Testing of Golf Course Ponds at Page, Arizona for Suitability as Grow-Out Facility for Razorback Sucker Using Surplus Fish from Ouray National Fish Hatchery

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Prepared in Cooperation with National Park Service,
U.S. Fish and Wildlife Service,
and Utah Division of Wildlife Resources

U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Testing of Golf Course Ponds at Page, Arizona for Suitability as Grow-Out Facility for Razorback Sucker Using Surplus Fish from Ouray National Fish Hatchery

by

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SUMMARY

Razorback suckers were stocked and successfully reared in ponds at the Lake Powell National Golf Course. The fish originated from stock that were hatched in 1993 at the Ouray National Fish Hatchery located in Vernal, Utah. Fish were stocked at numbers low enough that feeding and other hatchery associated maintenance was not necessary. Occasionally some fish were captured to monitor growth and overall condition and water parameter data was also collected. Mortality was minimal and suckers grew from an average length of less than 115 mm to nearly 360 mm in 12 months.

Water quality was generally good, however, under certain conditions dissolved oxygen and possibly pH could be considered marginal. Water conditions could worsen and possibly prove fatal to fish if the water supply or aeration system failed for any length of time. However, these same concerns and problems exist at hatchery facilities. Some mortality should be expected but inexpensive steps could be taken to safeguard fish health. If the conditions we witnessed continue, the ponds could prove to be an effective, low cost alternative to more expensive, hatchery rearing facilities. We estimate that 300-500, 30 cm fish could be raised per year. The project also provides an excellent opportunity for public education, student programs and volunteerism on endangered fish and other environmental programs.

We recommend the National Park Service and Fish and Wildlife Service take the lead to determine if a formalized agreement could be developed with Lake Powell National Golf Course for the purpose of rearing endangered fish. If such an agreement could be developed, other agencies, such as FWS, Utah Department of Natural Resources, Arizona Game and Fish Department, and the Navaho Nation may also be interested in participating.

INTRODUCTION

The razorback sucker *(Xyrauchen texanus)* is in serious decline throughout the Colorado River Basin. Restoring fish numbers in their former range is a major objective currently being attempted in both upper and lower basins. The availability of wild fish for brood stock is limited in the upper basin. Larval collection techniques have been developed which allow for the collection, identification, and sorting of razorback sucker larvae in the field (Muth and Wick 1997). It was our hope that wild larvae could be captured and reared in low cost facilities for further propagation and research needs. Golf course or similar municipal ponds could meet those needs.

During the past two decades, literally millions of small razorback suckers have been stocked in the wild resulting in little or no survival. Studies have identified that predation is a serious problem (Marsh and Brooks 1989). Exotic fish control is costly and thought to be impractical or unnecessary by many. Survival of stocked razorback suckers can be improved by rearing and stocking larger fish. During the past few years, larger fish have been stocked in both riverine and reservoir habitats that have survived (Ryder 1997, Marsh 1997). The stocking philosophy has shifted from one of stocking thousands of small fish, to stocking fewer, but larger fish (Mueller 1995, Ryder 1997). Hatcheries can produce unlimited numbers of fish, however, the primary problem in meeting stocking criteria is finding the pond space necessary to produce adequate numbers of large fish. Existing hatcheries are at, or exceed, designed capacities and funding simply isn't available to construct new rearing facilities.

The Native Fish Work Group, Bureau of Reclamation (NFWG BOR) and Fish and Wildlife Service (FWS) started to explore the use of golf course ponds as alternate rearing sites for razorback suckers several years ago. Agreements have been formalized among those agencies which allow biologists access to golf course ponds. The program has been quite successful. Not only are fish being reared cheaply, but municipalities and the public have become more involved in recovering these fish.

The Endangered Fish Species in the Upper Colorado River basin and the San Juan Recovery Program have identified and designed augmentation programs (USFWS 1992, USFWS 1994, Ryder 1997). These programs have acknowledged increased survival by stocking larger fish. The stocking criteria specified in the draft augmentation plan for the San Juan River sets a stocking size of at least 40 cm. The plan acknowledges that neither funding nor rearing space is presently available to meet production goals. Municipal ponds could be used to help reach these goals.

Methods and Results

The Lake Powell National Golf Course (LPNGC) facility is owned and operated by the city of Page, Arizona. The course is located along the Colorado River rim along Highway 89. Landscaping included the construction of two small ponds (1.1 and 2.3 acres) that not only

represent ball traps but also serve as irrigation reservoirs. The ponds are interconnected by underground pipe. Water suppling the ponds is a mixture of water coming from Lake Powell and the cities treated waste water plant. A pumping facility is located adjacent to the northern pond which pumps water to a sprinkler irrigation system. The ponds have a total surface area of approximately 3.4 acres and are a little more than 2 meters in depth. They each have plastic liners and are equipped with spray aerators.

Fish were stocked into the southern pond on May 16, 1996. Monitoring or sampling was integrated and supported by other activities in the area. Fish were collected by seine and by trammel net. Water parameters were measured using a hydrolab.

Water Quality Measurements In general, water quality was fairly good. Parameters did have some significant, but expected shifts, dependent upon season, irrigation demand, and the volume and source of water. The aeration system is probably critical to the fish's survival during the summer months. It contributed to water column mixing and has a significant influence on dissolved oxygen levels. Vertical measurements taken during the summer suggests that some stratification occurs near the pond's bottom. Here DO concentrations dropped to 2.7 mg/l which probably represents the lowest detection range of the equipment used. Observed temperatures ranged from 12.1 to 26.2 degrees C. Conductance varied between 946 to 1364 umohm/cm and pH ranged from 7.8 to 9.3. Surface and mid-water column concentrations were always above 5.0 mg/L and normally nearer 8 to 10 mg/L. Data is provided in the Appendix.

Fish On May 16, 1996, the pond was stocked with 296 razorback suckers that were raised from Green River brood stock in 1993. These fish had been designated as surplus and held in high concentrations which slowed growth and development. Their average length was 115 mm and they weighted 17 grams.

In July, the ponds were partially drained for maintenance reasons. The ponds were drawn down to less than a meter depth and floating algae covered about 50 percent of the surface. Several dead suckers were observed. Twenty-four fish were captured using a 15-m seine. Their average length was 194 mm (Table 1). It was discovered that fish had moved into the northern pond, apparently though the adjoining pipe. We also collected numbers of tiger salamander newts.

We attempted and had difficulty capturing fish in early March of 1997. Water temperatures were still cool and fish were dormant and not active. Eleven of the fish captured in trammel nets averaged 350 mm. Efforts were made again in early May which produced more than 130 fish. Fish were quite active at that time and were easily caught with trammel nets. None of the fish exhibited any sexual dimorphism which would be characteristic of active spawners. A subsample of 82 fish averaged 359 mm in length and an average weight of 641 grams. The range of lengths and weights were pronounced (Table 1, Figure 1).

Table 1. Length and weight averages and ranges of razorback suckers grown in the Lake Powell National Golf Course.

	Number	Avg. Length (mm)	(Range)	Avg. Weight (grams)	(Range)
May 16, 1996	296	115	--------	17	-------
July 3, 1996	24	194	(152-244)	84	(38-168)
March 4, 1997	11	347	(300-375)	-----	-------
May 2, 1997	82	358	(315-440)	641	(410-1,270)
August 19, 1997	7	383	(360-412)	645	(516-832)

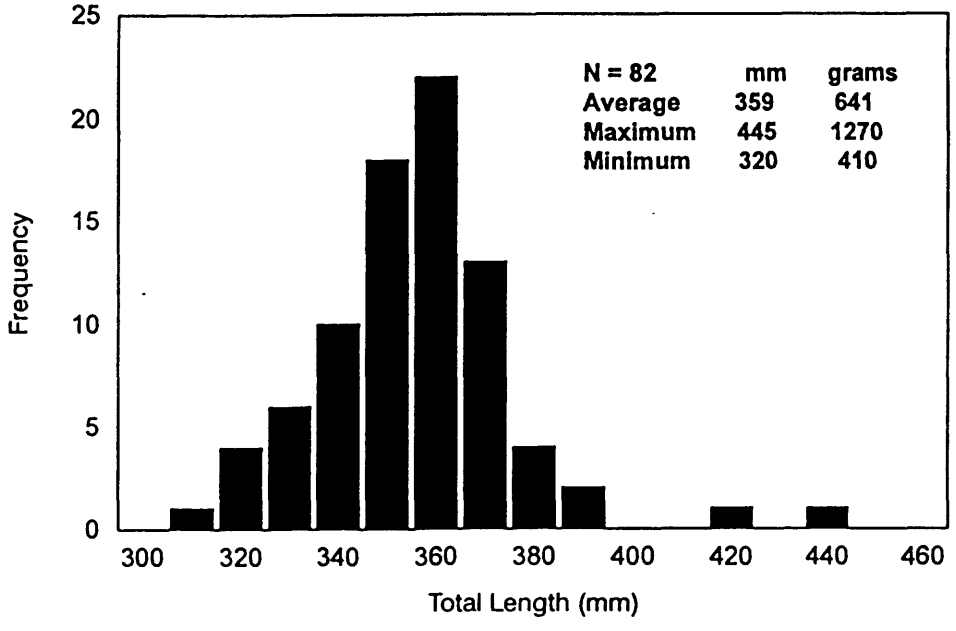

Figure 1. Length distribution of razorback suckers collected from the Lake Powell National Golf Course Ponds on May 2, 1997.

Our last fish collection was taken August 19th. It was quite warm and we were concerned about leaving nets set for any length of time that might stress or kill fish. A trammel net was set for 2-15 minute periods which captured seven suckers. They were in good condition, no external parasites were found and they averaged 383 mm and 645 grams. The August sample was small (7), however, if it is indicative of the entire population, it suggests little growth occurred since May. From our captures in May 1997, we estimate the ponds probably still contain over 150 fish.

DISCUSSION

The razorback suckers prospered and grew rapidly in the golf course ponds. They survived one winter and two summer seasons. Fish grew on average from 115 to 383 mm in a 15 month period. A health inspection proved the fish to be healthy, absent of tapeworm or external parasites, and fish had good visceral fat deposits. Occasionally, a dead fish was observed but survival appears to be high. In May, we captured more than 130 of the initial 296 fish with very little effort.

Not enough information is available for us to calculate the carrying capacity of the ponds. However, we can speculate that it's probably somewhere between 300 and 500 kilograms of fish (a 30-cm fish = 1 kg). Production levels could be increased by supplemental feeding. Either way, fish could be reared economically. Better methods of recapturing fish that might reduce fish stress and effort should be examined. Trap or fyke nets are being successfully used on Lake Mohave and Boulder City golf course ponds.

Under the environmental conditions which occurred these past few months razorback suckers grew rapidly. Survival was the ultimate test and the experimental phase is now ended. We recommend that NPS, FWS and the City of Page consider developing a fish rearing program which includes a strong public information/involvement element.

The primary question we confront you with, is: "How can the razorback benefit from this test?" They're a lot of possible options, some of which have already been implemented. There is a critical need for rearing space to raise these and other endangered fish to a size that insures their survival.

We would suggest that some type of management plan be developed that addresses this, and possibly other questions. The plan should be comprehensive, but flexible in identifying and prioritizing specific goals, production numbers, different stocking locations, several possible sources of young fish, and projected schedules. We believe the existing MOA and Lake Powell Fish Management Plan provides the vehicles for NPS and Utah Department of Natural Resources

(UDNR) to develop specific population goals for an adult razorback sucker population within Lake Powell.

Discussions thus far have dealt with stocking fish directly into Lake Powell. However, there are opportunities elsewhere. Reared fish could also be used by the San Juan Recovery Implementation Program to meet their recovery goals and there might be opportunities to stock fish below Glen Canyon Dam. These scenarios would not require a Utah entry permit and the associated sacrifice of 50 fish for health certification.

Potential Problems

Fish Losses To our knowledge, the fish did not cause any inconveniences to golf course personnel. Routine maintenance of the ponds and course met the fishes biological needs. While this is all good news, we must caution that it only covers a 16 mouth period. Problems with disease and equipment failure can easily occur and some degree of mortality must be expected There is always the potential of problems which can lead to fish die offs. Lawn chemicals can enter the ponds by heavy rains, water supplies can be interrupted, aerators can break or be shut off accidently, are all actions that can result in fish dying. These potential problems must be recognized, guarded against, and when they occur, must be accepted as part of aquaculture. A close working alliance needs to be fostered with professional fish culturists to minimize potential problems and insure that steps are taken to corrections problems when they arise.

Small Fish Restrictions The method in which these ponds are used as an irrigation reservoir restricts their use as larval or small fish rearing ponds. Fish less than 100 mm should not be stocked. We estimate that during the summer, possibly 25-35% of the ponds volume is pumped out daily for irrigation demands. We're not certain if the pump intakes are screened or if there is some type of filtering system. If there are screens, they're probably fairly large to reduce plugging. There is the potential that larvae or small fish could not only be lost through the pumps, but there isn't a filtering system they could also plug irrigation nozzles and valves.

The suckers that are currently in the pond are four years old and reaching sexual maturity. It is quite possible these fish will spawn this coming spring. If they do, the resulting larval suckers could cause the problems previously described.

Algae Control There is an obvious alga problem which is experienced at nearly all municipal ponds. Floating mats of algae collect along shore, are unsightly, and can clog circulation or irrigation systems. There has been some discussion about controlling this algae by stocking white amur (grass carp) or tilapia, two fish used for aquatic weed control. Unfortunately, these fish normally only feed on stemmed plants. Only in a few instances, where fish were near starvation, has it been shown that they feed on algae. Algal growth is a similar problem at the Boulder City golf course. There algal mats are removed manually using rakes.

Stocking Opportunities for the Razorback Sucker

Augmentation of Reservoir Populations Lake Powell impounds water from both the Colorado and the San Juan Rivers. Both these areas contain habitats suitable to sustain adult population. Information collected from the San Juan studies suggest that the establishment of reservoir populations would also result in sucker migrating further upstream in more natural habitats.

-San Juan Inflow Area-The stocking of either the inflow area or upper reaches of the San Juan River would increase the occurrence of razorback suckers inside the Park. There have been discussions concerning the reestablishment or expansion of an adult razorback sucker population in the San Juan Arm of Lake Powell. The inflow area was actually the location where San Juan razorback suckers were last collected for brood stock in 1991 (Stangl 1993). To our knowledge, no wild fish have been captured in the past six years.

A Memorandum of Agreement was developed between National Parks Service, Fish and Wildlife Service, and Utah Department of Natural Resources in 1996. The agreement identified that surplus production of razorbacks from the upper basin RIP could be stocked into a designated critical habitat (San Juan Arm) of Lake Powell. The agreement does not specifically include the golf course ponds, only the disposition of surplus fish. Although a Memorandum of Agreement exists, the administrative process to move fish back into Lake Powell from the golf course ponds is complex and involves the issuance of four special use permits. State health certification required to bring fish into Utah, requires the sacrifice of a minimum of 50 fish for inspection.

Recent telemetry studies have shown that sucker stocked in either the reservoir or river could travel significant distances and intermix (Ryder 1997, Mueller and Wydoski 1995, Karp and Mueller 1996). If a goal of augmenting the reservoir population was developed separately from the RIP, the expansion of reservoir numbers could also benefit San Jan RIP goals. Some fish stocking further upstream would undoubtedly be lost as some fish migrated into the reservoir. These numbers could be offset by establishing reservoir populations which would also migrate upstream. There is information that suggests that in some instances the inflow area might actually provide adults a refuge from high turbid flood flows (Karp and Mueller unpublished data).

The San Juan RIP recently released a draft augmentation plan that calls for the introduction of several thousand, large razorback suckers (Ryder 1997). Stocking criteria identifies the use of fish propagated from upper basin brood stocks or suckers naturally spawned in Lake Mohave. Regardless, of whether fish are stocked in the reservoir or further upstream, the end result will undoubtedly be more razorback suckers in Lake Powell.

-Colorado River Inflow Area- In the early to mid-1980, several razorback suckers were captured near the confluence with the Dirty Devil River (Stangl 1993). Some of these fish were emitting gametes at the time of capture. During the past 10 years, we are not aware of any coordinated, nor large scale efforts to collect razorback suckers in the Colorado inflow area. Biologists have sampled shoreline habitats using seines to capture juvenile Colorado squawfish. Juvenile

razorback suckers may not utilize these same barren shoreline habitats. Information gained this year suggests juvenile suckers prefer to hide in extensive vegetative cover where seining would not be effective.

Sampling further upstream in Canyonlands National Park has resulted in the collection of more than a hundred larvae and one juvenile razorback sucker. It is quite possible razorback suckers reside in the immense and remote areas of the upper reservoir. The shallow, flooded habitats found in Farley and White Canyons appear physically similar to habitats used by juveniles and adults elsewhere. Quite possibly these and other canyons or flooded areas in Colorado River inflow area continues to support remnant numbers of suckers.

Some researchers suspect that razorback suckers may be imprinted to natal spawning areas. If so, these fish would return to those areas upon reaching sexual maturity (Wick 1997). The capture and rearing of naturally spawned razorback sucker larvae would provide researchers the opportunity to test this hypothesis. If this type of research was conducted and proved successful, it might lead to the discovery of additional spawning groups and areas.

As in the San Juan inflow area, the establishment or augmentation of a population of adult razorback suckers would benefit the species. There appears to be ample habitat and the presence of increased numbers might lead to upstream migration and the reestablishment or expansion of riverine populations.

Augmentation of Riverine Populations

-San Juan River--The golf course ponds could be used to grow larger fish to support recovery in river reaches in- and outside of the Glen Canyon National Park. As discussed earlier, the San Juan RIP has set goals of stocking 40 cm fish, however, they have acknowledged they currently do not have the resources necessary to achieve that goal. Fish reared at the golf course ponds could be directed at those objectives. One possible side benefit in not releasing fish in Utah is the required sacrifice of 50 or more suckers for an entry permit. The San Juan plan involves stocking fish near Farmington, N.M.. It's not known what type of health certification that New Mexico authorities might demand of fish entering from Arizona. This would have to be explored.

-Colorado River--In recent years there has been quite a bit of discussion and one actual workshop devoted to the discussion of razorback sucker management in the Grand Canyon. Razorback suckers have been occasionally captured in upper portions of the Grand Canyon. Little is known regarding whether these fish are maintaining populations or if they represent relict individuals from a pre-dam era. The constant cold releases from Glen Canyon Dam probably limits, if not totally restricts, any mainstem spawning. Further downstream, below Hoover Dam, water temperatures are about 12 degrees C. Scuba surveys have revealed that razorbacks constituted more than 50 percent of the fish observed in the first 3 miles of river below the dam. While temperatures are far from idea, razorback do successfully spawn and their eggs hatch at these temperatures (Mueller 1989).

State biologists in Nevada are collecting and rearing razorback suckers that were naturally spawned in Lake Mead (Jim Hendrick, NDOW personal communique). It appears that similar efforts to capture larvae will not only be attempted, but expanded in future years. It,s speculated these fish will probably be used to augment Lake Mead's population.

Stocking of adult suckers would seem to be a logical step to maintain or expand existing populations. While some biologists feel any stocking attempt would simply result in fish being flushed downstream, we simply won't know until someone tries. Even if fish were simply flushed down into Lake Mead, some feel that additional razorback suckers in that reservoir would be a positive direction for the fish. This avenue could be explored with Grand Canyon National Park and the States of Arizona and Nevada and if it's positive, suckers raised in these ponds could be use.

Iceberg Canyon There has been some discussion about the use of the perched lake at Iceberg Canyon. This site was surveyed and mapped in 1995. The lake was formed when part of the canyon wall collapsed and formed a natural dam. The canyon is spring fed and at the time of the survey, the lake's elevation was about 10 meters higher than the reservoir's. During the past two years, high Lake Powell elevations have resulted in the reconnection of this area to the reservoir. The last reconnection resulted in a large fish kill. It's believed that inundated vegetative material caused a massive oxygen demand that depleted dissolved oxygen concentration resulting in fish affixation. This would probably only occur following full reservoir conditions.

Virtually nothing is known regarding the predatory interactions or spawning requirements of native fish. Natural reproduction has occurred for both razorback suckers and bonytail chub that have been stocked in small, isolated ponds adjacent to Lake Mohave (Tom Burke personal communique). It's apparent recruitment is possible under some conditions.

The lake found at the terminal end of Iceberg Canyon has the potential of not only growing larger fish but possibly providing the conditions required for natural recruitment. When reservoir elevations retreat, existing non-native fish would be removed and restocked with a native fish community. The resulting efforts could be the focus of research into the behavior and interactions of such species as razorback and bonytail. Populations could be maintained and controlled by stocking or the removal of large adults destined for other appropriate locations. If the reservoir does rise and overtop the existing berm, the fish would simply escape into the reservoir.

RECOMMENDATIONS

We recommend the experiment be phased into an actual program which is optimized to rear large razorback suckers or other endangered fish and foster public awareness and education concerning the plight of these fish. We recommend the following actions be considered and discussed among the appropriate parties:

I. Identification of a lead agency willing to implement and facilitate these actions into mult-agency programs.

A. Formalize some type of agreement between the City and appropriate agencies covering these activities.

B. Develop the appropriate budgets to cover costs of pond maintenance, PIT tags, fish removal, transportation and stocking.

C. Conduct the necessary NEPA compliance along with appropriate state and federal permit requirements and reporting.

II. Development of a flexible working document explaining the goals and objectives, identifying and describing the role of agency representation, identifying available and needed resources, local expertise, and fish health care resources.

A. Identify, prioritize, and pursue authorization for multiple release sites (i.e. San Juan River, San Juan Arm, Colorado River inflow).

B. Identity and pursue multiple sources of young fish (i.e. RIP surplus fish, Lake Mohave, larvae captured from the Green or Colorado Rivers).

1. Coordinate with other Colorado River parks and the Utah Department of Wildlife for possible capture of endangered larval fish, subsequent rearing and restocking of fish at a larger size.

III. Continue, and possibly expand, the public information program. Encourage media coverage of fish releases, participation of dignitaries, students etc. We would encourage the placement of a small information sign or brochure near the ponds to inform golfers how these ponds are aiding in recovery.

ACKNOWLEDGMENTS

A great number of people have assisted in this project. Dennis Dulaney (LPNGC) has been instrumental in providing assistance, equipment, and information. Christine Miller and Susan Thompson collected the water quality data. Other NPS staff, Page High School instructors and students have helped on various aspects of the experiment. Wayne Gustavason and Craig

Stalgarrd (Utah Division of Wildife) provided field support and expertise. John Ritenour, Norm Henderson, Dan Shaw have been instrumental in funding and program development. We wish to extend our gratitude to the City of Page and the Lake Powell National Golf Course for their support and to Mr. Norm Henderson and Dr. Lewis Boobar for providing comments on the manuscript.

REFERENCES

Karp, C., and G. Mueller. 1996. Annual Report of Razorback Sucker Telemetry Study in the lower San Juan River, Utah, 1996. Bureau of Reclamation, Denver Technical Service Center, D-8220, Denver, Colorado.

Marsh, P.C. 1997. Razorback sucker monitoring in Lake Mohave, Arizona and Nevada for the period 1 November 1995 to 31 October 1996. Contract 1425-97-PG-30-06390, Bureau of Reclamation, Boulder City, Nevada.

Marsh, P.C., and J.L. Brooks. 1989. Predation by ictalurid catfishes as a deterrent to re-establishment of introduced razorback suckers. The Southwestern Naturalist 34:188-195.

Mueller, G. 1989. Observations of spawning razorback sucker (*Xyrauchen texanus*) utilizing river habitat in the lower Colorado River, Arizona-Nevada. The Southwestern Naturalist 34:147-149.

Mueller, G. 1995. A Program for Maintaining the Razorback Sucker in Lake Mohave. AFS Symp. 15:127-135.

Mueller, G. and R. Wydoski. 1995. Fish survey of San Juan River inflow area of Lake Powell, March 13-28, 1995. National Biological Service, Denver, Colorado.

Muth, B., and E. Wick 1997. Field studies of larval razorback suckers in Canyonlands National Park and Glen Canyon National Recreation Area, 1993-1995. Final Report submitted May 1997. Larval Fishes Lab, Fort Collins.

Ryden, D.W. (draft) 1997. Five-Year Augmentation Plan for Razorback Sucker in the San Juan River. USFWS, Colorado River Fishery Project, Grand Junction, Colorado.

Stangl, K.J. 1993. Endangered Fish Recovery Summary: Glen Canyon National Recreation Area, Colorado Plateau. National Park Service, Glen Canyon National Recreation Area, Page, Arizona.

USFWS 1992. A Plan to Evaluate Stocking to Augment or Restore Razorback Sucker in Upper Colorado River. Recovery Program for the Endangered Fishes of the Upper Colorado. Fish and Wildlife Service, Denver, Colorado.

USFWS 1994. Coordinated Hatchery Facility Plan: Need for captive-reared endangered fish and propagation facilities. Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. Fish and Wildlife Service, Region 6, Denver, Colorado.

Wick, E. 1996. Endangered Fish Program Focuses on Razorback Sucker. Plateau: Quarterly Newsletter for the Colorado Plateau. Vol. 6, No. 3, Fall 1996.

Appendix A. Water Quality Data

Collected by the National Park Service
Glen Canyon National Recreation Area, Page, AZ.

Razorback Suckers at Lake Powell National Golf Course Ponds

Approximately 300 Razorback Suckers were placed in the Lake Powell National Golf Course Ponds on May 16,1996. The average weight was 16.9 grams. The average total length 115.25mm.

Golf Pond #1

TURB. 10 NTU DATE: 5/9/96

SECCHI-0.7

DEPTH	TEMP	D.O	pH	CONDUCTIVITY	REDOX
.1	16.67	12.61	9.42	1081	37
.5	16.0	12.55	9.41	1070	36
1.0	15.38	11.50	9.37	1069	33
1.5	15.30	10.75	9.32	1071	23
2.0	15.17	10.05	9.24	1072	15
2.6	15.1	9.53	9.19	1074	11

Golf Pond #2

TURB. 09.3 NTU DATE:5/9/96

SECCHI-0.8meters

DEPTH	TEMP.	D.O.	pH	CONDUCTIVITY	REDOX
0.1	16.14	12.58	9.03	1142	20
0.5	15.43	12.5	9.03	1143	22
1.0	15.23	12.69	9.07	1138	22
1.5	14.83	11.79	9.00	1150	13
2.0	14.74	11.33	8.89	1145	8

Golf Pond #1

SECCHI-1.40 DATE: 5/15/96

DEPTH	TEMP	D.O.	pH	CONDUCTIVITY	REDOX
0.1	19.24	10.59	8.60	1550	68
0.5	18.79	10.64	8.62	1535	76
1.0	18.55	10.53	8.61	1533	79
1.5	18.46	10.18	8.59	1538	79
2.0	18.44	9.96	8.58	1538	79
2.3	18.42	9.43	8.56	1538	85

Annotation at GP1C SECCHI DISK-0.7 METERS
Date (YYMMDD) :960509

Time HHMMSS	Temp deg C	pH units	SpCond uS/cm	Salin ppt	DO % Sat	DO mg/l	Redox mV	Depth meters	Turb NTU	Batt volts
--------	16.67	9.42	1081	---- ---------		12.61	37		0.1	
--------	16.00	9.41	1070	----------		12.55	36		0.5	
--------	15.38	9.37	1069	----------		11.50	33		1.0	
--------	15.30	9.32	1071	----------		10.75	23		1.5	
--------	15.17	9.24	1072	----------		10.05	15		2.0	
--------	15.10	9.19	1074	----------		09.53	11		2.6	

Annotation at GP2C2 SECCHI DISK-0.8M

------	16.41	9.03	1142	---- ---------		12.58	------		0.1	
------	15.43	9.03	1143	----------		12.57	------		0.5	
------	15.23	9.07	1138	----------		12.69	------		1.0	
------	14.83	9.00	1150	----------		11.79	------		1.5	
------	14.74	8.98	1145	----------		11.33	------		2.0	

Annotation at 960725 081050 : GP2C2
Date (YYMMDD) : 960725

TIME	TEMP.	pH	COND	%SAT	DO	REDOX	DEPTH		
081157	18.53	7.77	1116	102.5	8.45	74	0.1	14.7&	

Annotation at 960725 082848 : GP2C1

083356	19.80	8.35	1083	0.6	132.1	10.62	73	0.1	0.0?	14.6&

Annotation at 960725 084831 : GP1S2

TIME	TEMP.	pH	COND	%SAT	DO	REDOX	DEPTH		
085031	21.63	8.53	1053	0.6	120.4	9.33	78	0.1	16.8?	14.7&
085118	21.48	8.50	1059	0.6	120.9	9.40	78	0.1	11.9@	14.6&

Annotation at 960725 090159 : GP1S3

TIME	TEMP.	pH	COND	%SAT	DO	REDOX	DEPTH		
090453	19.82	8.50	1047	0.5	123.8	9.95	48	0.1	1.4?	14.7&
090609	19.87	8.50	1044	0.5	124.9	10.02	47	0.2	4.7?	14.6&

Variable or Calibration changed at 960731 142141
Variable or Calibration changed at 960731 143847
Annotation at 960801 085042 : GP1S3
Date (YYMMDD) : 960801

TIME	TEMP.	pH	COND	%SAT	DO	REDOX	DEPTH		
085331	20.58	8.44	1133	0.6	133.8	10.57	113	0.3	4.3@	14.7&

Annotation at 960801 085803 : GP1C

TIME	TEMP.	pH	COND	%SAT	DO	REDOX	DEPTH		
085931	20.78	8.49	1126	0.6	136.8	10.76	113	0.1	0.0?	14.7&
090154	20.75	8.49	1121	0.6	141.0	11.10	111	0.5	0.0@	14.6&
090453	20.57	8.50	1117	0.6	145.7	11.50	112	1.0	0.0@	14.6&
090705	20.44	8.45	1117	0.6	145.6	11.52	110	1.5	0.6@	14.6&

090821 20.41 8.43 1119 0.6 145.8 11.55 110 1.7 2.3@ 14.5&

Annotation at 960801 091759 : GP1S2
TIME TEMP. pH COND %SAT DO REDOX DEPTH
091907 21.23 8.59 1112 0.6 149.9 11.69 109 0.2 29.7@ 14.6&
Time Temp pH SpCond Salin DO DO Redox Depth Turb Batt
HHMMSS deg C units uS/cm ppt % Sat mg/l mV meters NTU volts

Date (YYMMDD) : 960801
094014 20.83 8.19 1172 0.6 121.1 9.52 64 0.1 0.0@ 14.6&
Annotation at 960801 094145 : GP2C1
094241 19.77 7.93 1172 0.6 112.5 9.02 59 0.5 0.0@ 14.6&
094426 18.83 7.83 1128 0.6 108.1 8.84 54 1.0 0.0@ 14.6&
094606 18.42 7.78 1086 0.6 103.9 8.57 49 1.4 0.0@ 14.6&
Annotation at 960801 100139 : GP2C2
100447 19.99 7.96 1202 0.6 123.8 9.89 73 0.1 0.0? 14.6&
100748 19.82 7.98 1190 0.6 125.8 10.08 73 0.5 5.0@ 14.6&

Variable or Calibration changed at 960801 145921
Variable or Calibration changed at 960808 114402
Annotation at 960808 134021 : GP2C2
Date (YYMMDD) : 960808
134403 21.32 8.60 1050 0.6 137.3 10.76 101 0.2 0.0? 14.6&
Annotation at 960808 135834 : GP2S3
140013 20.16 8.78 993 0.5 140.7 11.29 104 0.2 0.0? 14.6&
Annotation at 960808 140745 : GP1S2
141646 24.15 8.92 998 0.5 128.9 9.57 88 0.2 0.0? 14.5&
Annotation at 960808 142159 : GP1S28896
142359 22.85 8.95 996 0.5 155.8 11.87 101 0.2 0.0? 14.5&
Variable or Calibration changed at 960808 155917
Variable or Calibration changed at 960809 082702
Annotation at 960809 093121 : GP2C28996
Date (YYMMDD) : 960809
093359 18.05 8.26 1046 0.5 129.7 10.86 130 0.2 0.0@ 14.3&
093521 18.06 8.26 1046 0.5 131.6 11.02 126 0.5 0.0@ 14.2&
093756 17.82 8.33 1028 0.5 107.3 9.04 119 1.0 0.0@ 14.3&
094111 17.24 8.33 992 0.5 97.3 8.29 111 1.5 0.0@ 14.2&
094426 17.03 8.38 986 0.5 121.1 10.36 108 1.7 0.0@ 14.2&
Annotation at 960809 100300 : GP2C1
100325 18.71 8.61 994 0.5 124.6 10.30 95 0.1 2.9@ 14.2&
100701 18.72 8.60 993 0.5 122.9 10.16 91 0.2 0.0@ 14.2&
101126 18.27 8.54 993 0.5 117.1 9.77 87 0.6 0.0@ 14.1&
101400 17.80 8.50 991 0.5 119.1 10.03 86 1.0 0.0@ 14.1&

101644	17.46	8.74	986	0.5	132.0	11.19	104	1.5	0.0@	14.1&
101826	17.60	8.79	984	0.5	126.6	10.71	102	1.7	0.5@	14.1&

Time	Temp	pH	SpCond	Salin	DO	DO	Redox	Depth	Turb	Batt
HHMMSS	deg C	units	uS/cm	ppt	% Sat	mg/l	mV	meters	NTU	volts

Date (YYMMDD) : 960809
Annotation at 960809 102717 : GP2S3
102800 18.73 8.74 992 0.5 133.3 11.02 115 0.2 0.0? 14.1&
102833 18.68 8.72 992 0.5 144.2 11.93 116 0.1 0.0? 14.1&
Annotation at 960809 105719 : GP1S3
110013 22.37 8.94 1007 0.5 157.3 12.10 86 0.1 2.0? 14.2&
Annotation at 960809 110609 : GP1C
111049 20.37 8.92 1001 0.5 128.4 10.27 73 0.5 7.1? 14.1&
111155 22.12 8.87 1001 0.5 145.4 11.24 63 0.2 0.0@ 14.1&
111423 19.41 8.92 997 0.5 154.9 12.63 82 1.0 0.6@ 14.1&
111608 19.09 8.88 998 0.5 154.1 12.64 79 1.5 1.0@ 14.1&
111805 18.98 8.85 997 0.5 159.7 13.13 81 1.9 1.7@ 14.1&
112042 18.90 8.85 996 0.5 147.3 12.14 78 2.2 1.8@ 14.1&
Annotation at 960809 112930 : GP1S2
113034 21.66 8.93 1002 0.5 157.0 12.24 85 0.2 0.0@ 14.2&
Variable or Calibration changed at 960809 144919
Variable or Calibration changed at 960815 114535

Annotation at 960815 135502 : GP2C2
Date (YYMMDD) : 960815
135705 19.57 8.27 1083 0.6 126.7 10.24 119 0.2 0.0? 14.0&
135738 19.57 8.27 1082 0.6 126.5 10.23 117 0.2 0.0? 14.0&
140707 23.78 8.61 1094 0.6 122.7 9.14 143 0.1 0.0? 14.0&
140802 23.50 8.61 1095 0.6 126.3 9.46 137 0.2 0.0? 14.0&
Annotation at 960815 141701 : GP1S3
141858 21.12 8.79 1058 0.6 127.2 9.97 112 0.2 0.0? 13.9&

Variable or Calibration changed at 960815 152959
Variable or Calibration changed at 960823 141245
Annotation at 960823 143942 : GP2C2
Date (YYMMDD) : 960823
144233 21.10 8.36 1096 0.6 136.9 10.74 154 0.2 2.2? 13.3&

Annotation at 960823 145124 : GP2S3
145400 19.86 8.28 1032 0.5 129.3 10.40 147 0.2 0.0@ 11.9&
Annotation at 960823 150037 : GP1282396
150158 23.92 8.51 1035 0.5 128.1 9.53 109 0.4 6.4@ 11.8&
Annotation at 960823 150959 : GP1382396

Time	Temp	pH	SpCond	Salin	DO	DO	Redox	Depth	Turb	Batt
HHMMSS	deg C	units	uS/cm	ppt	% Sat	mg/l	mV	meters	NTU	volts

Date (YYMMDD) : 960823
151213 21.15 8.64 1021 0.5 145.9 11.45 115 0.1 10.3@ 9.8&
Variable or Calibration changed at 960830 103605
Variable or Calibration changed at 960830 105720
Annotation at 960830 121512 : GP2C2
Date (YYMMDD) : 960830
121617 20.80 8.35 1052 0.6 119.7 9.44 142 0.1 0.0@ 11.6
121641 20.20 8.24 1045 0.5 122.1 9.74 140 0.5 0.0@ 11.6
121844 19.92 8.18 1038 0.5 110.9 8.90 129 0.9 0.0@ 11.6
121915 19.42 8.18 1022 0.5 115.1 9.32 130 1.5 0.0@ 11.6
122010 19.37 8.18 1022 0.5 104.3 8.46 125 1.5 0.0@ 11.6
122104 19.31 8.18 1017 0.5 110.8 9.00 127 2.0 0.0@ 11.5
122220 19.32 8.20 1018 0.5 108.0 8.77 126 2.0 0.0@ 11.6
Annotation at 960830 123116 : GP2C1
123131 22.17 8.27 1014 0.5 105.7 8.11 118 0.1 0.0@ 11.6
123228 20.27 8.14 1013 0.5 107.0 8.52 112 0.5 0.0@ 11.5
123253 20.07 8.14 1014 0.5 104.8 8.39 111 0.5 0.0@ 11.5
123334 19.45 8.36 1012 0.5 124.2 10.06 123 1.0 0.0@ 11.5
123423 19.27 8.37 1012 0.5 129.9 10.56 122 1.5 0.0@ 11.5
123516 19.17 8.42 1010 0.5 133.9 10.91 126 1.8 0.0@ 11.6
123545 19.17 8.43 993 0.5 138.1 11.25 127 2.1 0.0@ 11.6
Annotation at 960830 125845 : GP1S3
125938 26.26 8.80 988 0.5 149.5 10.64 158 0.1 8.9@ 11.6
125946 26.30 8.80 987 0.5 149.6 10.64 157 0.1 6.9? 11.6

Annotation at 960830 130806 : GP1C
130824 21.59 8.78 972 0.5 142.4 11.06 134 0.1 0.0@ 11.6
131013 21.27 8.80 973 0.5 148.2 11.58 126 0.5 0.0@ 11.6
131058 21.53 8.80 972 0.5 150.3 11.68 125 0.5 0.0@ 11.6
131118 21.11 8.79 972 0.5 152.8 11.98 125 1.0 0.0@ 11.6
131228 20.82 8.78 972 0.5 154.2 12.16 125 1.1 1.0@ 11.5
131303 20.67 8.77 976 0.5 159.5 12.61 125 1.5 0.2@ 11.5
131430 20.15 8.71 978 0.5 161.4 12.89 126 2.0 0.9@ 11.6
131506 20.19 8.70 978 0.5 161.1 12.86 127 2.0 0.5@ 11.6
131530 20.10 8.70 978 0.5 161.7 12.93 127 2.5 0.1@ 11.5
131619 20.12 8.69 978 0.5 150.6 12.04 127 2.5 0.6@ 11.6
Annotation at 960830 132414 : GP1S2
132507 21.89 8.86 972 0.5 165.1 12.75 147 0.1 3.5? 11.5
132717 21.97 8.87 965 0.5 166.3 12.82 145 0.1 6.0? 11.6
Variable or Calibration changed at 960905 080907
Variable or Calibration changed at 960905 083323

Annotation at 960905 095629 : GP2C2
Date (YYMMDD) : 960905
100044 18.21 7.79 982 0.5 92.9 7.67 219 0.1 0.0@ 15.6&
100248 17.92 7.81 966 0.5 94.6 7.86 216 0.5 0.0@ 15.5&
100356 18.09 7.80 971 0.5 95.2 7.88 214 1.0 0.0@ 15.5&
100747 18.02 7.82 972 0.5 94.7 7.85 208 1.5 0.0@ 15.5&
101049 18.11 7.83 975 0.5 87.3 7.22 200 2.3 0.6@ 15.5&
Annotation at 960905 102241 : GP2C1
102602 18.17 7.88 962 0.5 90.5 7.48 161 0.5 0.0@ 15.4&
102643 18.13 7.89 962 0.5 87.4 7.22 158 0.5 0.0@ 15.4&
102904 18.04 7.89 961 0.5 91.4 7.57 155 1.0 0.0@ 15.4&
103111 18.00 7.91 961 0.5 90.5 7.50 150 1.5 0.0@ 15.4&
103335 18.00 7.92 949 0.5 89.1 7.39 145 2.2 7.5@ 15.3&
103347 18.00 7.92 948 0.5 89.7 7.43 148 2.2 9.3@ 15.3&
103432 18.00 7.90 961 0.5 89.7 7.44 145 1.5 6.9@ 15.3&
103448 18.03 7.90 961 0.5 90.8 7.52 146 1.0 3.7@ 15.3&
103510 18.20 7.90 961 0.5 92.1 7.61 148 0.5 0.0@ 15.3&
Annotation at 960905 105037 : GP2S3
105249 18.91 8.04 965 0.5 82.1 6.69 138 0.2 0.0? 15.4&
Annotation at 960905 110709 : GP1S2
111141 20.14 8.65 970 0.5 101.1 8.03 133 0.1 0.0? 15.3&
Annotation at 960905 112503 : GP1C1
112747 20.23 8.64 969 0.5 109.5 8.68 133 0.1 0.0@ 15.2&
113012 20.03 8.66 967 0.5 113.9 9.06 132 0.5 1.5@ 15.2&
113016 20.03 8.66 967 0.5 113.7 9.05 132 0.5 1.5@ 15.2&
113414 19.80 8.60 967 0.5 113.2 9.05 125 1.0 2.2@ 15.2&
113930 19.72 8.59 967 0.5 110.6 8.86 124 1.5 2.3@ 15.1&
114120 19.66 8.58 967 0.5 113.3 9.09 121 2.0 2.2@ 15.1&
114332 19.60 8.57 967 0.5 116.2 9.33 119 2.5 2.1@ 15.1&
114625 19.29 8.54 962 0.5 115.3 9.32 124 2.9 3.5@ 15.1&
Annotation at 960905 114930 : GP1S3
115418 20.84 8.64 971 0.5 117.8 9.23 117 0.2 8.4@ 15.0&
Variable or Calibration changed at 960905 152649
Variable or Calibration changed at 960912 091324
Annotation at 960912 101656 : GP2C291296
Date (YYMMDD) : 960912
101817 18.28 7.75 1004 0.5 86.6 6.59 160 0.2 0.0? 14.5&
101927 18.39 7.74 1000 0.5 84.7 6.43 152 0.2 0.0? 14.4&
Annotation at 960912 102903 : GP2391296
103159 17.50 7.87 989 0.5 80.4 6.21 134 0.3 0.0? 14.3&
Annotation at 960912 103905 : GP1291296
104200 21.06 8.47 1042 0.5 112.3 8.09 156 0.2 0.0? 14.3&
104207 21.05 8.47 1042 0.5 112.1 8.07 156 0.2 0.0? 14.3&
Annotation at 960912 105008 : GP1391296
105423 20.12 8.55 1033 0.5 111.4 8.17 133 0.3 0.0? 14.3&

Variable or Calibration changed at 960917 072209
Variable or Calibration changed at 960917 072805
Variable or Calibration changed at 960917 073307
Variable or Calibration changed at 960917 073918
Variable or Calibration changed at 960917 074407
Annotation at 960917 103218 : GP1C91796
Date (YYMMDD) : 960917
103438 17.89 8.74 965 0.5 94.4 7.88 148 0.1 4.8@ 14.0&

Time	Temp	pH	SpCond	Salin	DO	DO	Redox	Depth	Turb	Batt
HHMMSS	deg C	units	uS/cm	ppt	% Sat	mg/l	mV	meters	NTU	volts

Date (YYMMDD) : 960917

103559	17.52	8.77	966	0.5	96.1	8.09	146	0.5	6.1@	14.0&
103642	17.30	8.76	965	0.5	95.9	8.11	144	1.0	6.1@	13.9&
104030	17.21	8.76	964	0.5	98.6	8.35	139	1.5	6.0@	13.9&
104309	17.14	8.75	964	0.5	96.1	8.16	133	2.0	4.9@	13.8&
104313	17.14	8.76	964	0.5	96.4	8.18	133	2.0	5.0@	13.8&
104424	17.06	8.73	964	0.5	92.9	7.90	130	2.5	4.5@	13.8&
104522	17.07	8.73	965	0.5	93.0	7.91	126	2.5	4.9@	13.8&
104659	17.07	8.72	965	0.5	91.6	7.78	124	2.8	6.8@	13.7&

Annotation at 960917 105636 : GP1391796

105757	18.56	8.82	964	0.5	102.0	8.40	154	0.1	0.0@	13.8&
110049	18.88	8.77	965	0.5	116.8	9.57	186	0.1	0.0@	13.6&

Annotation at 960917 110126 : GP1291796

110351	18.57	8.81	964	0.5	99.8	8.23	188	0.1	0.0@	13.6&

Annotation at 960917 114236 : GP2C291796

114544	16.43	8.49	838	0.4	113.3	9.76	148	0.1	0.0@	13.6&
114612	16.46	8.46	838	0.4	114.1	9.82	147	0.1	0.0@	13.6&
114707	16.45	8.50	837	0.4	123.6	10.65	138	0.5	0.0@	13.5&
114805	16.30	8.53	838	0.4	122.4	10.58	135	1.0	0.0@	13.5&
114852	16.29	8.54	837	0.4	130.5	11.28	135	1.5	0.0@	13.5&
114937	16.28	8.55	837	0.4	125.3	10.83	132	2.0	0.0@	13.4&

Annotation at 960917 115414 : GP2C191796

115500	17.47	8.47	843	0.4	117.2	9.88	200	0.1	13.2@	13.4&
115702	16.98	8.43	845	0.4	114.5	9.75	183	1.5	0.0@	13.2&
115818	16.59	8.50	842	0.4	118.4	10.16	136	2.0	0.0@	12.8&

Variable or Calibration changed at 961009 152037
Variable or Calibration changed at 961009 153053
Variable or Calibration changed at 961009 153805
Variable or Calibration changed at 961009 153924
Variable or Calibration changed at 961009 154105
Variable or Calibration changed at 961009 154731
Variable or Calibration changed at 961009 155505
Variable or Calibration changed at 961028 090024
Variable or Calibration changed at 961028 090041
Power loss from 961028 090304 to 961028 090450
Variable or Calibration changed at 961106 081043
Variable or Calibration changed at 961106 081344
Variable or Calibration changed at 961106 081448
Variable or Calibration changed at 961106 081738
Variable or Calibration changed at 961106 082527
Variable or Calibration changed at 961106 083117

Variable or Calibration changed at 961106 085512
Annotation at 961106 121726 : GP1211096
Date (YYMMDD) : 961106
122544 11.30 8.55 1328 0.7 129.8 12.47 147 0.3 39.4@ 14.9&
Annotation at 961106 123028 : GP1110696
123238 10.41 8.62 1324 0.7 139.9 13.71 145 0.6 9.6@ 14.8&
123407 10.01 8.63 1322 0.7 139.1 13.76 144 1.0 9.0@ 14.8&
Annotation at 961106 124050 : GP1311096
124213 10.52 8.65 1319 0.7 131.5 12.86 133 0.5 12.5? 14.8&
124237 10.53 8.66 1319 0.7 131.6 12.87 132 0.5 12.5? 14.8&
Annotation at 961106 130045 : GP22110696
130157 11.86 7.66 1364 0.7 91.9 8.71 114 0.4 16.5@ 14.9& Time Temp pH SpCond Salin DO DO Redox Depth Turb Batt
HHMMSS deg C units uS/cm ppt % Sat mg/l mV meters NTU volts

Date (YYMMDD) : 961106
Annotation at 961106 130838 : GP2S3
131054 10.70 7.78 1362 0.7 104.8 10.20 112 0.8 7.9@ 14.6&
Variable or Calibration changed at 961109 140119
Variable or Calibration changed at 970401 163517
Annotation at 970404 102931 : GP2C2
Date (YYMMDD) : 970404
102949 10.24 8.64 794 0.4 144.9 14.08 -125 0.1 0.1@ 15.7&
103513 9.71 8.64 793 0.4 162.2 15.96 -123 1.0 0.2@ 15.7&
103625 9.58 8.64 794 0.4 161.6 15.95 -128 1.5 0.3@ 15.7&
103638 9.60 8.64 794 0.4 160.7 15.85 -130 1.5 0.3@ 15.6&
103736 9.52 8.60 795 0.4 155.1 15.33 -130 2.3 0.5@ 15.6&

Annotation at 970404 104519 : GP2C1
104549 10.54 8.65 795 0.4 160.2 15.46 -126 0.1 0.3@ 15.6&
104734 10.49 8.65 795 0.4 160.6 15.51 -124 0.5 1.2@ 15.6&
104838 10.05 8.66 793 0.4 160.9 15.70 -124 1.0 0.3@ 15.5&
104955 9.61 8.66 794 0.4 159.6 15.74 -129 1.5 0.4@ 15.6&
105119 9.58 8.66 794 0.4 160.3 15.83 -131 2.0 0.3@ 15.5&
105234 9.52 8.65 794 0.4 158.6 15.68 -128 2.2 0.4@ 15.5&
Annotation at 970404 110952 : GP1C
111003 10.84 8.73 808 0.4 126.9 12.16 -140 0.1 0.0? 15.6&
111214 10.40 8.73 807 0.4 121.9 11.80 -135 0.5 2.7@ 15.5&
111450 10.88 8.73 808 0.4 124.2 11.89 -141 0.5 0.8@ 15.5&
111630 10.64 8.74 808 0.4 123.1 11.85 -146 1.1 0.9@ 15.5&
111700 10.70 8.74 808 0.4 124.0 11.92 -146 1.0 0.9@ 15.5&
111815 10.12 8.75 807 0.4 123.8 12.07 -137 1.5 1.0@ 15.5&
111908 10.02 8.74 807 0.4 124.6 12.17 -147 2.0 1.0@ 15.4&
112029 10.00 8.73 808 0.4 124.0 12.11 -145 2.5 1.3@ 15.4&
112137 9.94 8.73 807 0.4 124.3 12.16 -146 2.6 1.4@ 15.4&

Variable or Calibration changed at 970404 140413
Variable or Calibration changed at 970617 125809
Annotation at 970618 145706 : GP2C2
Date (YYMMDD) : 970618

150151	17.92	9.03	881	0.5	182.7	15.11	-60	0.2	47.1@	15.6&
151402	25.95	9.39	805	0.4	196.3	13.91	-14	0.1	8.5?	15.5&

Annotation at 970618 152235 : GP1S2

153054	26.68	10.44	995	0.5	###.#	##.##	-16	0.1	0.0?	15.5&

Variable or Calibration changed at 970707 093058
Variable or Calibration changed at 970708 082650
Annotation at 970708 083057 : GP2C2
Date (YYMMDD) : 970708

083435	16.32	8.41	1021	0.5	105.7	9.04	-180	0.1	14.3@	15.6&
083510	16.40	8.39	1021	0.5	107.0	9.15	-187	0.5	12.3@	15.6&
083617	16.12	8.41	1002	0.5	106.8	9.18	-179	1.0	11.3@	15.5&
083710	16.18	8.40	1005	0.5	107.7	9.25	-177	1.5	9.2@	15.5&
083801	16.03	8.54	980	0.5	111.0	9.56	-167	2.1	13.3@	15.5&

Annotation at 970708 085419 : GP2C1

085436	16.31	8.52	984	0.5	110.3	9.44	-192	0.1	7.6@	15.5&
085928	16.12	8.58	972	0.5	116.8	10.04	-173	0.5	44.4@	15.5&
090233	16.02	8.54	969	0.5	112.9	9.72	-183	1.0	0.0@	15.4&
090601	15.97	8.57	970	0.5	122.4	10.56	-177	1.5	29.9@	15.4&
090805	15.91	8.59	974	0.5	118.7	10.25	-178	2.0	0.0@	15.4&
090915	16.18	8.82	964	0.5	132.5	11.37	-161	2.5	0.0@	15.4&
090943	16.05	8.94	968	0.5	161.2	13.88	-122	2.5	0.0@	15.4&

Annotation at 970708 093128 : GP1S3

093258	17.66	9.06	896	0.5	142.1	11.83	-124	0.1	0.0@	15.4&
093355	17.35	9.07	888	0.5	145.5	12.19	-116	0.5	3.1@	15.4&
093452	17.08	9.07	888	0.5	145.6	12.28	-114	1.0	0.0@	15.4&
093630	16.94	9.10	889	0.5	146.5	12.38	-117	1.5	7.0@	15.4&
093719	16.92	9.07	889	0.5	140.8	11.91	-136	2.0	0.0@	15.3&
093820	16.88	9.09	888	0.5	109.4	9.26	-136	2.5	1.2@	15.3&
094018	16.91	9.14	884	0.5	92.4	7.82	-153	3.0	62.1@	15.3&

Annotation at 970708 094434 : GP1C

094454	16.99	9.07	888	0.5	141.5	11.95	-138	0.1	45.6@	15.4&
094618	16.99	9.07	887	0.5	144.2	12.17	-141	0.5	0.0@	15.3&
094707	17.02	9.08	886	0.5	144.8	12.22	-141	1.0	0.0@	15.3&
094745	16.98	9.07	887	0.5	146.2	12.35	-140	1.0	0.0@	15.4&
094801	17.05	9.08	886	0.5	145.9	12.31	-140	1.6	0.0@	15.4&
094836	16.97	9.08	888	0.5	147.0	12.42	-141	1.5	0.0@	15.3&
095013	16.95	9.08	889	0.5	153.5	12.97	-136	1.9	0.0@	15.3&
095113	16.85	9.12	896	0.5	162.1	13.73	-127	2.2	0.0@	15.3&

095247 16.84 9.10 896 0.5 163.1 13.81 -131 2.5 0.0@ 15.3&
095811 16.83 9.16 897 0.5 93.2 7.90 -200 3.0 1.6@ 15.3&
100015 16.87 9.23 893 0.5 79.1 6.70 -183 3.1 0.0@ 15.2&

Annotation at 970708 101618 : GP1S2
101708 17.20 9.09 903 0.5 141.6 11.91 -166 0.1 0.0@ 15.4&
101859 17.02 9.09 895 0.5 150.4 12.70 -153 1.3 3.5@ 15.3&

Variable or Calibration changed at 970725 070400
Variable or Calibration changed at 970725 072306
Annotation at 970725 085113 : GP2C2
Date (YYMMDD) : 970725
085312 16.14 7.76 833 0.4 81.7 6.99 -207 0.1 0.0@ 14.9&
085457 16.02 7.77 831 0.4 81.7 7.00 -213 0.5 0.0@ 14.8&
085517 16.03 7.76 831 0.4 82.3 7.05 -211 1.0 0.0@ 14.9&
085610 16.01 7.76 830 0.4 82.4 7.06 -210 1.5 0.0@ 15.0&
085630 16.04 7.76 831 0.4 82.7 7.08 -211 1.8 0.0@ 14.9&
Annotation at 970725 090427 : GP2C1
090547 17.50 7.78 853 0.4 79.8 6.63 -216 0.1 0.0@ 14.9&
090856 16.54 7.76 843 0.4 78.5 6.66 -224 0.5 2.8@ 15.0&
091031 16.47 7.78 839 0.4 80.9 6.87 -222 1.0 0.0@ 14.9&
091056 16.44 7.77 839 0.4 81.1 6.89 -221 1.5 0.0@ 14.9&
091201 16.39 7.78 839 0.4 81.6 6.94 -221 2.0 0.0@ 14.9&
091247 16.33 7.82 837 0.4 86.7 7.38 -218 2.5 0.0@ 14.9&
Annotation at 970725 093213 : GP1S3
093442 21.88 8.74 992 0.5 131.6 10.01 -184 0.1 35.0@ 15.0&
093615 20.96 8.69 986 0.5 129.8 10.05 -149 0.5 0.0@ 15.0&
093819 20.27 8.65 979 0.5 120.4 9.45 -163 1.5 0.0@ 14.9&
093850 20.26 8.65 979 0.5 121.7 9.55 -163 1.9 0.8@ 14.9&
Annotation at 970725 094250 : GP1C
094324 21.00 8.66 1010 0.5 112.7 8.72 -168 0.1 26.4@ 15.0&
094354 20.58 8.65 997 0.5 119.3 9.30 -163 0.5 10.8@ 15.0&
094507 20.47 8.64 984 0.5 119.3 9.33 -162 1.0 0.0@ 14.9&
094535 20.34 8.63 983 0.5 117.1 9.18 -162 1.5 0.0@ 14.9&
094703 19.69 8.51 964 0.5 105.1 8.34 -179 2.0 0.0@ 14.9&
094745 19.79 8.49 961 0.5 103.7 8.22 -184 2.0 0.0@ 14.9&
094810 19.19 8.41 948 0.5 100.8 8.09 -187 2.6 0.0@ 14.9&
095124 19.39 7.54 982 0.5 34.7 2.77 -295 2.8 #####@ 14.9&

Annotation at 970725 095911 : GP1S3
095928 21.00 8.68 1005 0.5 125.7 9.73 -115 0.1 4.1@ 14.9&
100004 20.82 8.66 1004 0.5 125.5 9.74 -121 0.5 18.0@ 14.9&
100015 20.54 8.70 1002 0.5 127.6 9.96 -119 0.9 15.4@ 14.9&
Variable or Calibration changed at 970807 135151

Variable or Calibration changed at 970807 142749
Annotation at 970813 073748 : GP2C2
Date (YYMMDD) : 970813

074007	23.79	8.08	1503	0.8	86.0	6.35	-126	1.0	0.0@ 15.0&
074024	23.80	8.09	1501	0.8	85.9	6.33	-119	0.5	0.0@ 14.9&
074121	23.78	8.09	1502	0.8	86.0	6.35	-128	1.5	0.0@ 14.9&
074213	23.79	8.09	1503	0.8	85.0	6.27	-138	2.0	0.0@ 14.9&

Annotation at 970813 074851 : GP2C1

074938	23.81	8.11	1508	0.8	86.7	6.39	-126	0.5	22.4@ 14.9&

Time	Temp	pH	SpCond	Salin	DO	DO	Redox	Depth	Turb	Batt
HHMMSS	deg C	units	uS/cm	ppt	% Sat	mg/l	mV	meters	NTU	volts

Date (YYMMDD) : 970813

075017	23.73	8.08	1507	0.8	85.6	6.32	-130	1.0	0.6@ 14.9&
075106	23.72	8.07	1500	0.8	85.0	6.28	-134	1.5	0.2@ 14.9&
075158	23.71	8.06	1496	0.8	82.8	6.12	-144	2.0	0.0@ 14.8&
075238	23.72	8.05	1498	0.8	83.1	6.14	-148	2.3	0.7@ 14.8&

Annotation at 970813 080648 : GP1S3

080751	23.95	7.86	1495	0.8	73.5	5.40	-137	0.5	12.4@ 14.8&
080937	23.86	7.87	1494	0.8	73.2	5.39	-153	1.0	33.1@ 14.7&
081019	23.83	7.85	1495	0.8	71.7	5.28	-165	1.5	37.6@ 14.8&
081119	23.81	7.86	1497	0.8	72.3	5.33	-161	1.9	59.0@ 14.7&

Annotation at 970813 081456 : GP1C1

081526	23.94	7.87	1502	0.8	72.9	5.36	-163	0.5	8.8@ 14.7&
081603	23.81	7.86	1498	0.8	73.4	5.41	-163	1.0	9.9@ 14.7&
081639	23.78	7.86	1500	0.8	72.6	5.36	-168	1.5	9.3@ 14.7&
081907	23.78	7.86	1500	0.8	73.7	5.44	-169	2.0	9.5@ 14.7&
081943	23.78	7.87	1502	0.8	72.7	5.37	-172	2.5	9.1@ 14.7&
082048	23.76	7.85	1505	0.8	70.4	5.19	-177	2.7	107@ 14.7&

Annotation at 970813 082449 : GP1S2

082556	23.92	7.93	1504	0.8	81.9	6.03	-147	0.5	23.1@ 14.7&

Variable or Calibration changed at 970815 101530
Variable or Calibration changed at 970815 104154
Annotation at 970815 122854 : GP2C2
Date (YYMMDD) : 970815

123056	26.50	8.74	1441	0.8	167.1	11.71	-73	0.2	73.9? 14.9&
123206	26.47	8.73	1439	0.8	166.5	11.68	-73	0.4	68.5@ 14.8&
123243	24.92	8.71	1438	0.8	163.6	11.80	-84	1.2	47.0@ 14.9&
123308	24.86	8.71	1439	0.8	165.0	11.92	-85	1.3	37.9@ 14.8&

Annotation at 970815 123947 : GP2C1

124028	25.50	8.71	1434	0.8	159.7	11.40	-93	0.7	50.7@ 14.8&
124120	25.39	8.71	1435	0.8	162.3	11.61	-94	0.8	21.6@ 14.8&
124204	24.78	8.70	1432	0.8	162.6	11.76	-99	1.2	26.2@ 14.8&

Annotation at 970815 130215 : GP1C1

130429	26.16	8.13	1438	0.8	95.7	6.75	-160	0.1	9.1? 14.8&
130522	26.20	8.13	1438	0.8	96.7	6.81	-160	0.5	0.0@ 14.8&

130720 24.82 8.17 1440 0.8 101.7 7.35 -157 1.0 12.7@ 14.8&
130816 24.74 8.19 1435 0.8 100.7 7.29 -161 1.5 0.0@ 14.8&
Recovery finished at 970818 095055

Appendix B. Photographs

Photograph taken at the inflow area of the southern (upper) pond during the partial drainage in July 1996. (Note plastic liner and floating algae).

Photograph taken of the northern (lower) pond while the aerator was in operation.

DEPARTMENT OF THE INTERIOR

U.S. Fish and Wildlife Service

Appendix C. FISH HEALTH INSPECTION REPORT

This report is NOT evidence of future disease status. To determine current status, contact inspecting biologist below.

Name of Fish Source	Address or Location of Fish Source	Name of Owner ☐ or Manager ☒	Inspection Dates	Classification
Page Arizona Golf Ponds	Coconino Co, Ariz. adjacent to US HWY 89	Gordon Mueller, Biological Resources Div. POB 25007 D-8220,Denver, CO 80225	This 4/5/97 Prior	NA

FISH EXAMINED

Species[1]	Lot Number	Age[2]	Number in Lot	Obtained as Eggs(E) or Fish(F) FROM:	Pathogens Inspected for and Results[3] BF	BR	BK	SW	VE	VH	VP	VC	A	B
Razorback Suckers	none	24	300	Ouray NFH (F)	50 –				50 –		50 –		50 –	

Type of Fish Examined

☒ Hatchery growout ☐ Feral

☐ Salmonid ☒ Non-salmonid

Type of Water Supply

☐ Spring ☒ Well

☐ Stream ☐ Impoundment

☒ Enclosed ☒ Free of fish

Inspecting Biologist Signature

J.J. Landye

Fish Health Inspector

J.J. Landye

Concurred (signature & title)

J.J. Landye

Assist. Project Leader, Pinetop Fish Health Center, P.O. Box 160, Pinetop,AZ

Inspecting Biologist Address

Pinetop Fish Health Center

PO.Box 160

Pinetop, AZ 85935

Remarks:

A: Asian tapeworm-Negative

No external parasites found- These fish are extremely healthy with good fat deposits.

1 – Use standard FWS abbreviations (see back of this page).

2 – For hatchery fish give age in months: for feral fish use symbols e = eggs or fry; f = fingerlings; y = yearlings; b = older fish.

3 – See list of pathogen abbreviations on back of page; findings reported as $\frac{\text{number examined}}{\text{results}}$ where – = negative and + = positive; other pathogens listed in remarks.

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