibiting the use of 2-m tall gill nets. However, we were able to sample the entire reservoir by electrofishing. The low water levels allowed to not only sample the shoreline with electrofishing, but we were also able to sample by transecting the reservoir. It is likely that our catch was biased toward medium-sized fish. While we did catch several large common carp, several others were observed swimming away from the electrical current. Perhaps a more representative sample of common carp may have been captured if gill nets were not prohibited from our use during minimum pool sampling.

In 2010, we did not observe any recaptured fish that were originally tagged

amongst the 2,561 fish tagged during the 2005-2006 surveys, or the 1,140 marked fish from 2009. An additional 927 fish were marked during April and September 2010 sampling. A major objective of this project is to mark as many fish as possible. As of the end of 2010, a total of 4,628 fish have been tagged since 2005. This objective will remain as the primary focus of the project over the next three years with hopes of saturating the system with enough marked fish to elucidate movement patterns.

Similar to Robinson (2007), common carp and goldfish dominated the catch, suggesting these species comprise a majority of the fish assemblage. Goldfish composed between 41 and 47% of the electrofishing catch during the two sampling events in 2010, significantly lower than catch compositions observed in 2009. However, largemouth bass composed between 7 and 17% of the electrofishing catch during efforts in 2010, which is markedly higher than observed in 2009. It is likely that the substantial runoff that occurred during the spring of 2010 disadvantaged common carp and goldfish by scouring their preferred habitats. The subsequent nutrient loads in the system may have replenished the food and cover needed for largemouth bass habitat

Common carp and goldfish are considered to be generalists who typically favor large bodies with slow flowing water and soft sediment, but also thrive in large turbid rivers (Minckley 1973). This type of habitat is generally not favorable to largemouth bass that inhabit clearer water with good vegetation and overgrown banks (Minckley 1973). In the mid 1980's and 1990's during a relatively wet period, the reservoir would generally fill and carry-over storage occurred between years. Fish surveys during this time revealed a system dominated by centrarchids (largemouth bass, bluegill, and black crappie). Beginning in the late 1990's, with the onset of the current drought and as SRP operated reservoirs to maximize system storage, Horseshoe Reservoir was emptied annually and a minimum pool was maintained for extended periods of time. As a result, the fish community shifted to a cyprinid-dominated assemblage (e.g. common carp and goldfish; Robinson 2007). Common carp are the most abundant large-bodied fish species in the Verde River immediately upstream from Horseshoe Reservoir while red shiner are the most abundant fish species, of any size (Robinson 2007). In the small portion of the Verde River in the Horseshoe Reservoir bed surveyed during 2010, goldfish dominated the catch. Over 91% of the fish marked during the 2010 survey were either goldfish or common carp, in contrast to 2005-2006 survey when most (79.3%) of the 2,561 fish marked were common carp. Goldfish typically are rare above Sheep's Bridge located 16.5 km up stream from Horseshoe Reservoir dam (Rinne 2005; Curtis Gill, Arizona Game and Fish Department, *personal communication*). If future Verde River surveys also indicate that common carp are the most abundant large-bodied fish then it may be more useful to focus marking efforts on common carp as well as other large-bodied nonnative fish species commonly found upstream. More common carp could likely be captured and marked in Horseshoe Reservoir if sampling was done when water levels are slightly above minimum pool which would enable the use of gill nets in addition to electrofishing.

References

AZGFD (Arizona Game and Fish Department) 2004. Standard fish sampling protocol for state of Arizona Waters. Phoenix, AZ.

AZGFD (Arizona Game and Fish Department) and SRP (Salt River Project), 2009 Fish Surveys in Horseshoe Reservoir to meet Horsehoe-Barlett HCP Obligations. Collection Agreement 2009.

Jones, M.J., I.G. Stuart. 2009. Lateral movement of common carp (Cyprinus carpio L.) in a large lowland river and floodplain. Ecology of Freshwater Fish 18:72-82.

Minckley, W. L. 1973. Fishes of Arizona, Arizona Game and Fish Department, 293 p.

Paller, M. H., D. E. Fletcher, T. Jones, S. A. Dyer, J. J. Isely, J. W. Littrell. 2005.Potential of largemouth bass as vectors of 137Cs dispersal. Journal of Environmental Radioactivity 80: 27-43.

Rinne, J. N., R. M. Hughes, and B. Calamusso. (editors). 2005. Historical changes in fish assemblages of large rivers in the Americas. American Fisheries Society Symposium 45. American Fisheries Society, Bethesda, MD. 611 pp.

Robinson, A.T. 2007. Verde River and Horseshoe Reservoir Fish Surveys; Final Report to Salt River Project, Phoenix, Arizona. Arizona Game and Fish Department, Research Branch, Phoenix. 28 Pages.

Stewart, W. 2009. Horseshoe Reservoir HCP 2009 fish monitoring. Draft report to Salt River Project, Phoenix, Arizona. Arizona Game and Fish Department, Research Branch, Phoenix. 15 Pages.

Travnichek, V.H. 2004. Movement of flathead catfish in the Missouri River: examining opportunities for managing river segments for different fishery goals. Fisheries Management and Ecology 11:89-96.

USFWS (US Fish and Wildlife Service) 2008. Record of Decision: Horseshoe and Bartlett Reservoirs Habitat Conservation Plan Final Environmental Impact Statement, Maricopa and Yavapai Counties, Arizona.

Table 1. Total fish captured and percent composition by each gear type for each species during full pool (April 2010) and minimum pool (September 2010) sampling at Horseshoe Reservoir.

	Full Pool					Minimum Pool	
Species	**E-fishing**	**% comp**	**Gill nets**	**% comp**	**Totals**	**E-fishing**	**% comp**
Yellow Bullhead (*Ameiurus natalis*)	2	0.7%			2		
Goldfish (*Carassius auratus*)	109	40.7%	85	14.0%	194	238	46.4%
Common Carp (*Cyprinus carpio*)	73	27.2%	489	80.8%	562	174	33.9%
Red Shiner (*Cyprinella lutrensis*)	27	10.1%			27	11	2.1%
Channel Catfish (*Ictalurus punctatus*)	1	0.4%	30	5.0%	31		
Green Sunfsih (*Lepomis cyanellus*)	3	1.1%			3	1	0.2%
Bluegill (*Lepomis macrochirus*)	6	2.2%			6	2	0.4%
Smallmouth Bass (*Micropterus dolomieu*)	28	10.4%	1	0.2%	29		
Largemouth Bass (*Micropterus salmoides*)	19	7.1%			19	86	16.8%
Colordo Pikminnow (Ptychocheilus lucius)			2	0.3%	2		
Flathead Catfish (Pylodictis olivaris)			2	0.3%	2	1	0
Total	**268**		**609**		**877**	**513**	

Table 2. Mean catch per unit effort (CPUE) and standard error (SE) for species captured during full pool (April 2010) and minimum pool (September 2010) sampling at Horseshoe Reservoir.

	Full Pool				Minimum Pool					
	Gill Net		Electrofishing		Verde		Transect		Shoreline	
Species	**CPUE**	**SE**	**CPUE**	**SE**	**CPUE**	**SE**	**CPUE**	**SE**	**CPUE**	**SE**
Yellow Bullhead	0.03	0.03	0.04	0.04						
Goldfish	2.39	0.79	4.47	1.36	126.28	42.09	2.08	1.03	3.56	2.67
Carp	13.68	1.37	3.01	0.58	91.89	76.48	0.30	0.29	3.36	2.15
Red Shiner			1.12	0.69	2.96	2.96			0.40	0.25
Channel Catfish	0.83	0.20	0.04	0.04						
Green Sunfish			0.04	0.04					0.20	0.20
Bluegill			0.24	0.14	0.59	0.59			0.20	0.20
Smallmouth Bass	0.03	0.03	1.14	0.32						
Largemouth Bass	0.06	0.04	0.78	0.32	8.89	1.78	2.37	0.87	12.25	2.93
Colorado Pikeminnow	0.05	0.04								
Flathead Catifsh	0.05	0.04			0.59	0.59				

Table 3. Mean, minimum, and maximum total length of species captured during full pool (April 2010) and minimum pool (September 2010) sampling at Horseshoe Reservoir.

	Full Pool Electrofishing			**Full Pool** Gill Net			**Minimum Pool** Electrofishing		
Species	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Yell0w Bullhead	257	257	257	244	244	244			
Goldfish	178	131	340	170	144	392	168	83	240
Carp	426	36	643	395	132	675	187	103	701
Red Shiner	45	17	65				36	16	74
Channel Catfish	405	405	405	389	205	615			
Green Sunfish	122	122	122				72	72	72
Bluegill	159	142	185				99	65	132
Smallmouth Bass	154	101	251	237	237	237			
Largemouth Bass	249	116	419	333	253	413	131	91	387
Colorado Pikeminnow				418	390	445			
Flathead Catfish				389	344	433	380	380	380

Table 4. Number of fish marked at full pool (FP) and minimum pool (MP) sampling in 2009 and 2010 at Horseshoe Reservoir.

Species	FP 2010 Marked	MP 2010 Marked	MP 2009 Marked	Total Fish Marked
Yellow Bullhead	2			2
Goldfish	162	100	1,044	1,306
Carp	555	29	91	675
Channel Catfish	31		0	31
Green Sunfish	0		2	2
Bluegill	4			4
Smallmouth Bass	12			12
Largemouth Bass	16	14	3	33
Flathead Catfish	2			2
Total	**784**	**143**	**1,140**	**2,067**

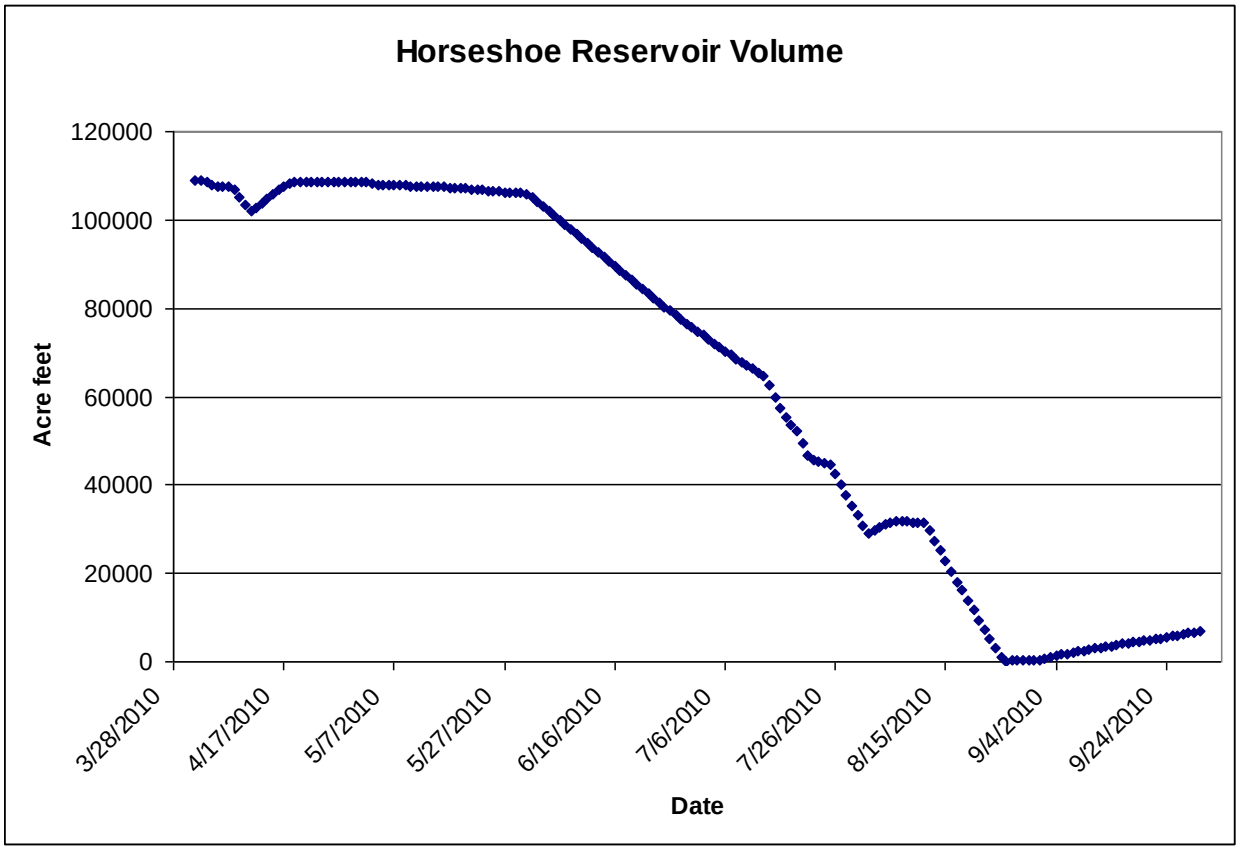


Figure 1. Volume (AF) of Horseshoe Reservoir from April 1, 2010 (98% full) to September 30, 2010 (< 1% full).

Figure 2. Image of Horseshoe Reservoir at full pool overlaid by actual size of reservoir during September 1-2, 2010.

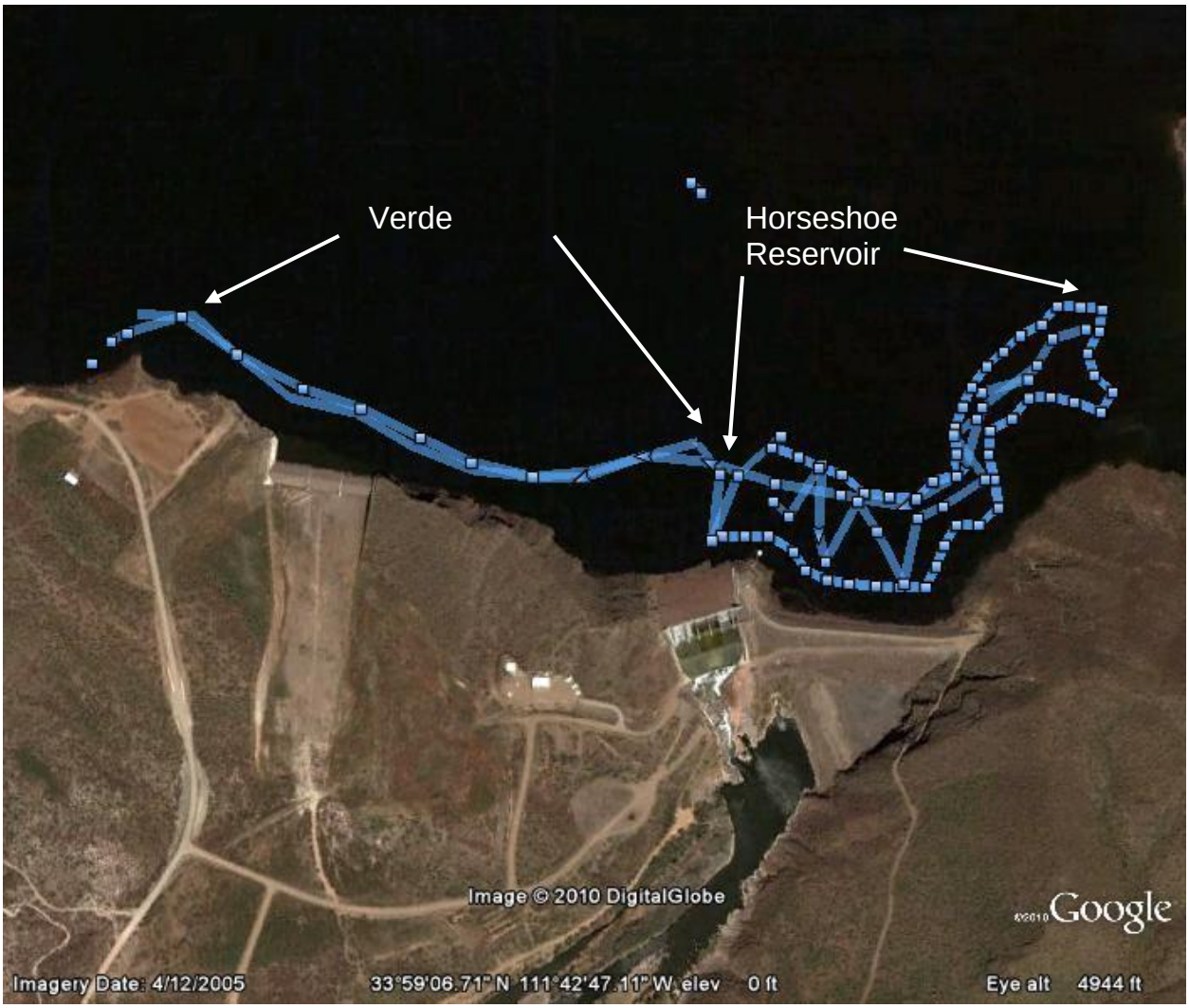


Figure 3. Areas electrofished in Horseshore Reservoir during September 1, 2010 surveys. Area 1 was the Verde River, Area 2 was the shoreline of Horseshoe Reservoir, and Area 3 were transects across Horseshoe Reservoir.

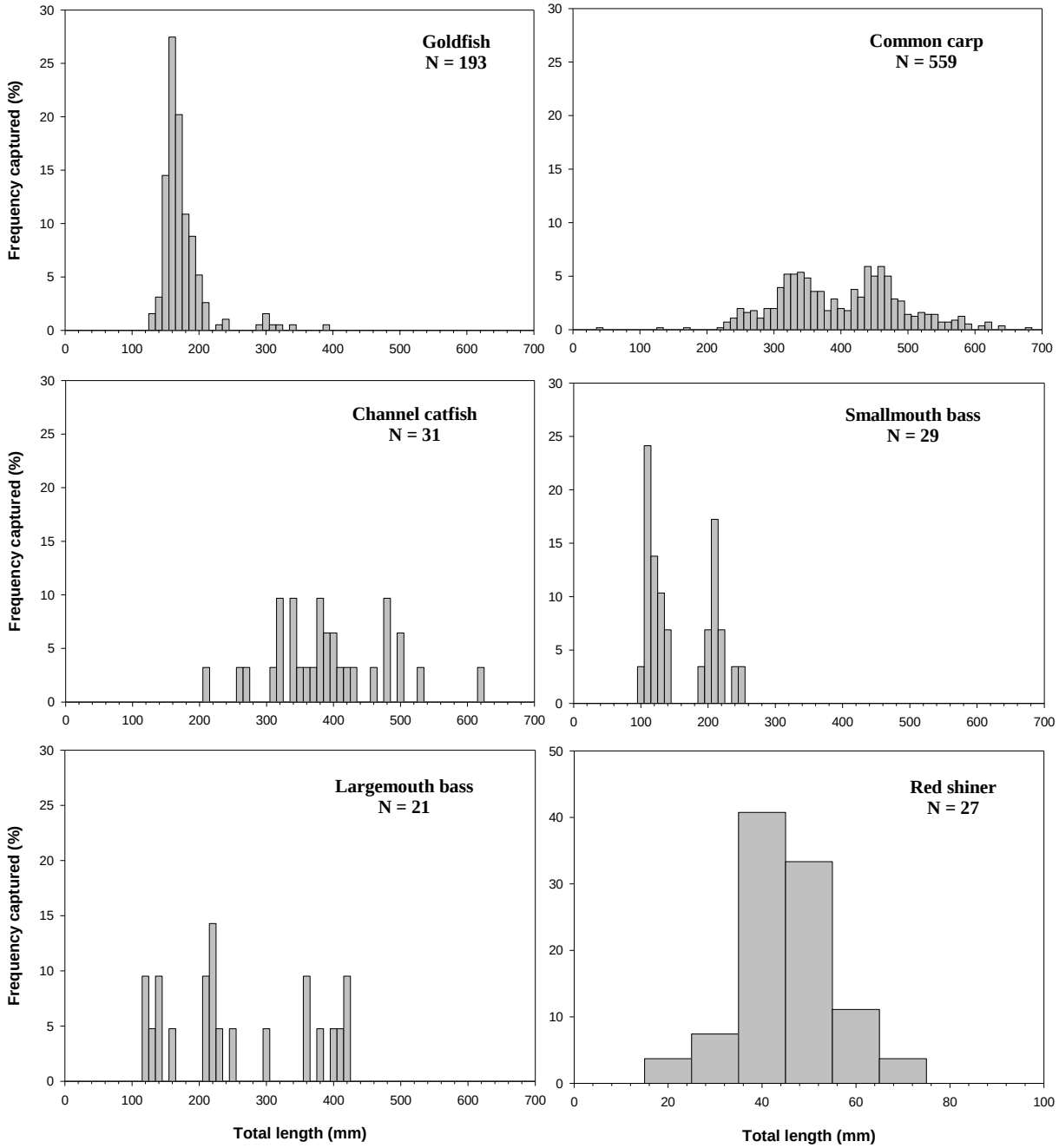


Figure 4. Length frequency histograms of goldfish (*Carassius auratus*; upper left panel), common carp (*Cyprinus carpio*; upper right panel), channel catfish (*Ictalurus punctatus*; middle left panel), smallmouth bass (*Micropterus dolomieu*; middle right panel), largemouth bass (*Micropterus salmoides*; lower left panel), and red shiner (*Cyprinella lutrensis*; lower right panel) captured during electrofishing and gill net surveys conducted on Horseshoe Reservoir while at full pool, April 2010. Note the difference in x- and y-axis scales for the lower right panel.

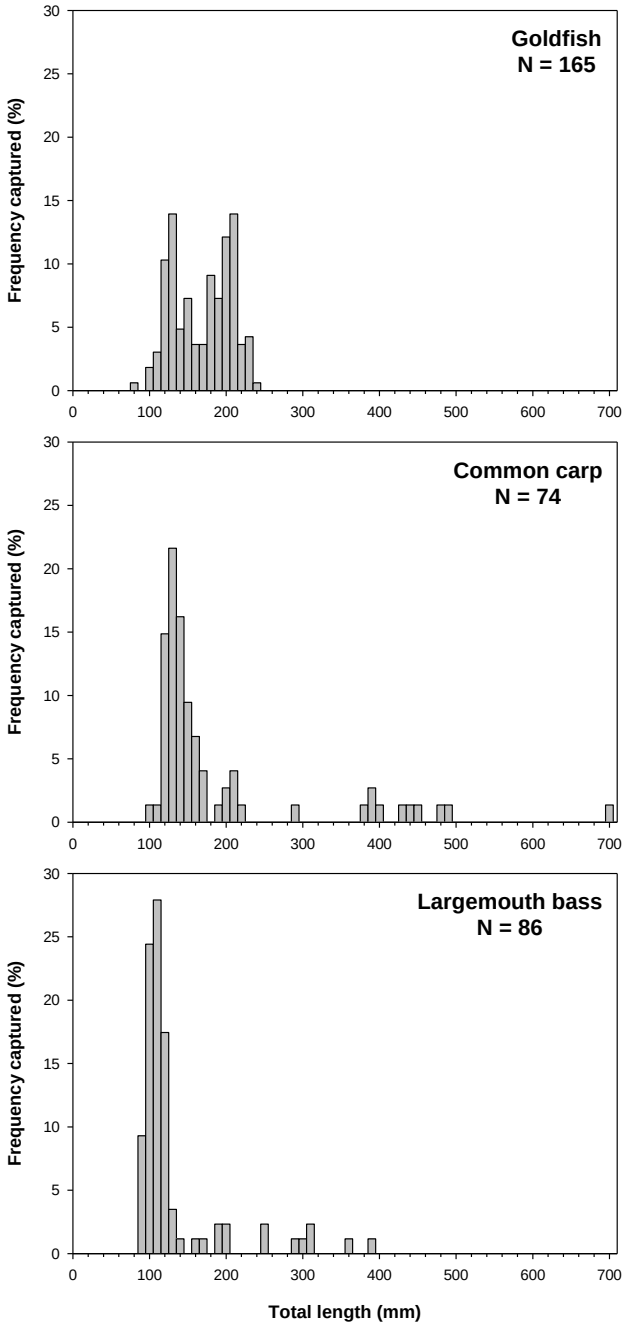


Figure 5. Length frequency histograms of goldfish (*Carassius auratus*; top panel), common carp (*Cyprinus carpio*; middle panel), and largemouth bass (*Micropterus salmoides*; lower panel) captured during electrofishing surveys conducted on Horseshoe Reservoir while at minimum pool, September 2010.

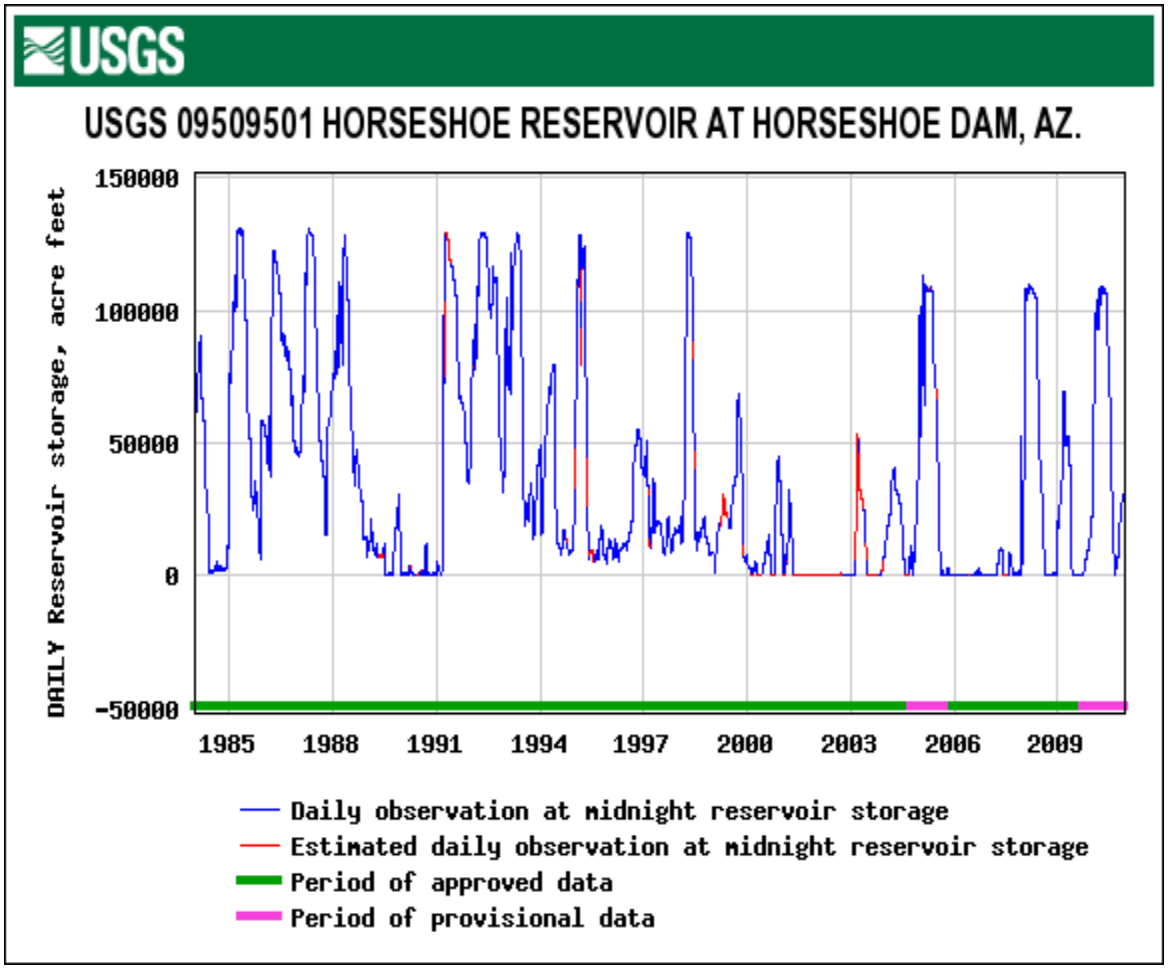


Figure 6. Daily water storage (AF) at Horseshoe Reservoir from 1984 to 2010.

APPENDIX B

ARIZONA GAME AND FISH DEPARTMENT REPORT

Verde River, Childs – Sheep Bridge, Fish Sampling

Results of the Verde River, Childs to Sheep Bridge, Fisheries Survey May 24 – 28, 2010

On May 24 – 28, 2010 Arizona Game and Fish biologists from Region VI conducted a comprehensive fish survey of the Verde River from Childs power plant to Sheep Bridge, a distance of roughly 53 km (Figure 1). The crew on this survey consisted of Curt Gill, Chris Cantrell, Lorraine Avenetti, Jeff Sorensen, Tim Grosch, Diana Rogers, and interns Wesley Dixon, Jamie Evans, and Jacob Jaeger. The primary purpose of this survey was to continue the annual monitoring of the razorback sucker (*Xyrauchen texanus*) and Colorado pikeminnow (*Ptychocheilus lucius*) reintroduction, which has been underway since 1994 with annual stockings of both species (Table 1). The exception to this was in 2006, when only Colorado pikeminnow were stocked and in 2008 when neither sepecies was stocked (Table 1). The crew also evaluated sport fish and other native fish populations within the sample area. The secondary purpose was to look for nonnative fish that were tagged in Horseshoe Reservoir in 2009 and 2010.

Methods

The survey was conducted using a Smith-Root 5.0 GPP electrofishing unit mounted in a canoe. Two biologists staffed the canoe, one to net fish and the second to monitor the generator and electrical output equipment and to navigate the canoe. Electrofishing unit settings were placed at high voltage of 500-1000 volts, pulsed DC at 60 pulses per second, and a 40% pulse width. These settings were utilized throughout the trip and resulted in an average of 4 amps of output. A second canoe was used as a chase/processing craft to collect fish that were missed by the electrofishing canoe and to weigh and measure fish at the end of each site. Five other inflatable boats and a canoe were used to carry equipment and provide general trip support.

Survey sites were chosen in advance based on a river map divided into 106 sites, each 500 meters long. A total of 40 sites were chosen for sampling. Eight sites were fixed sites that were chosen in 2006. The additional 32 sites were randomly chosen and adhere to the Department's Standard Fish Sampling Protocol (80% random/20% fixed). An inflatable kayak traveled ahead using a Garmin GPS unit to flag both the start and stop of the predetermined sample sites. At the end of each site the processing canoe identified, weighed (nearest 2g), and measured (nearest mm) the fish. All native fish were then released back into the river.

A 6'X15' seine with 1/8" mesh was also utilized to sample seven backwater pools during the survey. In addition, we set an experimental gill net in a large pool adjacent to camp for about 13 hours on the first night.

Results

During the 5-day survey the electrofishing crew sampled 28 of the 40 sites and shocked for a total of 13,917 seconds and physically captured 361 fish (Table 2). The electrofishing canoe capsized on the afternoon of day four, which precluded the sampling of the final twelve sites. Throughout the survey fish appeared to be adequately affected by the electrofishing equipment. Attempts were made to capture all species observed. Eleven fish species were collected during the survey, of which three were native (Table 3). Smallmouth bass (*Micropterus dolomieu*) was the most common species collected and comprised 28.3% of the relative abundance of fish collected (Table 4). Common carp (*Cyprinus carpio*) had the second highest relative abundance at 24.1%, followed by Sonora sucker (*Catostomus insignis*) at 17.5 %, red shiner (*Cyprinella lutrensis*) at 16.1%, and desert sucker (*Catostomus clarki*) at 7.8 % (Table 4). Largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), flathead catfish (*Pylodictis olivaris*) and Colorado pikeminnow *(Ptychocheilus lucius)* each comprised less than 2% of the relative abundance by species (Table 4). Red shiners were collected but only counted no length or weight was recorded.

We collected 459 fish from seven seining locations comprising at least three species (Table 7). There may have been as many as five species collected but the sucker and bass species were too small to confirm their identity with any certainty. The gill net only collected two fish, a common carp and a Sonora sucker (Table 7).

The largest fish collected throughout the survey was a 545 mm carp (Table 5). Native Sonora sucker collected during the survey ranged from 353 – 505 mm long and weighed an average of 1,101 g (Table 5). Native desert sucker ranged from 225 – 410 mm long and weighed an average of 425 g. Non-native predators such as smallmouth bass, largemouth bass, channel catfish, and flathead catfish collected were made up of a majority of smaller (<250 mm) individuals (Table 6). One Colorado pikeminnow was captured on day one of the trip. No razorback sucker or tagged nonnative fish were observed or collected throughout the survey.

Discussion

The weather remained clear and mild during the survey, although the crew typically experienced high upstream winds during the day and high downstream winds at night and early morning. Flows for the Verde River varied little throughout the week, with flows at Camp Verde being 97cfs on Monday, May 24th and dropping slightly to 91 cfs on Friday, May 28th.

Data was compared to past surveys that have been conducted annually since 2002. Since carp were not collected during many of the past surveys they were not included in comparisons. Catch per unit effort (CPUE) for all species was lower this year than in 2008 but still the second highest for the period of sampling (Table 8). Non-native

smallmouth bass showed a noticeable increase in CPUE, actual numbers collected, and relative abundance over 2008 (Table 8). The smallmouth bass CPUE was the second highest noted from 2002-2010. Lrgemouth bass CPUE stayed constant compared to 2007 and 2008 (Table 8). Native Sonora sucker increased in number collected and CPUE and was the highest recorded in the past surveys (Table 8). Native desert sucker CPUE and number collected were similar to 2007 and 2008. Other non-native species collected in the past (green sunfish, bluegill, and channel catfish) remained low in numbers collected, relative abundance, and CPUE (Table 8).

Recommendation

Although no razorback sucker and only one Colorado pikeminnow were collected in 2010, native desert and Sonora suckers seem to be rebounding in the Verde River between Childs and Sheeps Bridge. Therefore, it is recommended that stocking efforts of razorback sucker and Colorado pikeminnow continue in this reach of the Verde River. The trip will also be beneficial in identifying whether fish that are tagged in Horseshoe Lake move upstream into the Verde River as the reservoir empties.

Submitted by: Curt Gill
Region VI Fish Specialist
August 3, 2010

Table 1. Stocking data for razorback sucker (XYTE) and Colorado pikeminnow (PTLU) stocked in the Verde River from 2000 – 2007.

Date (YYYYMMDD)	Species	Stocking location	Number stocked	Mean length (mm)	Origin[a]	Tag location
19941013	**XYTE**	Childs	1935	386	BPSH	CWT nose
19941121	**XYTE**	Childs	269	324	DNFH	PIT tag data in RVI
19950202	**XYTE**	Childs	3000		BPSH	CWT nose
19950323	**XYTE**	Childs	63	442	BPSH	CWT right cheek
19950329	**XYTE**	Childs	93	432	BPSH	CWT right cheek
19951211	PTLU	Beasley Flats	1000	305	BPSH	CWT nose
19951211	PTLU	Childs	1033	305	BPSH	CWT nose
19951221	PTLU	Beasley Flats	329	381	DNFH	CWT right opercle
19951222	PTLU	Childs	309	381	DNFH	CWT right opercle
19960207	**XYTE**	Childs	480	254	BPSH	CWT nose
19961121	PTLU	Beasley Flats	999	362	BPSH	CWT left opercle
19961125	PTLU	Childs	1045	362	BPSH	CWT left opercle
19961211	**XYTE**	Childs	927	325	BPSH	CWT right dorsal
19961212	**XYTE**	Childs	980	325	BPSH	CWT right dorsal
19961213	**XYTE**	Childs	1530	325	BPSH	CWT right dorsal
19970711	PTLU	Childs	33	477	DNFH	CWT right dorsal
19970711	**XYTE**	Childs	765	287	DNFH	CWT left dorsal
19971022	**XYTE**	Childs	320	392	BPSH	CWT left dorsal
19971023	**XYTE**	Childs	556	394	BPSH	CWT left dorsal
19971106	PTLU	Beasley Flats	500	445	BPSH	CWT right dorsal
19971106	PTLU	Childs	1000	432	BPSH	CWT right dorsal
19971110	PTLU	Beasley Flats	644	430	BPSH	CWT right dorsal
19980223	**XYTE**	Childs	351	330	BPSH	CWT left dorsal
19981125	**XYTE**	Childs	2040	305	BPSH	CWT left caudal
19981217	PTLU	Childs	980	318	BPSH	CWT left caudal
19981218	PTLU	Beasley Flats	665	330	BPSH	CWT left caudal
19990909	**XYTE**	Childs	2000	381	BPSH	UNKNOWN
18990914	PTLU	Beasley Flats	364	406	BPSH	UNKNOWN
20000907	**XYTE**	Childs	10	580	Stehr Lake	PIT (data in dbase)
20001130	**XYTE**	Childs	968	328	BPSH	CWT nose
20001204	**XYTE**	Childs	896	305	BPSH	CWT nose
20001207	**XYTE**	Childs	257	328	BPSH	CWT nose
20011109	**XYTE**	Childs	74	440	San Pedro	CWT right caudal peduncle
20011212	**XYTE**	Childs	1500	300	BPSH	CWT right caudal peduncle
20020315	PTLU	Beasley Flats	266	300	BPSH	CWT right pectoral base
20020925	**XYTE**	Childs	412	350	BPSH	CWT right cheek
20021030	**XYTE**	Childs	1610		BPSH	CWT right cheek

[a] BPSH = Bubbling Ponds State Hatchery, DNFH = Dexter National Fish Hatchery

Table 1. Continued

Date (YYYYMMDD)	Species	Stocking location	Number stocked	Mean length (mm)	Origin[a]	Tag location
20030129	PTLU	Beasley Flats	2049	400	BPSH	CWT left pectoral base
20030130	**XYTE**	Childs	378	330	BPSH	CWT left pectoral base
20040128	**XYTE**	Beasley Flats	461	424	BPSH	CWT left caudal
20040205	**XYTE**	Beasley Flats	973	360	BPSH	CWT left caudal
20040206	**XYTE**	Beasley Flats	891	361	BPSH	CWT left caudal
20040129	PTLU	Beasley Flats	833	440	BPSH	CWT left caudal
20040130	PTLU	Beasley Flats	711	440	BPSH	CWT left caudal
20050202	**XYTE**	Beasley Flats	1024	310	BPSH	CWT right cheek
20050419	**XYTE**	Beasley Flats	980	386	BPSH	CWT right cheek
20050420	PTLU	Beasley Flats	1550	385	BPSH	CWT right cheek
20060802	PTLU	Beasley Flats	506	412	BPSH	CWT left dorsal
20070710	PTLU	Beasley Flats	550	432	BPSH	CWT right pectoral
20070711	PTLU	Beasley Flats	1025	432	BPSH	CWT right pectoral
20070711	**XYTE**	Beasley Flats	45	475	BPSH	CWT right pectoral
20090319	PTLU	Beasley Flats	575	480	BPSH	CWT Right caudal peduncle
20090319	PTLU	Beasley Flats	512	480	BPSH	CWT Right caudal peduncle
20090320	PTLU	Beasley Flats	575	480	BPSH	CWT Right caudal peduncle
20100107	PTLU	Beasley Flats	980	410	BPSH	CWT left dorsal
20100310	**XYTE**	Beasley Flats	994	285	BPSH	CWT dorsal
20100422	**XYTE**	Beasley Flats	1088	288	BPSH	CWT dorsal

[a] BPSH = Bubbling Ponds State Hatchery, DNFH = Dexter National Fish Hatchery

Table 2. Summary statistics for each site sampled on the Verde River between Childs and Sheeps Bridge May 24-28, 2010. One electrofishing unit (EFU) is equivalent to 900 seconds of pedal on time.

Site ID	Shock Time (seconds)	EFU's	Number of Fish Collected	CPUE (fish/EFU)
1F	491	0.55	20	36.7
2F	368	0.41	15	36.7
3F	513	0.57	4	7.0
7R	319	0.35	5	14.1
10R	407	0.45	23	50.9
13R	464	0.52	15	29.1
16R	462	0.51	18	35.1
17R	448	0.50	12	24.1
19R	348	0.39	4	10.3
20R	538	0.60	14	23.4
21R	530	0.59	33	56.0
23R	594	0.66	18	27.3
24R	467	0.52	7	13.5
25R	615	0.68	14	20.5
28R	732	0.81	16	19.7
30R	519	0.58	20	34.7
34R	628	0.70	21	30.1
35F	735	0.82	21	25.7
37R	559	0.62	13	20.9
38F	466	0.52	15	29.0
39R	397	0.44	3	6.8
45R	432	0.48	6	12.5
51R	453	0.50	9	17.9
56R	414	0.46	4	8.7
60R	467	0.52	8	15.4
65R	536	0.60	3	5.0
68R	368	0.41	11	26.9
71R	647	0.72	9	12.5
Combined	13917	15.46	361	23.3
Mean	497	0.55	13	23.2
St. Dev.	107	0.12	7.3	12.7

Table 3. Species codes, common and scientific names, and status of species collected from the Verde River, Childs to Sheep Bridge, May 24-28, 2010.

Species Code	Common Name	Scientific Name	Status*
CACL	desert sucker	*Catostomus clarki*	N
CAIN	Sonora sucker	*Catostomus insignis*	N
CYCA	common carp	*Cyprinus carpio*	I
CYLU	red shiner	*Cyprinella lutrensis*	I
ICPU	channel catfish	*Ictalurus punctatus*	I
LECY	green sunfish	*Lepomis cyanellus*	I
LEMA	bluegill	*Lepomis macrochirus*	I
MIDO	smallmouth bass	*Micropterus dolomieu*	I
MISA	largemouth bass	*Micropterus salmoides*	I
PYOL	flathead catfish	*Pylodictis olivaris*	I
PTLU	Colorado pikeminnow	*Ptychocheilus lucius*	N

* N = native, I = introduced

Table 4. Summary data of species collected among all sites sampled on the Verde River May 2010. Catch per unit effort (CPUE) is reported as the number of fish per electrofishing unit (1 EFU = 900 seconds).

Species	Count	% Frequency	EFU's	CPUE
CACL	28	7.8	15.5	1.8
CAIN	63	17.5	15.5	4.1
CYCA	87	24.1	15.5	5.6
CYLU	58	16.1	15.5	3.8
ICPU	3	0.8	15.5	0.2
LECY	7	1.9	15.5	0.5
LEMA	1	0.3	15.5	0.1
MIDO	102	28.3	15.5	6.6
MISA	6	1.7	15.5	0.4
PTLU	1	0.3	15.5	0.1
PYOL	5	1.4	15.5	0.3
Total	361	100	15.5	23.3

Table 5. Length and weight summary data of species collected from the Verde River, Childs to Sheep Bridge, May 24-28, 2010.

Species	Count	Length (mm)			Mean Weight (g)
		Mean	Min	Max	
CACL	28	317	225	410	425
CAIN	63	437	353	505	1101
CYCA	87	430	297	545	1047
ICPU	3	101	86	113	11
LECY	7	141	103	135	66
LEMA	1	147	147	147	74
MIDO	102	189	125	432	108
MISA	6	221	110	360	184
PTLU	1	483	483	483	680
PYOL	5	251	185	306	206

Table 6. Length-frequency data for species collected among the thirty-one 500-m reaches sampled on the Verde River, Childs to Sheep Bridge, May 24-28, 2010. Species with fewer than four individuals collected were not included.

Length Range (mm)	CACL	CAIN	CYCA	LECY	MIDO	MISA	PYOL
0-99	0	0	0	0	0	0	0
100-149	0	0	0	5	17	2	0
150-199	0	0	0	2	51	1	1
200-249	2	0	0	0	28	1	1
250-299	8	0	1	0	1	0	2
300-349	11	0	2	0	2	1	1
350-399	5	13	17	0	1	1	0
400-449	2	20	37	0	1	0	0
450-499	0	27	15	0	0	0	0
500-549	0	2	10	0	0	0	0
550-599	0	0	0	0	0	0	0
>600	0	0	0	0	0	0	0
Total	**28**	**62**	**82**	**7**	**101**	**6**	**5**

Table 7. Summary of fish species collect from seining (SN) and gill netting (GN) sampled on the Verde River, Childs to Sheep Bridge, May 24-28, 2010.

	UTM's (NAD 83)			Number	Total	Weight
Site ID	**Easting**	**Northing**	**Species[a]**	**Collected**	**Length (mm)**	**(g)**
1SN	437926	3796278	CASP	150		
2SN	437440	3794820	CYLU	21		
3SN	437910	3794340	MISP	36		
			CYLU	11		
4SN	439015	3794887	CASP	2		
			CYLU	100		
			MISP	14		
5SN	438851	3793874	CASP	15		
6SN	436294	3790615	CASP	107		
7SN	435259	3786349	MISP	3		
1GN	438917	3800257	CYCA	1	466	1672
1GN			CAIN	1	410	916

[a] CASP = unidentified sucker species MISP = unidentified bass species.

Table 7. Summarized comparison of Verde River fisheries survey data from 2002 to 2010, excluding carp. Relative abundance is reported for each year with actual number collected below in parentheses. Catch per unit effort (CPUE) is reported as the number of fish per electrofishing unit (1 unit of effort = 900 seconds). The total number of electrofishing units is in parentheses below the year.

	Relative Abundance (%)								**CPUE (fish/EFU)**							
Year→ Species↓	**2002 (N)**	**2003 (N)**	**2004 (N)**	**2005 (N)**	**2006 (N)**	**2007 (N)**	**2008 (N)**	**2010 (N)**	**2002 (19.8)**	**2003 (19.1)**	**2004 (6.5)**	**2005 (22.2)**	**2006 (11.8)**	**2007 (16.1)**	**2008 (17.4)**	**2010 (15.5)**
CACL	5.2 (19)	6.9 (18)	5.7 (5)	12.7 (10)	6.6 (10)	18.3 (33)	8.4 (33)	7.8 (28)	0.96	0.94	0.77	0.45	0.85	2.05	1.90	1.81
CAIN	9.0 (33)	12.6 (33)	21.6 (19)	15.2 (12)	12.5 (19)	32.2 (58)	14.8 (58)	17.5 (63)	1.67	1.73	2.92	0.54	1.61	3.60	3.33	4.06
ICPU	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	2.6 (4)	3.3 (6)	1.5 (6)	0.8 (3)	0.00	0.00	0.00	0.00	0.34	0.37	0.34	0.19
LECY	4.1 (15)	8.4 (22)	2.3 (2)	1.3 (1)	2.6 (4)	2.2 (4)	1.0 (4)	1.9 (7)	0.76	1.15	0.31	0.05	0.34	0.25	0.23	0.45
LEMA	2.5 (9)	0.4 (1)	2.3 (2)	0.0 (0)	0.0 (0)	0.6 (1)	0.3 (1)	0.3 (1)	0.45	0.05	0.31	0.00	0.00	0.06	0.06	0.06
MIDO	19.1 (70)	21.4 (56)	25.0 (22)	48.1 (38)	52.6 (80)	11.7 (21)	5.4 (21)	28.3 (102)	3.54	2.93	3.38	1.71	6.78	1.30	1.21	6.58
MISA	16.6 (61)	25.2 (66)	17.0 (15)	6.3 (5)	6.6 (10)	3.3 (6)	1.5 (6)	1.7 (6)	3.08	3.46	2.31	0.23	0.85	0.37	0.34	0.39
PYOL	41.1 (151)	23.7 (62)	21.6 (19)	13.9 (11)	15.1 (23)	28.3 (51)	13.0 (51)	1.4 (5)	7.63	3.25	2.92	0.50	1.95	3.17	2.93	0.32
PTLU	0.0 (0)	0.4 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.3 (1)	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.06
XYTE	2.5 (9)	1.1 (3)	4.5 (4)	2.5 (2)	1.3 (2)	0.0 (0)	0.0 (0)	0.0 (0)	0.45	0.16	0.62	0.09	0.17	0.00	0.00	0.00
Overall	**(367)**	**(262)**	**(88)**	**(79)**	**(152)**	**(180)**	**(392)**	**(361)**	**17.58**	**12.77**	**12.77**	**3.11**	**12.03**	**11.17**	**22.53**	**19.55**

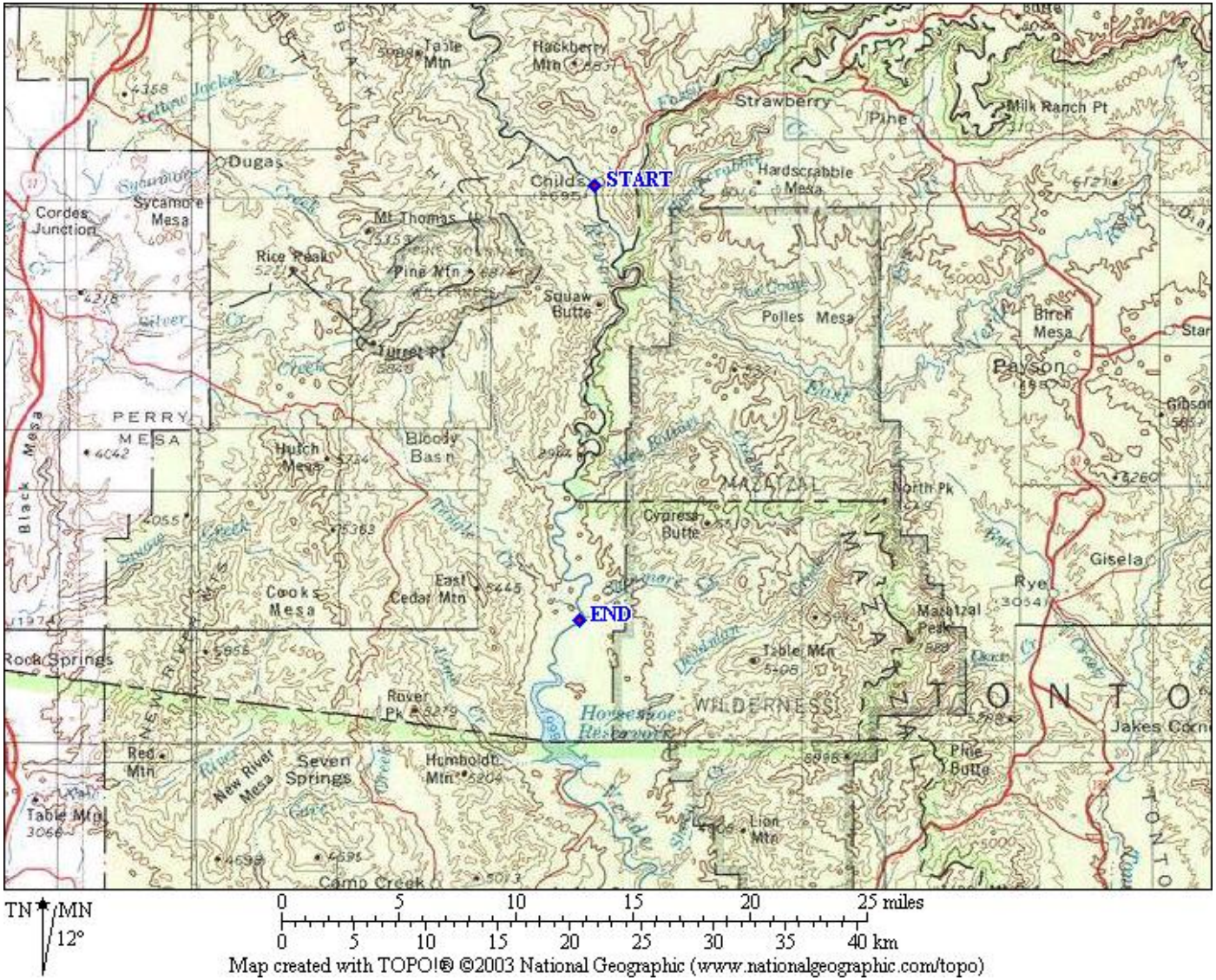


Figure 1. Map of the area sampled on the Verde River, between Childs and Sheeps Bridge, from May 24 – 28, 2010.

APPENDIX C

Lime Creek Trip Photos

July 14, 2010

Pool located in lower portion of creek.

Mosquitofish captured in downstream pool.

Lowland leopard frog captured in creek.

Sampling just downstream of barrier site.

Sampling upstream (~25 m) of barrier site – 100's of longfin dace.

Location of barrier - **May 22, 2006**

September 4, 2009

July 14, 2010

APPENDIX D

Lime Creek Fish Barrier
Special Use Permit

and

Construction Photos

Project Summary:

- Start date: October 18, 2010
- Completion Date: November 4, 2010
- Constructed by NAC Construction, Marana, AZ, under contract with SRP.
- SRP Project Manager: Chuck Paradzick
- SRP Construction Inspector: Nate Turner
- USFS Project Managers: Todd Willard & Andre Silva, Cave Creek RD, Tonto NF
- Engineering Design: Andy Ashby and Jeff Riley, U.S. Bureau of Reclamation,
  Kal Chhibber, Salt River Project
- Drawings and Specs on file at SRP
- SRP Flight Services provided helicopter support
- Biological & Cultural Environmental Consultants: EcoPlan, AZTEC, Alex Smith.
- Funding: Salt River Project and City of Phoenix
- $130,000 - estimated cost (construction and environmental compliance)

Authorization ID: **CVC600**
Contact ID: **SALTRIVERPROJECTLIMECREEK**
Expiration Date: **12/31/2040**
Use Code: **922**

FS-2700-4 (10/09)
OMB No. 0596-0082

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SPECIAL USE PERMIT

Federal Land Policy and Management Act
(Ref.: FSH 2709.11, section 41.53)

Salt River Project of PO Box 52025 PHOENIX AZ 85072 (hereinafter "the holder") is authorized to use or occupy National Forest System lands in the **Tonto National Forest or Cave Creek Ranger District** unit of the National Forest System, subject to the terms and conditions of this special use permit (the permit).

This permit covers 1 acres or 0 miles in the Sec. 31, T. 8 N., R. 6 E., GILA AND SALT RIVER MERIDIAN, ("the permit area"), as shown on the map attached as Appendix B. This permit issued for the purpose of:

Construction, monitoring, and maintenance of a concrete fish barrier in Lime Creek.
See Appendix A for approved specifications.

TERMS AND CONDITIONS

I. GENERAL TERMS

A. AUTHORITY. This permit is issued pursuant to **Federal Land Policy and Management Act** and 36 CFR Part 251, Subpart B, as amended, and is subject to their provisions.

B. AUTHORIZED OFFICER. The authorized officer is the Forest or Grassland Supervisor or a subordinate officer with delegated authority.

C. TERM. This permit shall expire at midnight on **12/31/2040, 30 years** from the date of issuance.

D. RENEWAL. This permit is not renewable. Prior to expiration of this permit, the holder may apply for a new permit that would renew the use and occupancy authorized by this permit. Applications for a new permit must be submitted at least 6 months prior to expiration of this permit. Renewal of the use and occupancy authorized by this permit shall be at the sole discretion of the authorized officer. At a minimum, before renewing the use and occupancy authorized by this permit, the authorized officer shall require that (1) the use and occupancy to be authorized by the new permit is consistent with the standards and guidelines in the applicable land management plan; (2) the type of use and occupancy to be authorized by the new permit is the same as the type of use and occupancy authorized by this permit; and (3) the holder is in compliance with all the terms of this permit. The authorized officer may prescribe new terms and conditions when a new permit is issued.

E. AMENDMENT. This permit may be amended in whole or in part by the Forest Service when, at the discretion of the authorized officer, such action is deemed necessary or desirable to incorporate new terms that may be required by law, regulation, directive, the applicable forest land and resource management plan, or projects and activities implementing a land management plan pursuant to 36 CFR Part 215.

F. COMPLIANCE WITH LAWS, REGULATIONS, AND OTHER LEGAL REQUIREMENTS. In exercising the rights and privileges granted by this permit, the holder shall comply with all present and future federal laws and regulations and all present and future state, county, and municipal laws, regulations, and other legal requirements that apply to the permit area, to the extent they do not conflict with federal law, regulation, or policy. The Forest Service assumes no responsibility for enforcing laws, regulations, and other legal requirements that fall under the jurisdiction of other governmental entities.

G. NON-EXCLUSIVE USE. The use or occupancy authorized by this permit is not exclusive. The Forest Service reserves the right of access to the permit area, including a continuing right of physical entry to the permit area for inspection, monitoring, or any other purpose consistent with any right or obligation of the United States under any law or regulation.

The Forest Service reserves the right to allow others to use the permit area in any way that is not inconsistent with the holder's rights and privileges under this permit, after consultation with all parties involved. Except for any restrictions that the holder and the authorized officer agree are necessary to protect the installation and operation of authorized temporary improvements, the lands and waters covered by this permit shall remain open to the public for all lawful purposes.

H. ASSIGNABILITY. This permit is not assignable or transferable.

I. CHANGE IN CONTROL OF THE BUSINESS ENTITY.

1. Notification of Change in Control. The holder shall notify the authorized officer when a change in control of the business entity that holds this permit is contemplated.

a. In the case of a corporation, control is an interest, beneficial or otherwise, of sufficient outstanding voting securities or capital of the business so as to permit the exercise of managerial authority over the actions and operations of the corporation or election of a majority of the board of directors of the corporation.

b. In the case of a partnership, limited partnership, joint venture, or individual entrepreneurship, control is a beneficial ownership of or interest in the entity or its capital so as to permit the exercise of managerial authority over the actions and operations of the entity.

c. In other circumstances, control is any arrangement under which a third party has the ability to exercise management authority over the actions or operations of the business.

2. Effect of Change in Control. Any change in control of the business entity as defined in paragraph 1 of this clause shall result in termination of this permit. The party acquiring control must submit an application for a special use permit. The Forest Service is not obligated to issue a new permit to the party who acquires control. The authorized officer shall determine whether the applicant meets the requirements established by applicable federal regulations.

J. CONVEYANCE OF LANDS COVERED BY THIS PERMIT. The authorized officer shall give the holder at least 90 days prior written notice of any pending conveyance of the lands covered by this permit. With the holder's consent, the Forest Service may convey the lands covered by this permit without reserving the right-of-way granted by this permit. If the holder does not consent to conveyance without reservation of the right-of-way, the Forest Service may convey the lands covered by this permit only if the lands are subject to the right-of-way granted by this permit.

II. IMPROVEMENTS

A. LIMITATIONS ON USE. LIMITATIONS ON USE. Nothing in this permit gives or implies permission to build or maintain any structure or facility or to conduct any activity, unless specifically authorized by this permit. Any use not specifically authorized by this permit must be proposed in accordance with 36 CFR 251.54. Approval of such a proposal through issuance of a new permit or permit amendment is at the sole discretion of the authorized officer.

B. PLANS. All plans for development, layout, construction, reconstruction, or alteration of improvements in the permit area, as well as revisions to those plans must be prepared by a professional engineer, architect, landscape architect, or other qualified professional based on federal employment standards acceptable to the authorized officer. These plans and plan revisions must have written approval from the authorized officer before they are implemented. The authorized officer may require the holder to furnish as-built plans, maps, or surveys upon completion of the work.

C. CONSTRUCTION. Any construction authorized by this permit shall commence by **September 1, 2010** and shall be completed by **November 30, 2010**.

III. OPERATIONS.

A. PERIOD OF USE. Use or occupancy of the permit area shall be exercised at least **2 days** each year.

B. CONDITION OF OPERATIONS. The holder shall maintain the authorized improvements and permit area to standards of repair, orderliness, neatness, sanitation, and safety acceptable to the authorized officer and consistent with other provisions of this permit. Standards are subject to periodic change by the authorized officer when deemed necessary to meet statutory, regulatory, or policy requirements or to protect national forest resources. The holder shall comply with inspection requirements deemed appropriate by the authorized officer.

C. INSPECTION BY THE FOREST SERVICE. The Forest Service shall monitor the holder's operations and reserves the right to inspect the permit area and transmission facilities at any time for compliance with the terms of this permit. The holder's obligations under this permit are not contingent upon any duty of the Forest Service to inspect the permit area or transmission facilities. A failure by the Forest Service or other governmental officials to inspect is not a justification for noncompliance with any of the terms and conditions of this permit.

IV. RIGHTS AND LIABILITIES

A. LEGAL EFFECT OF THE PERMIT. This permit, which is revocable and terminable, is not a contract or a lease, but rather a federal license. The benefits and requirements conferred by this authorization are reviewable solely under the procedures set forth in 36 CFR Part 251, Subpart C, and 5 U.S.C. 704. This permit does not constitute a contract for purposes of the Contract Disputes Act, 41 U.S.C. 601. The permit is not real property, does not convey any interest in real property, and may not be used as collateral for a loan.

B. VALID OUTSTANDING RIGHTS. This permit is subject to all valid outstanding rights. Valid outstanding rights include those derived under mining and mineral leasing laws of the United States. The United States is not liable to the holder for the exercise of any such right.

C. ABSENCE OF THIRD-PARTY BENEFICIARY RIGHTS. The parties to this permit do not intend to confer any rights on any third party as a beneficiary under this permit.

D. SERVICES NOT PROVIDED. This permit does not provide for the furnishing of road or trail maintenance, water, fire protection, search and rescue, or any other such service by a government agency, utility, association, or individual.

E. RISK OF LOSS. The holder assumes all risk of loss associated with use or occupancy of the permit area, including but not limited to theft, vandalism, fire and any fire-fighting activities (including prescribed burns), avalanches, rising waters, winds, falling limbs or trees, and other forces of nature. If authorized temporary improvements in the permit area are destroyed or substantially damaged, the authorized officer shall conduct an analysis to determine whether the improvements can be safely occupied in the future and whether rebuilding should be allowed. If rebuilding is not allowed, the permit shall terminate.

F. DAMAGE TO UNITED STATES PROPERTY. The holder has an affirmative duty to protect from damage the land, property, and other interests of the United States. Damage includes but is not limited to fire suppression costs, damage to government-owned improvements covered by this permit, and all costs and damages associated with or resulting from the release or threatened release of a hazardous material occurring during or as a result of activities of the holder or the holder's heirs, assigns, agents, employees, contractors, or lessees on, or related to, the lands, property, and other interests covered by this permit. For purposes of clause IV.F and section V, "hazardous material" shall mean (a) any hazardous substance under section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9601(14); (b) any pollutant or contaminant under section 101(33) of CERCLA, 42 U.S.C. § 9601(33); (c) any petroleum product or its derivative, including fuel oil, and waste oils; and (d) any hazardous substance, extremely hazardous substance, toxic substance, hazardous waste, ignitable, reactive or corrosive materials, pollutant, contaminant, element, compound, mixture, solution or substance that may pose a present or potential hazard to human health or the environment under any applicable environmental laws.

1. The holder shall avoid damaging or contaminating the environment, including but not limited to the soil, vegetation (such as trees, shrubs, and grass), surface water, and groundwater, during the holder's use or occupancy of the permit area. If the environment or any government property covered by this permit becomes damaged during the holder's use or occupancy of the permit area, the holder shall immediately repair the damage or replace the damaged items to the satisfaction of the authorized officer and at no expense to the United States.

2. The holder shall be liable for all injury, loss, or damage, including fire suppression, prevention and control of the spread of invasive species, or other costs in connection with rehabilitation or restoration of natural resources associated with the use or occupancy authorized by this permit. Compensation shall include but not be limited to the value of resources damaged or destroyed, the costs of restoration, cleanup, or other mitigation, fire suppression or other types of abatement costs, and all administrative, legal (including attorney's fees), and other costs. Such costs may be deducted from a performance bond required under clause IV.I.

3. The holder shall be liable for damage caused by use of the holder or the holder's heirs, assigns, agents, employees, contractors, or lessees to all roads and trails of the United States to the same extent as provided under clause IV.F.1, except that liability shall not include reasonable and ordinary wear and tear

G. HEALTH, SAFETY, AND ENVIRONMENTAL PROTECTION. The holder shall promptly abate as completely as possible and in compliance with all applicable laws and regulations any activity or condition arising out of or relating to the authorized use or occupancy that causes or threatens to cause a hazard to public health or the safety of the holder's employees or agents or harm to the environment (including areas of vegetation or timber, fish or other wildlife populations, their habitats, or any other natural resources). The holder shall prevent impacts to the environment and cultural resources by implementing actions identified in the operating plan to prevent establishment and spread of invasive species. The holder shall immediately notify the authorized officer of all serious accidents that occur in connection with such activities. The responsibility to protect the health and safety of all persons affected by the use or occupancy authorized by this permit is solely that of the holder. The Forest Service has no duty under the terms of this permit to inspect the permit area or operations and activities of the holder for hazardous conditions or compliance with health and safety standards.

H. INDEMNIFICATION OF THE UNITED STATES. The holder shall indemnify, defend, and hold harmless the United States for any costs, damages, claims, liabilities, and judgments arising from past, present, and future acts or omissions of the holder in connection with the use or occupancy authorized by this permit. This indemnification provision includes but is not limited to acts and omissions of the holder or the holder's heirs, assigns, agents, employees, contractors, or lessees in connection with the use or occupancy authorized by this permit which result in (1) violations of any laws and regulations which are now or which may in the future become applicable, and including but not limited to those environmental laws listed in clause V.A of this permit; (2) judgments, claims, demands, penalties, or fees assessed against the United States; (3) costs, expenses, and damages incurred by the United States; or (4) the release or threatened release of any solid waste, hazardous waste, hazardous materials, pollutant, contaminant, oil in any form, or petroleum product into the environment. The authorized officer may prescribe terms that allow the holder to replace, repair, restore, or otherwise undertake necessary curative actions to mitigate damages in addition to or as an alternative to monetary indemnification.

I. BONDING. The authorized officer may require the holder to furnish a surety bond or other security for any of the obligations imposed by the terms and conditions of this permit or any applicable law, regulation, or order.

1. The holder shall have in force liability insurance covering losses, including those arising from strict liability, associated with the use or occupancy authorized by this permit arising from personal injury or death and third-party property damage in the minimum amount of (self insured) as a combined single limit per occurrence.

2. Depending on the holder's operations, the Forest Service may require the holder to demonstrate the availability of funds to address any release or threatened release of hazardous materials that may occur in connection with the holder's use or occupancy. Any requirements imposed would be established on a case-by-case basis by the authorized officer based on the degree of environmental risk from the holder's operations. The storage and use of normal maintenance supplies in nominal amounts generally would not trigger financial assurance requirements.

J. LOSS OF AUTHORIZED IMPROVEMENTS. If authorized temporary improvements in the permit area are destroyed or substantially damaged, the authorized officer shall conduct an analysis to determine whether the improvements can be safely occupied in the future and whether rebuilding should be allowed. If rebuilding is not allowed, the permit shall terminate.

K. HEALTH, SAFETY, AND ENVIRONMENTAL PROTECTION. The holder shall take all measures necessary to protect the environment, natural resources, and the health and safety of all persons affected by the use and occupancy authorized by this permit. The holder shall promptly abate as completely as possible and in compliance with all applicable laws and regulations any physical or mechanical procedure, activity, event, or condition existing or occurring before, during, or after the term of this permit, and arising out of or relating to any activity, event, or condition existing or occurring during the term of this permit, that causes or threatens to cause a hazard to workers' safety or to public health or safety or harm to the environment (including but not limited to areas of vegetation or timber, fish or other wildlife populations, their habitats, or any other natural resources). The holder shall prevent impacts to the environment and cultural resources by implementing actions identified in the operating plan to prevent establishment and spread of invasive species. The holder shall immediately notify the authorized officer of all serious accidents that occur in connection with such activities. The responsibility to protect the health and safety of all persons affected by the use and occupancy authorized by this permit is solely that of the holder. The Forest Service has no duty under the terms of this permit to inspect the permit area or operations and activities of the holder for hazardous conditions or compliance with health and safety standards.

L. LIABILITY FOR INJURY. As an agency of the United States, the holder is limited by federal law as to the assumption of liability for its acts or omissions. The holder agrees, within its legal limitations and limitations of appropriations, to be responsible for all damages arising from injury to persons or property associated with the use and occupancy authorized by this permit. The holder further agrees, to the extent legally permissible, to use its appropriations and resources as required to pay any claims and to repair damage to the federal lands covered by this permit. The Forest Service is exempt from any burdens, other than administrative costs, which may arise in connection with the use and occupancy authorized by this permit.

V. RESOURCE PROTECTION

A. COMPLIANCE WITH ENVIRONMENTAL LAWS. The holder shall in connection with the use or occupancy authorized by this permit comply with all applicable federal, state, and local environmental laws and regulations, including but not limited to those established pursuant to the Resource Conservation and Recovery Act, as amended, 42 U.S.C. 6901 et seq., the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq., the Oil Pollution Act, as amended, 33 U.S.C. 2701 et seq., the Clean Air Act, as amended, 42 U.S.C. 7401 et seq., CERCLA, as amended, 42 U.S.C. 9601 et seq., the Toxic Substances Control Act, as amended, 15 U.S.C. 2601 et seq., the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, 7 U.S.C. 136 et seq., and the Safe Drinking Water Act, as amended, 42 U.S.C. 300f et seq.

B. VANDALISM. The holder shall take reasonable measures to prevent and discourage vandalism and disorderly conduct and when necessary shall contact the appropriate law enforcement officer.

C. PESTICIDE USE. Pesticides may not be used outside of buildings to control undesirable woody and herbaceous vegetation (including aquatic plants), insects, rodents, fish, and other pests and weeds without prior written approval from the authorized officer. A request for approval of planned uses of pesticides shall be submitted annually by the holder on the due date established by the authorized officer. The report shall cover a 12-month period of planned use beginning 3 months after the reporting date. Information essential for review shall be provided in the form specified. Exceptions to this schedule may be allowed, subject to emergency request and approval, only when unexpected outbreaks of pests or weeds require control measures that were not anticipated at the time an annual report was submitted. Only those materials registered by the U.S. Environmental Protection Agency for the specific purpose planned shall be considered for use on National Forest System lands. Label instructions and all applicable laws and regulations shall be strictly followed in the application of pesticides and disposal of excess materials and containers.

D. ARCHAEOLOGICAL-PALEONTOLOGICAL DISCOVERIES. The holder shall immediately notify the authorized officer of all antiquities or other objects of historic or scientific interest, including but not limited to historic or prehistoric ruins, fossils, or artifacts discovered in connection with the use and occupancy authorized by this permit. The holder shall leave these discoveries intact and in place until directed otherwise by the authorized officer. Protective and mitigative measures specified by the authorized officer shall be the responsibility of the holder.

E. NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION. In accordance with 25 U.S.C. 3002(d) and 43 CFR 10.4, if the holder inadvertently discovers human remains, funerary objects, sacred objects, or objects of cultural patrimony on National Forest System lands, the holder shall immediately cease work in the area of the discovery and shall make a reasonable effort to protect and secure the items. The holder shall immediately notify the authorized officer by telephone of the discovery and shall follow up with written confirmation of the discovery. The activity that resulted in the inadvertent discovery may not resume until 30 days after the authorized officer certifies receipt of the written confirmation, if resumption of the activity is otherwise lawful, or at any time if a binding written agreement has been executed between the Forest Service and the affiliated Indian tribes that adopts a recovery plan for the human remains and objects.

F. PROTECTION OF HABITAT OF THREATENED, ENDANGERED, AND SENSITIVE SPECIES. The location of sites within the permit area needing special measures for protection of plants or animals listed as threatened or endangered under the Endangered Species Act (ESA) of 1973, 16 U.S.C. 1531 et seq., as amended, or identified as sensitive or otherwise requiring special protection by the Regional Forester under Forest Service Manual (FSM) 2670, pursuant to consultation conducted under section 7 of the ESA, may be shown on the ground or on a separate map. The map shall be attached to this permit as an appendix. The holder shall take any protective and mitigative measures specified by the authorized officer. If protective and mitigative measures prove inadequate, if other sites within the permit area containing threatened, endangered, or sensitive species or species otherwise requiring special protection are discovered, or if new species are listed as threatened or endangered under the ESA or identified as sensitive or otherwise requiring special protection by the Regional Forester under the FSM, the authorized officer may specify additional protective and mitigative measures. Discovery of these sites by the holder or the Forest Service shall be promptly reported to the other party.

G. CONSENT TO STORE HAZARDOUS MATERIALS. The holder shall not store any hazardous materials at the site without prior written approval from the authorized officer. This approval shall not be unreasonably withheld. If the authorized officer provides approval, this permit shall include, or in the case of approval provided after this permit is issued, shall be amended to include specific terms addressing the storage of hazardous materials, including the specific type of materials to be stored, the volume, the type of storage, and a spill plan. Such terms shall be proposed by the holder and are subject to approval by the authorized officer.

H. CLEANUP AND REMEDIATION

1. The holder shall immediately notify all appropriate response authorities, including the National Response Center and the authorized officer or the authorized officer's designated representative, of any oil discharge or of the release of a hazardous material in the permit area in an amount greater than or equal to its reportable quantity, in accordance with 33 CFR Part 153, Subpart B, and 40 CFR Part 302. For the purposes of this requirement, "oil" is as defined by section 311(a)(1) of the Clean Water Act, 33 U.S.C. 1321(a)(1). The holder shall immediately notify the authorized officer or the authorized officer's designated representative of any release or threatened release of any hazardous material in or near the permit area which may be harmful to public health or welfare or which may adversely affect natural resources on federal lands.

2. Except with respect to any federally permitted release as that term is defined under Section 101(10) of CERCLA, 42 U.S.C. 9601(10), the holder shall clean up or otherwise remediate any release, threat of release, or discharge of hazardous materials that occurs either in the permit area or in connection with the holder's activities in the permit area, regardless of whether those activities are authorized under this permit. The holder shall perform cleanup or remediation immediately upon discovery of the release, threat of release, or discharge of hazardous materials. The holder shall perform the cleanup or remediation to the satisfaction of the authorized officer and at no expense to the United States. Upon revocation or termination of this permit, the holder shall deliver the site to the Forest Service free and clear of contamination.

I. CERTIFICATION UPON REVOCATION OR TERMINATION. If the holder uses or stores hazardous materials at the site, upon revocation or termination of this permit the holder shall provide the Forest Service with a report certified by a professional or professionals acceptable to the Forest Service that the permit area is uncontaminated by the presence of hazardous materials and that there has not been a release or discharge of hazardous materials upon the permit area, into surface water at or near the permit area, or into groundwater below the permit area during the term of the permit. This certification requirement may be waived by the authorized officer when the Forest Service determines that the risks posed by the hazardous material are minimal. If a release or discharge has occurred, the professional or professionals shall document and certify that the release or discharge has been fully remediated and that the permit area is in compliance with all federal, state, and local laws and regulations.

VI. REVOCATION, SUSPENSION, AND TERMINATION

A. REVOCATION AND SUSPENSION. The authorized officer may not revoke or suspend this permit without the consent of the head of the agency that holds this permit.

C. APPEALS AND REMEDIES. Written decisions by the authorized officer relating to administration of this permit are subject to administrative appeal pursuant to 36 CFR Part 251, Subpart C, as amended. Revocation or suspension of this permit shall not give rise to any claim for damages by the holder against the Forest Service.

D. TERMINATION. This permit shall terminate when by its terms a fixed or agreed upon condition, event, or time occurs without any action by the authorized officer. Examples include but are not limited to expiration of the permit by its terms on a specified date and termination upon change of control of the business entity. Termination of this permit shall not require notice, a decision document, or any environmental analysis or other documentation. Termination of this permit is not subject to administrative appeal and shall not give rise to any claim for damages by the holder against the Forest Service.

E. RIGHTS AND RESPONSIBILITIES UPON REVOCATION OR TERMINATION WITHOUT RENEWAL. Upon revocation or termination of this permit without renewal of the authorized use, the holder shall remove within a reasonable period prescribed by the authorized officer all structures and improvements installed by the holder in the permit area and shall restore the site to the satisfaction of the authorized officer.

VII. MISCELLANEOUS PROVISIONS

A. MEMBERS OF CONGRESS. No member of or delegate to Congress or resident commissioner shall benefit from this permit either directly or indirectly, except to the extent the authorized use provides a general benefit to a corporation.

B. CURRENT ADDRESSES. The holder and the Forest Service shall keep each other informed of current mailing addresses, including those necessary for billing and payment of land use fees.

C. SUPERIOR CLAUSES. If there is a conflict between any of the preceding printed clauses and any of the following clauses, the preceding printed clauses shall control.

This permit is accepted subject to the conditions set out above.

HOLDER: Salt River Project

By: Sandra D. Byra
Sandra D. Byra

Title: Manager Land Department

Date: 8/17/10

U.S. DEPARTMENT OF AGRICULTURE
Forest Service

By: Gene Blankenbaker
GENE BLANKENBAKER

Title: **Forest Supervisor**

Date: 8/16/10

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond, to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0596-0082. The time required to complete this information collection is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and, where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call toll free (866) 632-9992 (voice). TDD users can contact USDA through local relay or the Federal relay at (800) 877-8339 (TDD) or (866) 377-8642 (relay voice). USDA is an equal opportunity provider and employer.

The Privacy Act of 1974 (5 U.S.C. 552a) and the Freedom of Information Act (5 U.S.C. 552) govern the confidentiality to be provided for information received by the Forest Service.

Appendix A

Lime Creek Fish Barrier

Project Description

The proposed site is located at the lower end of a 500-ft long exposed bedrock stream channel (see attached map). The bedrock consists of granite porphyry and would be used as the base and abutments for the proposed barrier. This bedrock would allow for secure anchoring of the structure and eliminate channel migration that could compromise the barrier. The stream channel at the site is narrow, with a width of 5 ft at the water surface/base and widening to about 22 ft at 4 ft above ground. An existing bedrock chute provides a high velocity section below the proposed fish barrier site, which improves its effectiveness to prevent upstream movement of nonnative fish.

Barrier Design

The barrier would be comprised of reinforced concrete (approximately 5 cubic yards) anchored into the existing bedrock. It is designed to accommodate low and high flows, including a 100-year frequency flood of 14,900 cfs. The concrete would be colored to match the existing bedrock thereby minimizing the visual impact of the barrier. To inhibit crayfish movement no texture would be applied to the downstream face of the barrier. To date no crayfish have been detected above the proposed barrier location.

The barrier would be approximately 5 ft wide at the base and widening to about 22 ft at its top. The barrier would be constructed at a height which provides for a 4 ft drop on the downstream side. The top of the barrier would include a low flow notch. The low flow notch would be large enough to accommodate the normal daily flows of Lime Creek. The barrier would be attached to the bedrock with anchor bars that are molded into the concrete and grouted into holes drilled in the bedrock. To properly accommodate the barrier's anchors, approximately 42 linear feet of holes would be drilled in the bedrock. Additionally, about 0.15 cubic yards of bedrock would be excavated as a minimal foundation cleanup for the barrier and deposited on the upstream side of the proposed barrier within the stream channel, where sediment from upstream would accumulate once construction was complete.

Construction Access

Overland access to the site is limited. An existing USFS road (FR1530, level 2 designation) provides 4x4 high-clearance vehicle and off-highway vehicle (OHVs) access from the Horseshoe Dam road (FR 205, a maintained road) to the Lime Creek floodplain approximately 1.75 mile downstream of the barrier site. From the end of the FR1530 road, the construction crew would hike to the barrier site. To minimize disturbance, construction materials and equipment would be flown to the barrier site using a helicopter.

Aircraft access

A helicopter would be used to transport equipment, supplies, and concrete for construction purposes. All equipment and supplies would be "long-lined" from the SRP field house to the construction site (Figure 1). The helicopter would not land at the barrier construction site. The supplies and equipment would be placed in a designated staging area at the barrier site (see contractor use area).

The helicopter would be used at least three times during construction: 1) at the onset of the project to transport supplies, materials, and equipment to the site; 2) during construction to transport concrete (approximate eight trips); and 3) at the end of the project to transport material out of the site. Dust abatement would be provided at the field house.

In addition, an emergency landing spot would be designated near the construction site for evacuation of injured personnel. The emergency extraction site would be located downstream of the construction site on a hilltop that allows safe helicopter landing. Only in the case of emergency, vegetation (1 ocotillo, 3 - 4 palo verde, 1 hopbush, and 1 jojoba) would be trimmed with hand tools to allow safe landing and takeoff.

Vehicle access
An existing two track road (FR1530) begins at the Horseshoe Dam road and ends approximately 1.75 mi downstream from the proposed barrier site. This road is currently designated as open for all vehicles (USFS 2009). FR1530 would serve as worker access using high clearance vehicles or OHVs and require little to no repairs. If necessary, minor repairs would be made to the road (e.g., filling in washouts or large ruts) but any such actions would be limited to the existing road prism and the use of hand tools. Along FR1530, endangered Arizona cliff rose (*Purshia subintegra*) would be flagged to protect this plant species from damage.

Pedestrian access
Construction personnel would access the site by hiking from the end of FR1530 where the road terminates at Lime Creek. Recreation trails are absent in this area; thus, the crew would hike up the creek to the barrier construction site.

Construction staging area
A staging area would be delineated at the construction site for the storage of supplies and materials. The staging area (20 x 30 ft) would be located approximately 50 ft downstream of the barrier site on a terrace above the flood prone area of the creek. The area has sandy substrates and is surrounded by bedrock. No vegetation clearing or grading in this area would be required.

Other construction materials, such as those needed early in construction could be placed by long-line at the barrier site on the bedrock. Although the majority of concrete would be flown into the site premixed and poured into forms, any bags of concrete stored at the staging area would be protected from precipitation to prevent hardening prior to placement. Precision placement by helicopter sling line eliminates the need for clearing near terraces. All construction materials and debris not part of the completed barrier would be removed from the job site.

Camping area

The contractor may chose to camp along the FR1530 road to reduce the daily travel time to the construction site. The crew camp would be placed along the FS1530 road in a previously disturbed area that has been used by recreational campers (Figure 1). The camping area would be delineated with flagging to avoid impacts to cultural resources. The contractor would coordinate other camping requirements and restrictions (e.g., fire restrictions) with the Cave Creek Ranger District. At the completion of the project, the area would be reseeded with native grass seed mix.

Construction Methods and Materials

Construction would be accomplished with small portable tools powered by an onsite air compressor or generator. A small coffer dam may be constructed upstream of the barrier site using sandbags or other similar materials, and stream flow may be temporarily piped downstream of the barrier to maintain a dry construction area. The construction crew would employ typical methods for building a concrete structure (USBR 2009). Concrete would be batched at or delivered to the SRP field house, and flown by helicopter to the construction site once the forms have been set. Remaining materials and equipment would be removed from the site once construction is completed.

Approximately 5,000 gallons of water would be used to complete the project. Water (2,500 gallons) would be used at the barrier site for construction (e.g., cleaning the foundation and mixing grout).

The water supply would be taken from the creek (if surface flow is available) or flown to the site with other materials. An additional 2,500 gallons would be used for dust control at the SRP field house during helicopter use. A water truck would draw the water from the Verde River or Horseshoe Reservoir.

Construction Timing

The barrier would be constructed between September and November and take approximately 30 to 45 days to complete. The timing of construction, during late fall after monsoon rains, minimizes the risk of flooding and avoids the migratory bird breeding period (spring-summer).

Aquatic Species Conservation Measures

In September 2009, the barrier site was dry, thus no impacts to aquatic species would be expected to occur. However, surface water has been present in the past and could be present during construction. Conservation measures are described and would be implemented if fish or other aquatic organisms were present during construction. Block nets would be placed approximately 150 ft upstream and downstream of the project site to isolate the project site and prevent fish from moving into the construction area. The area inside the block nets would be thoroughly sampled using various gear types (electroshocking unit, dipnets, and seines) prior to construction. Captured native fish and frogs would be moved upstream of the project site above the block net. If heavy precipitation occurs during the construction period, which compromises the block net, construction would cease until the area can be re-sampled, fishes moved, and block nets repositioned.

Fish Barrier Monitoring and Maintenance

The Special Use Permit requires SRP to monitor and maintain the barrier for the term of the ITP Regular monitoring of the barrier's integrity and condition would occur no less than 1 time in any 5-year period by SRP. Access to the site would be the same as for the construction crews (i.e., OHV on the FS1530 road and hike to the barrier site). Road repairs to improve access would be minimized and restricted as described above. Additional monitoring of the barrier by SRP would occur if there were extremely high stream flows in the creek, and/or if SRP received information from USFS or another agency of structural problems with the barrier.

SRP would maintain the condition of the barrier. Maintenance includes activities that are necessary to maintain the effectiveness of the barrier, but do not increase the footprint of the barrier or cause temporary impacts greater than those described for construction.

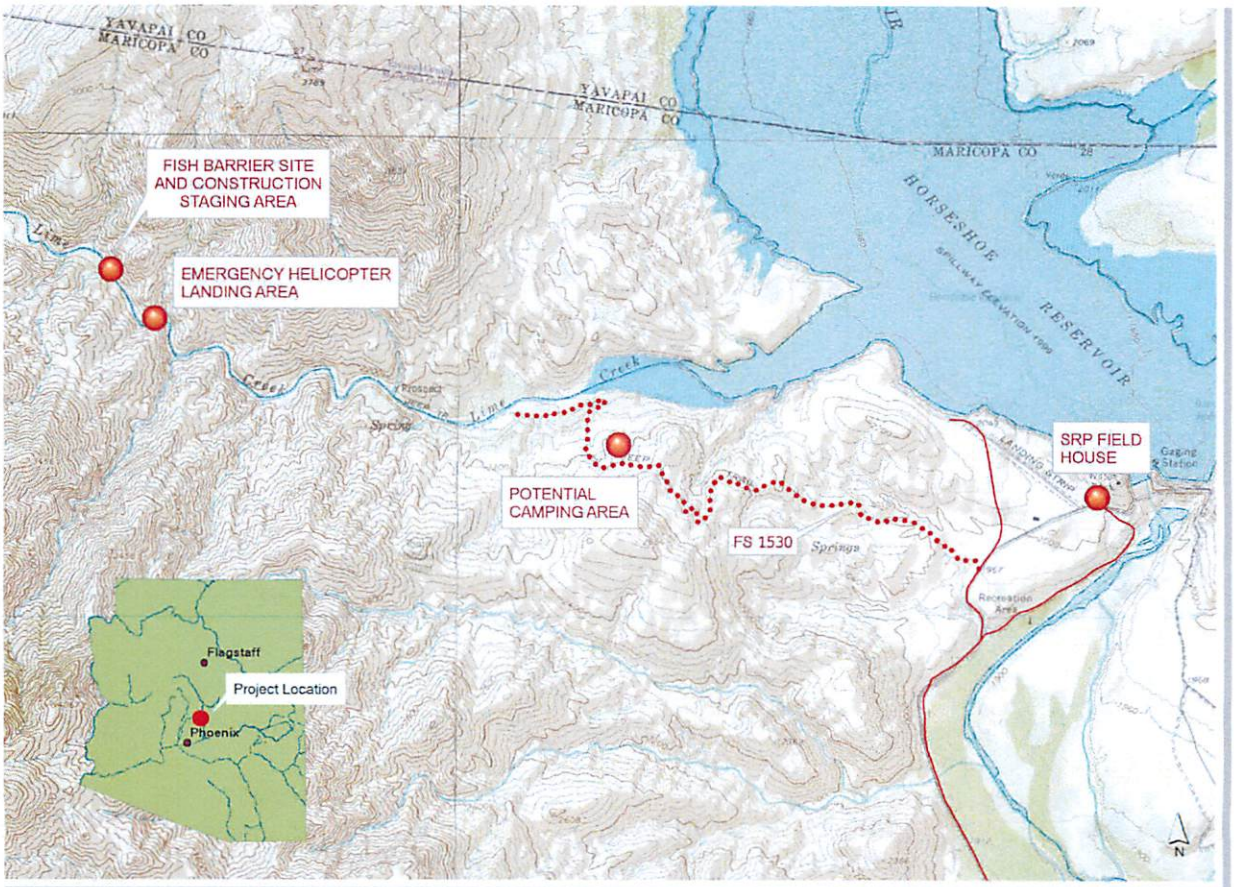
If repairs are necessary, the same mitigation and avoidance measures as described above and in Section 3.3 would be implemented (e.g., material flown to the site, sensitive aquatic and plant species protected, and culture sites avoided). Maintenance actions may include, but are not limited to patching and repairing cement, and/or re-anchoring the barrier. Any maintenance activities of the barrier by SRP must first be approved by the Forest Service and will be identified in the SUP.

Mitigation Measures

To avoid or minimize potential impacts of the proposed action on the environment, the following measures were incorporated into the proposed action:

- To reduce the visual impact of the barrier, it would be constructed of colored concrete to match the existing rock surface.
- To minimize surface disturbance, helicopter operations would be employed to "long-line" equipment to the construction site. The helicopter would not land on site and the equipment would be placed in a designated laydown area or on exposed bedrock terraces.
- To minimize impact to the site and avian species, construction activities would occur between September and November, during the low flow period and outside of the spring/summer migratory bird nesting season.
- To minimize disturbance to the environment, vehicles would be limited to existing road surfaces. Although not anticipated, if repairs to the FR1530 are necessary, actions would be conducted with hand tools and would be limited to the existing roadway. No heavy equipment would be used.
- The contractor may elect to camp within a designated location along FR1530. The area would be delineated to protect cultural resources. The contractor would coordinate other requirements and restrictions (e.g., fire restrictions) prior to camping. The camping area would be seeded with a weed-free native grass seed mix.
- All equipment that may be carrying seeds or appears muddy/dirty would be washed prior to its transportation to the construction site. Any erosion control measures (hay bales, etc.) would be weed-free.
- The immediate area on both sides of FR1530 would be surveyed for Arizona cliffrose prior to construction activities. Any cliffrose that are located would be flagged and construction crews given instructions to avoid harming the plants.
- Prior to construction activities, fish netting would be placed above and below the barrier site. All native fish and frogs would then be captured and moved upstream of the construction site. If there is a breach of the nets during construction, activities would cease until the nets were reestablished, the barrier site was sampled for fish and frogs, and individuals were relocated upstream.
- Lubricants and fuel would be stored only in areas not subject to inundation during high flows. These materials would be stored in temporary, clearly marked, above-ground containers that would provide for secondary containment. Any spills would be corrected immediately in accordance with state and federal regulations.
- Construction personnel would coordinate with the Cave Creek Ranger District regarding fire precautions and shall observe all posted fire restrictions and closures.
- Steps would be taken to prevent contact between stream flow and barrier concrete until the concrete cures and curing agents have evaporated.
- At the completion of construction, all unused materials, supplies, and construction debris would be removed from the site.

Appendix B



LIME CREEK FISH BARRIER

SRP C&GISS 02.26.10 LimeCreek_Barrier.MXD

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APPROVED IN ACCORDANCE WITH SPECIAL USE PERMIT DATED _____

K. Blanchard FOREST SUPERVISOR 2/16/10

Signed Title Date

TONTO NATIONAL FOREST

Salt River Project Lime Creek Fish Barrier
Approximately 0.1 acre

T.8 N., R.6 E., Section 31, G&SRM.

CAVE CREEK RANGER DISTRICT
TONTO NATIONAL FOREST
MARICOPA COUNTY ARIZONA

Longfin dace captured from barrier site and relocated downstream; placement of block netting prior to construction.

Mobilization and transport of supplies and equipment from SRP Horseshoe Dam fieldhouse to barrier site.

Placing supplies and equipment at barrier site; crew camp; and temporary diversion dam used to dewater construction site.

NAC Construction drilling 30” rebar anchors, saw cutting bedrock, & building rebar structure and form.

Barrier site during construction, completed form with concrete bucket platform, SRP flight operation transporting first load of concrete.

Concrete being delivered to site; pouring concrete into form.

Completed barrier – from left: Nate Turner (SRP Inspector); NAC Crew: David Kay (Foreman), Joaquin Ortiz, Paul Zale, Heath Edwards, Travis Whelan; Chuck Paradzick (SRP, Project Manager).

Lime Creek fish barrier - completed Nov 4, 2010. Andre Silva, USFS.

Close up of the fish barrier, Chuck Paradzick.